THE VALUE OF WALKABILITY

IN

MIDTOWN TULSA

By

VICTORIA LIGHTFOOT

Bachelor of Science in Education
Oklahoma State University
Stillwater, Oklahoma
1980

Master of Business Administration
Oklahoma State University
Stillwater, Oklahoma
1986

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Dissertation Approved:

Dr. Jonathan Comer

Dissertation Adviser

Dr. G. Allen Finchum

Dr. Hongbo Yu

Dr. Chandra Story

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Name: VICTORIA LIGHTFOOT

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Abstract:

This study examines various factors that influence home prices in the midtown area of Tulsa, Oklahoma with particular focus on factors related to walkability. Home sales price is used as a proxy for demand and as a measure of the value that residents of Midtown Tulsa place on neighborhood walkability. Using parcel data obtained from the Tulsa County Assessor's Office, combined with various walkability factors, the project looks for areas of Midtown Tulsa in which home prices appear to be influenced by pedestrian-oriented amenities.

The results of the statistical analysis suggest that there are indeed residential clusters in Midtown Tulsa where home prices appear to be influenced by walkability factors. In particular, the geographically weighted analysis provides clear evidence that relationships between home prices and selected variables are not uniform across the study area and that such relationships are varied and complex. Maps of the GWR results display clustered groupings, sometimes of significant positive relationships, sometimes of negative relationships for any given variable. The results raise questions about the nature of the built environment in Midtown Tulsa and the nature of residents, who may or may not place a value on living in a walkable place. This study has illustrated the complex mix of factors that influence home prices in Midtown Tulsa and has suggested the possibility that walkability might factor into the equation, at least in some pockets.

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CHAPTER I

INTRODUCTION TO THE STUDY

There are many reasons for building cities and neighborhoods that are compact, walkable, and human-scaled. In the past, before the automobile drove urban planning, neighborhoods were constructed with the assumption that residents would walk to school, to work, to the bus stop, to a neighborhood park, to the corner grocery, or to the drugstore. Today, in many American suburbs, walking has been designed out of the neighborhood, to the detriment of public health, energy efficiency, and neighborhood cohesiveness. In many cases, the American suburb is a sprawling hodgepodge of low-density housing that tends to be disconnected from jobs and shopping facilities and completely dependent on the automobile. In contrast to earlier, walkable forms of urbanism, the structural environment of today's suburbia has reduced the need for physical activity in everyday life. In a culture that relies on computers and cars, elevators and television, the amount of time spent in physical activity has decreased, while the amount of time spent in sedentary pursuits has increased. Today, at least 60 percent of adults in the United States are not meeting recommended levels of physical activity. And according to the U.S. Centers for Disease Control and Prevention (CDC), physical inactivity accounts for as much as 23 percent of all U.S. deaths from major chronic diseases, and plays a major role in promoting obesity, which increases the risk of many illnesses (Jackson 2003).

While many factors contribute to low rates of physical activity, there is some evidence that the built environment of cities, particularly at the neighborhood level, is related to the physical activity and obesity levels of residents (Booth et al. 2005). The "built environment" consists of "the neighborhoods, roads, buildings, food sources, and recreational facilities in which people live, work, are educated, eat, and play" (Sallis and Glanz 2006). Although it is difficult to prove that neighborhood factors such as the presence of sidewalks or neighborhood parks actually cause residents to be more active, the built environment can facilitate walking behavior and at the least "should not impede the propensity for walking and physical activity" ("Does the Built Environment Influence Physical Activity?" 2005; Loukaitou-Sideris 2006). Evidence suggests that patterns of land use, features of urban design, and transportation systems that encourage walking and bicycling can help communities be healthier, more active, and ultimately, more livable (Handy et al. 2002).

While there has been some nationwide backlash against the continued development of isolated, automobile-dependent suburbs, New Urbanist and smart growth initiatives that promote pedestrian-centered development patterns have been slow to influence the middle parts of the United States. Currently, Oklahoma cities tend to be quite automobile-oriented and appear to be lagging behind most of the country in terms of their interest in pedestrian-oriented development. In a survey sponsored by Prevention Magazine and the American Podiatric Medical Association, 501 cities in the U.S. were ranked in terms of the walkability of each city with the implicit assumption that city walkability is one of the most effective health-promoting features of a place. In the 2008 list of walkable cities, Oklahoma City was ranked last, the city of Enid, Oklahoma was ranked 406, while Tulsa ranked 407 (U.S. Department of Health and Human Services 2008). The Congress for New Urbanism, a group that promotes itself as "the leading organization promoting walkable, neighborhood-based development as an alternative to sprawl", currently has charter members in 36 states with the major exceptions of Oklahoma, Arkansas and a number of western states (Congress for the New Urbanism 2010). Furthermore, the state of Oklahoma ranks among the bottom of all U.S. states in terms of leading health indicators. One particular assessment, America's Health Rankings, provides state rankings based on various health determinants including behavioral factors, public policies, clinical care, and community and environmental factors. Their most recent rankings, released in November, 2009, ranked the state of Oklahoma 49 out of 50 states in terms of general health and physical activity level, measured as the percent of adults who reported participating in physical activity during the past month (U.S. Department of Health and Human Services 2008). In places like Oklahoma, residents are not clearly demanding pedestrian-friendliness in their neighborhoods, despite the fact that Oklahoma lags behind much of the country in terms of key health factors and overall walkability ratings (U.S. Department of Health and Human Services 2008). Although smarter development practices are achievable and badly needed in cities like Tulsa, it is unclear whether or not there is a demand for walkability.

This project will explore the walkability of neighborhoods in Midtown Tulsa and will attempt to locate residential and commercial areas of Midtown that are pedestrian-friendly. Then, the study will examine the demand for these walkable areas, by indirectly exploring residents' willingness to pay a premium to live in neighborhoods where the built environment is conducive to walking.

Statement of the Problem

While city leaders have clearly stated their goals of making Tulsa more walkable (Tulsa Vision 2010) it is unclear if there is a real demand for pedestrian-friendliness by residents of Tulsa. Furthermore, it appears that many of the stated developmental goals of Tulsa's comprehensive plan for future development have failed to materialize, in part because developers are reluctant to take the financial risk of developing homes that people don't want to buy, in neighborhoods that are different from the usual suburban development. Likewise, there is risk associated with redevelopment efforts, both to developers and to local government entities that sometimes offer incentives for infill development. Costs are often higher because home construction and remodeling efforts must fit within the constraints of existing development patterns and infrastructure, whereas new homes built on undeveloped land are more easily and cheaply mass produced (Leinberger 1998). Certain neighborhoods of Midtown Tulsa are likely more pedestrian-friendly than others and ripe for infill development, but it is unclear where these walkable neighborhoods are located. Furthermore, home prices in some neighborhoods may be impacted by factors related to walkability. Preliminary research suggests that, at the least, walkable infrastructure exists in certain Tulsa neighborhoods, especially in neighborhoods that were developed before 1950. Features like gridded streets, sidewalks, and close residential proximity to pedestrian-friendly destinations are the norm in certain older neighborhoods, but it is unclear if these features are valued by residents, developers, or city officials. There appears to be some recognition of the intrinsic value of charm, neighborhood cohesiveness, pedestrian-oriented development, and visually-appealing streetscapes, judging by home listings that champion historic neighborhoods, Craftsman-style homes, and community parks. One real estate advertisement states that a particular home is located "in the heart of Brookside" and the home owner can "walk to shopping, restaurants and the River Parks". Another listing describes a home as being "nestled into the heart of midtown" and that the property provides residents with "all that the prestigious life of midtown offers" (Sheppard 2011). Still, there is no clear financial incentive for developers or the city to invest in the development and redevelopment necessary to make and keep residential areas walkable and more livable.

Purpose of the Study

The purpose of this study is to explore walkability in Midtown Tulsa and to determine if residents of Midtown Tulsa are willing to pay a premium to live in pedestrian-oriented areas. The project will examine features of the built environment including street patterns, the presence of sidewalks, residential proximity to neighborhood parks and pedestrian paths, the proximity to commercial/retail destinations, and the presence of barriers including busy streets and large parking lots. The study will then look for relationships between these features and home sales prices to determine if residents of Midtown Tulsa appear to place a value on neighborhood walkability.

Research Questions

This study will examine specific walkability factors and home sales prices in Midtown Tulsa, in order to answer the following questions:

What are the factors that influence home prices in Midtown Tulsa and is walkability one of these factors? To help answer this question, data will be obtained for home prices, structural features of the homes and selected features of the built environment that may be related to pedestrian activity including neighborhood amenities like parks, trails, commercial destinations, density of street intersections, and sidewalks. In addition, the project will incorporate barriers to walking such as busy streets and large parking lots. Regression analysis techniques will be used to look for both structural and walkability-related factors that significantly influence home prices.

Are residents of midtown Tulsa willing to pay a premium to live in close proximity to pedestrian-oriented amenities? The project will look for neighborhoods or clusters where residents of Midtown appear to be willing to pay higher home prices to live near pedestrian-oriented amenities. Alternatively, the study will attempt to uncover areas in which home prices are influenced in unexpected ways by proximity to pedestrian-oriented amenities.

Motivation for the Study

In spite of evidence and assumptions that residents value walkability and New Urbanist-style neighborhoods, there remains doubt about what types of residential developments are really in demand by consumers. New Urbanism, according to the founders of the movement which emerged in the 1980s, promotes "the restoration of existing urban centers and towns within coherent metropolitan regions, the reconfiguration of sprawling suburbs into communities of real neighborhoods and diverse districts, the conservation of natural environments, and the preservation of our built legacy" (Tu and Eppli 1999). Gordon and Richardson (2001) have strongly opposed top-down regulations from organizations or government, arguing that there has been little discussion about the financial costs of New Urbanist-style developments or whether the consumer really wants the new urban forms. Sharply critical of New Urbanist communities, they argue that because New Urbanist communities have a limited variety and number of retail establishments, most residents end up living beyond a comfortable walking distance from services. A walkable distance is generally considered to be between one-quarter and one-half mile (Song 2003; Talen 2005; Tilt 2007).

The propensity of developers to build sprawling suburbs has been cited as evidence of a lack of demand for other types of development. From the developers' point of view, the key to profitability is simplicity. They can generally maximize profits by following the easy path, which means creating single-use projects on the periphery. Such development patterns are familiar to financial institutions and local governments (which equates to fewer barriers for developers) and they are easy to market and manage (Leinberger 1998). Furthermore, Gordon and Richardson (2001) argue that developers, who often have extensive marketing expertise, will produce the housing that buyers want, in order to guarantee their profitability. "If New Urbanist-type developments were demanded by consumers, they would be built." (Gordon and Richardson 2001,140). A study by Matthews and Turnbull (2007) suggests that existing suburban development patterns satisfy the demands of today's consumers and are not solely a product of developers, conservative banks and misguided municipalities, a view that contradicts the basic tenants of new urbanism.

This project should provide useful insight into the market demand for pedestrian-oriented neighborhoods in Midtown Tulsa. Furthermore, this research has practical applications for city planners, real estate developers, and local governments especially if it shows that there is a demand for more pedestrian-oriented development. Real estate developers, seeking to maximize profits, continue to build suburban-style developments because they are easier, quicker, and cheaper than constructing New Urbanist and infill projects. Evidence that residents may pay a premium for certain types of walkable neighborhoods might promote a greater variety of projects in communities like Tulsa. Likewise, if there appears to be a demand for walkability, local government might facilitate new types of development by removing barriers like zoning restrictions, streamlining the process of applying for development variances, and offering financial incentives to both developers and local businesses.

The concept of neighborhood walkability has implications beyond the personal health of residents. City governments might use these study results as part of a more comprehensive energy or fuel-efficiency program that focuses on identifying or creating pockets of Pedestrian-friendliness or even "auto-free" zones within the city, where residents can live with minimal use of automobiles. Such a program could involve focusing new transit development in these pedestrian-friendly areas to lessen the need for an automobile and improving existing infrastructure to promote walking behavior.

The results of this research can also lay the groundwork for further research on a variety of topics related to urban design, the promotion of physical activity and "smart" development practices. This study will most likely raise additional questions about factors related to walkability, the relative importance of variables that were not used in this study, and how the study could be replicated in other urban neighborhoods.

Background of the Study

There has been a significant decrease in physical activity levels in the United States in recent decades while at the same time there has been an increase in obesity levels across all racial and ethnic groups, all ages, and both genders (Office of the Surgeon General 2010). While the U.S. Department of Health and Human Services emphasizes that Americans need to be physically active for optimal health, fewer people are incorporating the recommended level of activity into their daily routine. Lack of physical activity is associated with an increased risk of obesity, a health problem that is becoming a serious issue, particularly in developed countries like the United States (Brownson et al. 2005). Studies show that regular physical activity leads to long-term health benefits and can reduce the risk of many diseases including heart disease, stroke, high blood pressure, certain types of cancer, type 2 diabetes, and depression (U.S. Department of Health and Human Services 2008).

There are certain characteristics of the built environment that appear to be related to physical activity levels of neighborhood residents. For example, studies have suggested that the presence or absence of sidewalks, the proximity of residential areas to destinations like stores, restaurants, parks and jobs may be related to pedestrian-activity. In addition, research suggests that mixed-use areas (those with residential, light commercial and retail uses co-existing in close proximity) can be related to pedestrian activity, as can neighborhoods with short, gridded street patterns, and dense, pedestrian-scaled development patterns (Jackson 2003; Talen 2005; Vojnovic 2006; Cerin et al. 2007; Tilt et al. 2007).

There appears to be an increasing demand for walkability in America's cities. Studies suggest that residents are willing to pay a premium for certain neighborhood characteristics associated with pedestrian friendliness. Song and Knapp (2003) characterize this increased demand as "a result of changing demographics, changing tastes, and the closing of the suburban frontier". Studies have suggested, for example, that residents are willing to pay more to live in close proximity to a park, and will therefore pay higher property taxes to the local government which will, in turn, offset the cost of removing these park lands from tax rolls (Crompton 2001). Anderson and West (2006) also showed that residents will pay more to live in close proximity to open space. In fact, there may be a healthy demand (mostly unmet) for walkable communities (Handy et al. 2006) although this demand for dense, more traditional development is often hindered by the existing regulatory environment, including zoning setback codes and lot size requirements (Plantinga and Bernell 2007).

One way to evaluate residents' demand for walkable neighborhoods is to study home sales prices in both walkable and non-walkable neighborhoods, and attempt to isolate walkability factors with the goal of discovering if residents are willing to pay more to live in pedestrian-friendly neighborhoods. In real estate analysis, the actual selling price of homes, rather than other indicators such as appraised values, provides the only direct observation of the real estate market and prices (Kahr and Thomsett 2005). The value of a property is affected by a host of attributes, including factors related to the home's construction such as its building materials, square footage, number of bedrooms and bathrooms, year built, condition, quality of construction, and lot size.

But a home's value may also be affected by characteristics of the external environment of the home including its surrounding neighborhood, proximity to local amenities, the value of neighboring properties, and the presence or absence of negative amenities like busy streets, noise, or high crime rates. In real estate analysis, the immediate local environment of a property is extremely important as a determinant of the home's value, for even in the same portion of a city, home values can vary from block to block depending on specific amenities or dis-amenities of each specific location. A hedonic housing price method is often used to estimate buyers' willingness to pay for local environmental amenities (Keohane and Olmstead 2007).

History and Nature of the Study Area

This study focuses on the Midtown area of Tulsa, Oklahoma, an area defined in this study as being bounded by the Arkansas River to the west, state highway 64 to the north and east, and Interstate 44/Skelly Drive to the south and east (Figure 1.1) The Midtown area is characterized by a mix of residential development patterns ranging from older-style gridded streets lined with charming bungalows to 1960s era ranch houses. Likewise, commercial areas include both pedestrian-friendly shops and large strip malls. In general, most residential and commercial structures range in age from the 1920s to the 1960s. The Midtown portion of Tulsa was chosen as the study area because of its interesting mix of neighborhood features, because it is sufficiently big to provide a large quantity of data for analysis, and because many of its neighborhoods offer the potential for infill forms of development. These unique features will allow for comparisons between different types of walking, different types of commercial or retail areas, and their associated relationship to real estate values.

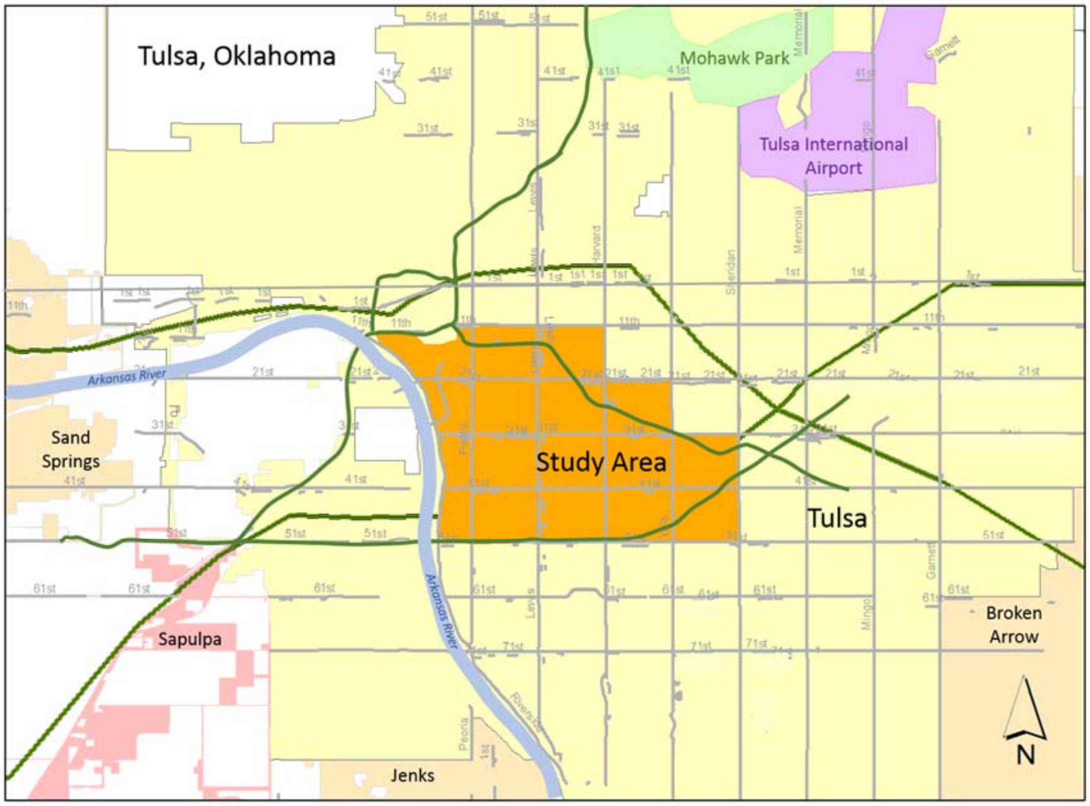


Figure 1.1 The Study Area in Context

The city of Tulsa began as a small Creek Indian settlement on the Arkansas River. Initially referred to as Tallasi, after its namesake town in Alabama, whites began to pronounce the unfamiliar name as Tulsi, Tulsee, and eventually, Tulsa. By 1887, the town of Tulsa consisted of three mud streets: Main Street intersected by First and Second Streets. Interestingly, the early residents of Tulsa demonstrated a clear demand for walkability in their new town when they insisted that their streets be no wider than eighty feet wide as “anything wider was too far to walk in the mud” (Goble 1997). The town was granted its official charter of incorporation on January 18, 1898. In time, the city of Tulsa received the title of the Oil Capital of the World and by 1927, fifteen hundred oil-related companies were headquartered in Tulsa. Refineries in the Tulsa area produced more gasoline than any other city in America (Goble 1997).

As the city expanded, developers and city officials made some attempt at creating order and well-planned neighborhoods. The streets of Tulsa were laid out so that streets east of Main street borrowed their names from places east of the Mississippi River, while streets west of Main, were named after places west of the Mississippi. The main streets, like Peoria, Lewis, Harvard and Yale were laid out along old section lines. In 1923, Tulsa adopted its first comprehensive zoning plan, and even though many of its provisions were not enforced, city leaders showed a certain progressiveness by the fact that they created a plan at all. For at this time, before the era of the New Deal and the Federal Housing Administration, there were no national housing standards. Still, in spite of Tulsa's ordinances, the development pattern in the growing city was mostly dictated by the market, rather than by design (Goble 1997).

During Tulsa's oil-boom period, private developers created the upscale, well-planned neighborhoods of Maple Ridge, Terwilleger Heights, Forest Park, and others. Developers were paid very well for these projects, which became known for their quality construction and design. Likewise, the market rewarded developers for middle-class developments like Florence Park, a development that featured distinctive bungalows that were not on the scale of Terwilleger Heights, but offered charm, quality, and affordability. The working class residents of the city were not as fortunate. Because developers didn't make as much money on lower-end, working class housing, they built fewer affordable homes, and what they did build was quickly and cheaply built, and sometimes even substandard. During the Second World War, Tulsa needed working-class housing in order to attract military contracts. Working with the National Housing Board and the War Production Board, the Chamber of Commerce constructed hundreds of small, cheap, two and three-bedroom houses, many of which were substandard (Goble 1997).

Spatially, the city of Tulsa bulges to the east and south, a result of the convergence of several factors including the physical barrier represented by the Arkansas River to the West, a social/cultural "barrier" represented by the poor, black sections of town to the north, and a series of administrative decisions that set aside large areas of land to the north and northeast of downtown for the Tulsa International Airport and Mohawk Park. Not only did the city's residential areas sprawl to the east and south from the central city, but the shopping centers that spread after WWII, were increasingly larger and further removed from Tulsa's central, historic core. In some ways, the uneven growth pattern of the city, particularly its failure to radiate out evenly in all directions from downtown, exacerbated the soon-to-be ubiquitous problems of automobile-dependence, long commute times, sprawling suburbs, and elongated shopping strips and may have contributed to the decline of downtown as a shopping destination.

In the 1970s and 1980s, city leaders began to show an interest in smarter development and redevelopment practices. As part of their "Vision 2000" program, the Tulsa Metropolitan Area Planning Commission adopted a comprehensive plan that included specific developmental guidelines and goals for each of 26 districts in the Tulsa Metropolitan Area. A result of nearly two decades of work, the plan is remarkably progressive in its call to make residential neighborhoods more livable and more pedestrian-friendly, improve the connectivity of pedestrian paths and bikeways, minimize adverse effects of growth and development, and preserve the nature and character of certain neighborhoods. For the area of Tulsa designated as District 6, which corresponds to the study area for this project, city leaders state a goal of making sure that all residents have access to quality open spaces and recreational areas. Furthermore, they recommend that existing bicycle trails should be expanded to connect schools, parks and shopping areas in order to "ensure a safe means of pedestrian and bicycle travel for District residents" (City of Tulsa Planning Department 2010). One of the reasons cited for the development of the River Parks system along the Arkansas River, was to help promote "balanced growth", to help stabilize and revitalize the central city, and to provide recreational facilities to serve existing housing areas. The comprehensive plan was to extend the River Parks trail system into neighborhoods adjacent to the park, to connect with the downtown Tulsa pedestrian trails and to promote the use of the abandoned Midland Valley Railroad bed as a pedestrian path (City of Tulsa Planning Department 2010).

Certain portions of Midtown Tulsa certainly have the potential to be marketed and developed as walkable, human-scaled neighborhoods. Frumpkin (2002) suggested that there are likely many different types of built environments that can promote health and walkability and it is likely that "optimal approaches will borrow elements of cities, suburbs, and small towns" (Frumpkin 2002). Midtown Tulsa has elements of all three. It may be that the types of older traditional neighborhoods as well as early suburban residential areas offer the greatest potential for retrofitting in terms of adding elements of walkability to the existing neighborhoods. The basic infrastructure, in some cases, is already in place. Neighborhoods like Brookside, Cherry Street, Maple Ridge, and Swan Lake already contain some of the same structural elements that New Urbanist communities promote, like gridded street patterns, small residential lots, sidewalks, on-street parking, nearby shopping and public parks. The Cherry Street commercial area, from 15th and Peoria to 15th and Utica is "pedestrian-scale in nature" and features businesses that occupy the original 1920s-era buildings (City of Tulsa Planning Department 2010). The question is: are residents willing to pay a premium to live near these types of neighborhoods? The answer to this question will help determine the demand for walkability in a part of the country that appears to prefer the automobile.

CHAPTER II

REVIEW OF THE LITERATURE

The existing literature on the subject of the built environment as it relates to physical activity is varied and multidisciplinary. The topic has been studied in various ways by researchers from fields as diverse as health, nutrition, urban planning, geography, environmental science, and transportation planning, among others. Most of the health-related research focuses on trying to find ways to motivate people to be more physically active and makes heavy use of participant surveys regarding perceptions and behavior related to exercise and neighborhood environmental factors. The literature rooted in urban planning, geography, and transportation-related fields is oriented more towards measuring and analyzing elements of the built environment including residential density, proximity of residential areas to desirable destinations, and transportation infrastructure like sidewalks, street patterns, and accessibility (Committee on Physical Activity, Health, Transportation, and Land Use 2005). Outside of the academic realm, there is increasing interest in pedestrian-oriented development from a variety of interest groups including environmentalists, new urbanism and "smart growth" advocates, health and fitness promoters, historic preservation movements, and bicycling and pedestrian groups (Talen 2005).

The Built Environment and Pedestrian-Oriented Development

> The ideal is to walk out your back door and have privacy; walk out your front door and have community; walk a few blocks for services, maybe for work; and walk a few blocks further for a nature preserve.
>
> (Leinberger 1998)

One possible contributing factor to decreasing rates of physical activity in the United States is that many Americans live in sprawling, suburban developments that were not developed with pedestrians in mind and that demand nearly total reliance on the automobile. In the older cities of the northeast, high-density, renter-occupied, multi-family dwellings are prevalent while the single-family home is more typical of cities of the heartland, where there is an abundance of space. In urban developments that were built after WWII, entire neighborhoods have been built to accommodate the automobile. These ubiquitous urban settlements of sprawling, single-family homes located in isolated enclaves have been widely criticized as inefficient, resource-hogging, and of simply poor urban design. Zoning ordinances that require large residential lots and a segregation of land uses have often encouraged the development of these residential-only subdivisions that are often totally dependent on the automobile. (Schilling and Linton 2005).

While suburbia’s effect on obesity is still unclear, studies suggest that residents of more traditional neighborhoods walk more than residents in suburban neighborhoods (Handy et al. 2006). While there is much speculation that sprawling, suburban-style development might be unhealthy by discouraging physical activity, it is less clear whether or not a built environment that is conducive to walking actually causes people to walk more. Few studies have tried to examine the cause and effect aspects of the built environment and physical activity, partly because of the difficulty of designing research that can prove causality. Furthermore, it appears that homeowners who are interested in being physically active tend to self-select into pedestrian-oriented neighborhoods (Handy et al. 2006; Vojnovic 2006).

Current literature suggests a number of characteristics of the built environment that may be related to the physical activity-levels of residents, and although evidence showing causality is rare, certain neighborhood features can likely promote or discourage physical activity. The Task Force on Community Preventive Services (an organization dedicated to helping communities choose programs and policies to help improve health and prevent disease) recommends urban design elements that include greater proximity of residential areas to destinations such as stores, jobs, schools and recreational facilities as well as streets and sidewalks that exhibit high levels of connectivity and continuity. The task force further suggests the importance of the aesthetic quality and safety levels of communities as well as certain policy methods of affecting change such as changes in zoning laws, building codes and building practices (The Community Guide 2010).

Part of the difficulty faced by researchers is determining which factors of the built environment are related to walking behavior, and how to isolate specific urban design elements during the research process. In many studies, researchers have begun with the assumption that certain factors, like the presence of sidewalks, street lighting, and parks, are related to pedestrian activity in a given neighborhood, only to discover that the issue is more complex and often more contradictory than expected. In one survey of existing studies, researchers and experts attempted to produce a list of the most important factors in a community that improve opportunities for regular exercise. After an extensive literature review and much discussion, one team of investigators came up with a list of ten indicators of activity-friendly communities that include such factors as “land use environment”, aesthetics, travel patterns, social environment, and access to exercise facilities (Ramirez et al. 2006). These types of extensive literature review and consensus building projects can serve as a starting point for further research, and can suggest ideas for variable selection.

Jackson (2003) emphasizes the importance of neighborhood opportunities for walking to accomplish routine and necessary tasks like shopping, banking and going to work. Such daily lifestyle activities appear to be as effective as structured aerobic exercise in maintaining health and losing weight. Research shows that the provision of well-designed walkways through a mixed-use, human-scaled urban environment increases pedestrian activity. The term "conducive neighborhood design" is sometimes used to refer to the type of built environment that allows residents to easily and conveniently walk to everyday, routine destinations (Jackson 2003).

There appears to be a positive association between access to destinations such as retail stores, restaurants, parks, schools, post offices, recreation centers, transit stops, and jobs, and transportation-related walking behavior. Higher density development is widely believed to encourage pedestrian activity because such neighborhoods tend to be less sprawling, more compact, and therefore more walkable. In their study of transportation-related walking, researchers find that proximity of the workplace is a significant factor in whether or not residents walk for utilitarian purposes, and that certain commercial destinations are particularly related to walking behavior. Food stores, for instance, appear to be significantly related to transportation walking while such commercial institutions as car and home-related shops are not good predictors of pedestrian activity (Cerin et al. 2007). Another study of transportation-related walking behavior suggests that higher density neighborhoods tend to promote utilitarian pedestrian travel but it also shows that lower density neighborhoods promote leisure walking. In the end, the researchers conclude that higher densities alone do not appear to affect overall physical activity (Forsyth et al. 2007).

A 2006 article explores the association between home age and walking behavior. Home age was used as a proxy measure of the built environment, the assumption being that older homes (and older neighborhoods) are associated with greater density, mixed uses, sidewalks and greater street connectivity – all elements of urban form that are believed to be pedestrian-friendly. The survey data used in this study included a measure of walking behavior from respondent answers to the question: "In the past month, how often did you walk a mile or more at a time without stopping?" The survey data used in this study also included a measure of other leisure-time physical activity. The results of this study show that residents of homes built before 1974 (in urban or suburban areas) are more likely than those who live in newer homes to walk 20 times or more per month, a finding that seems to support the suggestion that home age can be used as a proxy measure of characteristics of urban form that influence walking behavior (Berrigan and Troiano 2006).

A study conducted by Vojnovic provides an overview of how to promote pedestrian activity in urban areas. After a brief discussion of the problem of obesity and related health issues in the United States, the author considers design factors in the built environment that facilitate physical activity. Specifically, the study considers three geographic scales – the regional, sub-regional, and city block scale – and discusses variables in each of these levels that affect individual choice to walk or ride a bicycle. For instance, at the regional level, urban density and land-use mix are used to examine travel, particularly focusing on how to shape a spatial structure that minimizes vehicle miles of travel, especially travel associated with work. At the sub-regional level, the author focuses on connectivity issues and begins to emphasize other types of destinations (besides just work) and considers shopping, schools, entertainment and various other urban activities and functions. Finally, at the city block level, the author considers issues such as building typologies, pedestrian rights of way and other micro-level urban environments that encourage physical activity. Findings suggest that the greatest impact on neighborhood walkability can be implemented at the block scale by encouraging a mix of uses along arterials, promoting smaller lot and building sizes, and incorporating more commercial and civic space within residential areas (Vojnovic 2006).

It is likely that factors of the built environment can work in different ways to discourage or promote pedestrian behavior depending on particular socioeconomic factors of residents. For example, women and the elderly are often concerned about their personal safety when it comes to walking outside and will sometimes forego walking completely rather than walk alone, in the dark, or on streets that seem dangerous. There appear to be connections between the physical activity levels of residents and their perceptions of neighborhood safety, feelings of fear, and assumptions of risk (Loukaitou-Sideris 2006). Certain features of the built environment may act as barriers to physical activity, particularly for certain segments of the population. For example, the presence of large, busy street intersections, high crime rates, lack of street and sidewalk connectivity, the lack of appealing destinations, and low density housing may discourage pedestrian activity. Talen (2005) uses the term "lost space" to refer to areas like parking lots and vacant lots that often serve as barriers to pedestrian activity. In a study by Eyler and Vest, women cited the lack of sidewalks as a major complaint. Most of the women surveyed in this study are willing to walk for exercise but cite a lack of sidewalks as a major barrier, along with uneven pavement and traffic. In addition, personal safety is a major concern, particularly in regards to walking at night in poorly lit areas (Eyler and Vest 2002). A recent article provides a synopsis of research on parks and physical activity and suggests that proximity to a park is a strong factor in whether or not someone will use park facilities yet certain groups such as the elderly, racial minorities, and females, are less likely to make use of parks (Bedimo-Rung et al. 2005).

Children use their neighborhood surroundings in completely different ways than adults, and may encounter features of their environment that facilitate play and outdoor recreation as well as neighborhood obstacles to physical activity. In one study of the effects of the built environment on childhood obesity, researchers claim that children know instinctively that features of the built environment around their home and in their neighborhood affect just how physically active they can be. In certain areas, physical activity is easy, natural, and encouraged by such features as sidewalks, parks, and playgrounds while in other neighborhoods, elements of land use, transportation patterns, and community design can discourage or limit outdoor activity for children (Sallis and Glanz 2006).

Neighborhood walkability is particularly important to an aging population, who can benefit greatly from exercise and from relying less on automobiles to get around. As Baby Boomers age, the United States must find ways to cope with a rapidly changing demographic that includes larger numbers of retired and elderly people. Communities that make it possible for residents to walk to daily necessities, like food stores, banks, and pharmacies, will allow for longer "functional independence" within elderly populations by providing essential destinations within walking distance of older people who may not be able to drive a car (Vojnovic 2006).

New Urbanism and Smart Growth

New Urbanism has been touted as the most significant and important philosophy of city planning to come along in recent years. A number of New Urbanist developments have appeared over the past thirty years. Proponents believe they are "leading the way out of the wilderness of sprawl, and into a more peaceful and ordered land where things work right" (Marshall 2000). The concept of New Urbanism in urban design has developed, in part, as a reaction to the poor design of urban sprawl. New Urbanist communities seek to build neighborhoods that borrow the best features of urban design from a pre-1950s style of town planning, when houses were closer together, closer to the street, and streets were straight, gridded networks, rather than curvy, cul-de-sac-heavy affairs. In short, the New Urbanist neighborhood is designed to be built on a human, pedestrian scale, with relatively dense settlement, a mix of uses (residential and commercial) as well as a mix of dwelling types. While these new, older-style communities have aesthetic appeal, they have been widely criticized as being sterile, elitist, and expensive enclaves for the wealthy. More importantly, the New Urbanist developments often promote appearances over function. Developers of New Urban neighborhoods admire and mimic a town style that developed years ago under different transportation systems, when two-car garages were unnecessary, and residents rode in carriages, walked, or traveled by streetcar. Marshall (2000) argues that developers cannot copy the style of an older community without also copying its transportation system, and that in spite of its shortcomings, at least suburbia's development pattern is an honest and functional way to build neighborhoods for the way people live and travel today. In other words, building high-priced homes in disconnected neighborhoods that are aesthetically pleasing and nostalgic, in part because they pretend that residents are not as dependent on cars as they really are, is not necessarily the answer to the problems of urban sprawl.

The results of one study suggest that residents of New Urbanist neighborhoods do not engage in more or less physical activity than residents of conventional neighborhoods; however, there are differences between the two types of neighborhoods in terms of the kind of physical activity favored by residents. The research shows that residents of New Urbanist neighborhoods are more likely to engage in utilitarian pedestrian travel than residents of traditional neighborhoods, a finding that makes sense if destinations like stores and restaurants are within walking distance in New Urbanist neighborhoods. This utilitarian travel appears to replace a certain amount of leisure activity. In other words, in places where people live close to shops and restaurants, they may choose to walk to these destinations instead of walking around the block for fun or exercise. In addition, residents of New Urbanist communities are more likely to engage in physical activity in their neighborhood, rather than going elsewhere to walk or ride a bicycle, presumably because there are desirable places to go that are close to home (Rodriguez et al. 2006).

One major drawback of New Urbanism is that it tends to promote brand new development as opposed to improving existing urban and suburban neighborhoods. As Marshall (2000) says, “For every New Urban development being built on the edge of town, there are multiple real urban neighborhoods decaying or in need of attention within the same metropolitan area. Why go outside of town to buy something that could be had more fully and more cheaply, within it?” (39). Many U.S. cities have older urban homes available at reasonable prices, plenty of gridded streets, traditional urban neighborhoods, and existing shops within walking distance. New Urbanist communities tend to be isolated enclaves and, while they feature high levels of connectivity within their own neighborhood, they usually fail to be connected to the wider community or to tie into the infrastructure of the existing city (Marshall 2000).

One highly-promoted “solution” to the negative health impacts of urban sprawl has become known as “smart growth,” which generally refers to development practices that feature high density patterns of land use, contiguous and connected development patterns, the preservation of green space, a mix of uses, limited road construction, transportation choices, and coordinated planning. (Frumpkin 2002). Advocates of smart growth embrace some of the same design principles as New Urbanists, especially in regards to the desirability of creating walkable neighborhoods, fostering a sense of community, encouraging mixed-use neighborhoods, and promoting compact building design but the smart growth movement has a distinct environmentally-oriented “green” focus that is sometimes overlooked in new urbanism. For example, while New Urbanist neighborhoods tend to be built as new, isolated enclaves, smart growth principles encourage developers and city leaders to “…direct development towards existing communities”, and to preserve open space and farmland (Smart Growth Online).

Smart growth proponents call for resource conservation, environmentally-friendly practices, energy conservation, increases in public transit and innovative programs like the push to encourage very small houses, and the re-use of building materials from demolished buildings.

The Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) initiative is designed to recognize development projects that "protect and enhance the overall health, natural environment, and quality of life of our communities" and that reduce automobile dependence by providing jobs and services that are accessible by pedestrians or by transit. The program uses a ranking system to award certification to neighborhoods that meet a minimum standard of smart growth and New Urbanist "best practices" and is designed to be used by local and state governments as a policy tool to promote sustainable communities (LEED for Neighborhood Development Rating System 2007).

In spite of increasing interest in new urbanism and "smart" growth, there remains a lack of consensus on exactly what constitutes good urban form and on the more troublesome issue of how to encourage, or even mandate, the development of better neighborhoods. The response to urban sprawl problems is often a call for more regulatory control of zoning and land use issues at the state, regional, or even national level. Frumpkin (2002), for example, cites the need for policy-related incentives to encourage the development of more walkable communities. Local government plays a critical role in combating sprawl and in promoting smart and pedestrian-friendly infill development. Suburban sprawl is not just a result of the prevalence of automobiles, but also of local government policies and decisions regarding the construction of roads, expressways, sewer lines, and other basic components of infrastructure that allow for sprawl to happen in the first place (Marshall 2000). Pro-active local governments can also institute incentives for developers to take on infill projects and to include pedestrian-friendly elements in their neighborhood projects. On the other hand, radical policy measures designed to combat sprawl, such as restrictions on automobile use or density requirements, may not succeed and could create an unpleasant climate of control that will be met with deep resentment by urban constituents. The United States has a strong tradition of local land use and zoning controls and strong adherence to basic principles of states' rights that makes it difficult to adopt any type of national-level land use policy to control development in all states. Furthermore, attempts at strict controls will likely encourage developers to move out to urban fringe areas in order to bypass regulations (Gordon and Richardson 1998; 2001).

Measuring Good Urban Form

There is a notable lack of standard, accepted, and objective ways to measure the quality of the built environment as it relates to walkability. A number of methods for measuring the pedestrian environment have been developed, but most of these methods either ignore important factors of the built environment, depend on data that is not widely available, are expensive, or require extensive fieldwork. Parks and Schofer (2006) recommend using measures of the built environment that:

- Do not require field costly and time-consuming field visits
- Use objective rating methods
- Strike a balance between the level of detail obtained and data collection costs
- Allow for the development of ratings for any proposed urban designs
- Are based on reliable data sources

The researchers develop a method of evaluating the pedestrian environment that is objective and does not require field visits, that is cost-effective, and that is based on reliable data. Using 23 Chicago-area neighborhoods as their study area, the authors use digital aerial photographs and US Census TIGER files as their main data sources, making use of a geographic information system (GIS) to store and analyze the data. Of these neighborhoods, seven are categorized as “city” neighborhoods, seven are considered “inner suburbs”, and nine are labeled “outer suburbs” (Parks and Schofer 2006). The study considers six factors that are believed to be associated with good pedestrian design, all of which can be measured remotely. These include:

- Sidewalks
- Parking lots
- Building setbacks
- Block length
- Intersection type
- Census block density

The authors also use several calculated variables including the sidewalk ratio (the total sidewalk length in feet over the centerline feet of roadway), the average building setback, and the adjacent parking ratio (Parks and Schofer 2006).

One study that was undertaken by Talen (2005) from an urban planning perspective presents techniques for the detailed measurement of good urban form. The author defines good urban form in terms of the philosophies and tenets of movements variously labeled new urbanism, sustainable development, smart growth and livable cities. Most of these ideologies share the belief that good urban environments tend to be compact, diverse, and walkable, in contrast to automobile-oriented, traditional suburban development. Specifically, the author defines good urban form as having the following characteristics:

- Spaces are defined and enclosed
- Attention is given to the public realm
- Residential lots are small
- Streets are relatively narrow
- Neighborhoods are mixed-use
- Residents have accessibility to services and public spaces

Talen recognizes several reasons for attempting to create and preserve good urban form. She mentions the potential health benefits of having pedestrian-friendly neighborhoods, but also suggests that the old-style, urban pattern of certain poor, inner-city neighborhoods may have intrinsic and historic value that is often overlooked. She suggests that certain older neighborhoods be protected from suburban-style new development that corrupts the uniformity and traditional structure of such places. Thus, the quest for good urban form can be motivated by a combination of health, environmental, aesthetic, and historic preservation reasons (Talen, 2005).

Talen (2005) uses DOQs, parcel data, and street data (three sources of data that are available for most cities) to evaluate spatial enclosure and definition, the public realm, spatial suitability, and land use mix. She also includes proximity to certain destinations as a variable in the analysis, using retail facilities and public space as important destinations. In her analysis, Talen creates buffers at 1/8 mile, 1/4 mile and 1/2 mile around various destinations, and produces a layer in GIS that shows the areas of neighborhoods that are more or less proximal to these desired facilities. By combining layers in a GIS, she creates a map that highlights areas that score high on measures of good urban form. Furthermore, this layer is converted to a raster surface to produce a composite that shows how urban form varies across the urban landscape (Talen, 2005).

Another study that makes effective use of GIS examines the associations between physical activity and the built environment but looks at both perceived and objective measures of the built environment (McGinn et al. 2007). A GIS provides the container for the key “objective” measures that are central to this study. A GIS is used to manage the following data:

- Geocoded addresses of survey participants
- Street networks (from TIGER data)
- Traffic speed (obtained by using posted speed limits of street segments)
- Traffic volume (obtained from existing traffic count data from study sites)
- Street connectivity (measured in several different ways using TIGER road network data)
- Traffic accidents involving pedestrians or bicycles (obtained from the University of North Carolina Highway Safety Research Center (HSRC)) for the ten-year period from 1993 to 2002

In general, the study shows little agreement between objective and perceived measures of the built environment and suggests mixed outcomes with regard to the built environment and physical activity. However, when both perceived and objective measures of the built environment are combined into the same model, the researchers observe independent associations with physical activity, leading them to recommend including both types of measures of the built environment (McGinn et al. 2007).

One study from the health promotion literature combines both survey data and objective measures of neighborhood characteristics to evaluate walking trips in Seattle, Washington and how walking is related to neighborhood destinations and vegetation. The researchers hypothesize that the number of destinations within walkable distance of a residence (accessibility) and that the amount of vegetation within that walkable area will be positively related to the number of walking trips and positively related to body mass index (BMI). This particular study uses a GIS to create layers of residential parcels, destinations (including parks, grocery stores, restaurants, banks, schools and others), and street networks. From these data, the researchers examine which residential parcels are within a 0.4 mile distance of each destination and label this variable "objective accessibility". Because they want to study vegetation, the researchers use a normalized difference vegetation index (NDVI) as a way to objectively measure the amount of "greenness" in the walkable neighborhood for each parcel and calculate the NDVI of the area within the 0.4-mile walking distance for each parcel. Results of the study suggest that having many destinations close to residential areas is related to increased total walking trips. Furthermore, the study shows that the perceived importance of walking to these places is related to walking trips (Tilt et al. 2007).

The Value of Walkability

A number of studies suggest that people are willing to pay a premium to live in walkable neighborhoods (Crompton 2001; Plaut and Boarnet 2003; Song and Knapp 2003; Anderson and West 2006). If so, this may have important implications for future development patterns. If pedestrian-friendly neighborhoods are in demand, market-driven developers will likely respond, as will local government allowing or making easier the construction of developments with features of traditional design such as reduced building setbacks, on-street parking, a mix of commercial and residential uses, and pedestrian pathways. Song and Knaap (2003) study various aspects of urban form related to new urbanism and how these characteristics of neighborhoods, streets, amenities, socioeconomic characteristics and attributes of homes are capitalized into residential property values. Interestingly, the authors find that some, but not all, of the traits associated with new urbanism are valued by homeowners to the extent that they were willing to pay a premium for these features. The researchers attempt to disaggregate the separate elements that affect home price including attributes of the home, its location, socioeconomic factors, the availability of amenities, public services, as well as features of new urbanism in the neighborhood. The researchers find that residents are willing to pay a premium to live in neighborhoods with better connected street networks, more streets, better pedestrian accessibility to commercial areas, and proximity to transit (Song and Knaap 2003). Other studies suggest that consumers, in general, are willing to pay a premium to live in New Urbanist communities (Tu and Eppli 1999; 2001). Matthews and Turnbull (2007) find that house prices are positively affected by proximity to retail establishments, but only in neighborhoods with gridded street patterns. However, in neighborhoods without good street connectivity, retail proximity actually has a negative effect on home prices. In general, this study suggests that residents place a value on proximity to retail establishments only if the neighborhood presents easy access to these retail areas. Handy et al. (2006) also cites evidence of a strong demand for walkable communities, suggesting that housing prices (and associated higher property taxes) in walkable neighborhoods may help offset the cost of improvements (Handy et al. 2006).

A study by Song and Knapp (2003) offers useful insight into which features of new urbanism are most valued in the marketplace. It appears from the results of this study that residents are willing to pay premiums for:

- More connective street networks
- More streets
- More and smaller blocks
- More evenly distributed mixed land uses
- Proximity to light rail stations

In his article on "Incentive Property Taxation", Gihring (1999) makes the case for a revised property tax system that would discourage suburban sprawl while encouraging revitalization and "infill" of urban centers. Gihring suggests the imposition of a two-tiered system that would impose a higher property tax on land making it more costly to hold on to vacant, centrally-located land, encouraging infill development and lowering the demand for peripheral sites at the urban fringe. At the same time, he advocates a reduction in the tax burden on improvements which he argues would facilitate revitalization of urban centers and encourage greater development on vacant and underutilized urban sites. In the end, Gihring concludes that while a two-tiered system of taxation may have the potential to produce some of the desired effects associated with growth management objectives, there are limitations to how useful a revised tax structure can be (1999).

There is evidence that residents are willing to pay a premium to live in close proximity to parks and open spaces, and that the associated higher property taxes paid by residents near parks can help offset the cost to municipalities of setting aside the open space. Crompton (2001) examined the results of some 30 different studies and found that all but five supported the "proximate principle", a term used to refer to the "capitalization of park land into the value of nearby properties" (Crompton 2001). Interestingly, this capitalization effect was used to fund early parks, including the earliest parks in England, and is used today to help fund municipal golf courses. While the magnitude of the effect appears to vary depending on the type of park, Crompton found that this proximate effect can have a positive impact of up to 20 percent on the value of properties fronting a "passive" park (one that is generally used for passive purposes, rather than for active recreation), and can have a positive effect of up to 10 percent on properties that are located two or three blocks away from more active and busy parks. The assumption is that residents don't want to **front** active and presumably noisy parks, but do place a value on living **close** to active parks. His studies are important because they demonstrate the value of parks, particularly for community officials who tend to see only the costs of parks and suggest that setting aside land in urban areas is not necessarily going to lose money. Crompton's focus is on the economic impact of parks, and his research findings suggest that city officials should consider the potential economic value of including parks and open space in development and infill projects. However his studies also add to the body of work that suggests that features of the built environment can affect property values; that residents are willing to pay more to live in close proximity to a park. (Crompton 2001; 2005).

The Gihring (1999) study provides both some interesting parallels and radical departures from the "proximate principle" theories discussed by Crompton. Both the theories deal with property values and property taxes, but Gihring takes the view that urban land should be intensively developed, and that vacant and "underutilized" land in urban areas should be developed. He makes no mention of urban parks and green spaces or whether these parks are considered underdeveloped and should, therefore, be developed, but Gihring does suggest that existing urban areas should be developed intensively and that the amount of vacant land should be minimized. Interestingly, he states that the effect, over time, of this intensive development is to increase property values and thus the tax base. Crompton would argue that the presence of a well-designed park in an urban area, and the intentional preservation of open spaces and parks, can also increase property values of nearby residences (Crompton 2001).

In spite of the evident demand for certain walkability factors promoted by new urban and smart growth initiatives, it is not clear that Americans are ready to give up their sprawling suburbs. The high density living promoted by new urbanism can be particularly difficult to sell to the United States' market, especially to Baby Boomers who grew up and went to school in quiet, spacious suburbs with large backyards. Even Frank Lloyd Wright believed that the ideal density level for promoting individual freedom and creativity would be only one person per acre (Thomas 1998). There is some evidence that residents expect to pay less for houses in neighborhoods that are dense, contain more commercial, multifamily, and public uses, and contain major transportations arterials. It has been suggested that residents are not enamored with the higher density levels found in New Urbanist communities, but rather put up with being closer together in order to enjoy other benefits of living in a New Urbanist neighborhood. Likewise, residents are not necessarily looking for heavily commercialized neighborhoods with too many public uses (Song and Knapp 2003). In short, despite the claims of New Urbanists, the street patterns, low connectivity, segregation of uses, and low density in the typical American suburb doesn't necessarily represent a market failure and appears, instead, to be driven by the demands of a large portion of the urban market (Matthews and Turnbull 2007).

Real estate developers can also be a barrier to new ways of creating neighborhoods, and to undertaking extensive redevelopment efforts. Developers are in business to make money and are reluctant to undertake projects that seem financially risky and outside of the norm. This leads to a marked conservatism in terms of projects they are willing to undertake (Swaback 2007), which suggests that whenever developers gather to discuss a project, their expertise "becomes a constraint". They "know" what won't work, what won't make it past local governing boards, what the site's neighbors will oppose, and what projects have not been economically profitable in the past.

The price that consumers are willing to pay for a particular home is a function of many different factors including structural features of the home itself, the age of the home, features of the home's neighborhood or external environment, the overall location of the home, socioeconomic factors of the surrounding area, the availability and cost of credit, and the overall strength of the economy. For potential homebuyers, the purchase of a home is a personal and often an emotional decision. Buying decisions are influenced by factors such as the cost of a mortgage, the potential equity or capital gains on a particular piece of property, the down payment required at time of purchase, and credit constraints of potential buyers. But potential homeowners are also influenced by subjective factors like the curb appeal of a home, interior finishes, and the perceived desirability of a specific location. If a particular neighborhood is seen as desirable, real estate prices can increase, as the perceived value of neighborhood attributes attracts buyers and investors (Leece 2004). Attempting to discern the value of specific amenities can be difficult, as there is not an explicit market for the factors related to real estate value, and there are often issues of multicollinearity in the data that must be dealt with statistically in order to produce plausible estimates of individual effects on property value (Gilley and Pace 1995).

The price of a particular property is often studied using a hedonic price model in which housing is seen as a bundle of attributes such as site characteristics, structural elements, location, and market characteristics. In real estate, the hedonic model is commonly used to estimate the demand for certain environmental amenities and attempts to isolate relevant features of the built environment from other attributes of single family homes. The model is used in part because there is not a clear and overt market for certain specific real estate amenities. In a hedonic model, housing value is calculated by the type and quantity of attributes found in a house, and the implicit price of each attribute. A typical hedonic model can be represented by the following equation (Tu and Eppli 2001):

$$P = f\,(x_i,\ \beta_i) = \sum \beta_i \cdot x_i + \varepsilon_i$$

Where:
P = housing value
x_i = quantity of the i^{th} housing attribute
β_i = price of the i^{th} housing attribute
ε = error term

There are a number of other ways to estimate the market demand for real estate. For instance, the market can be observed indirectly by studying trends in the length of time that properties are listed on the market, with the assumption that the longer a home is on the market, the lower the demand. In high-demand areas, properties tend to sell quickly. Another potential indicator of the demand for a particular property is the spread between the asking price and the final sales price of the home. The method assumes that wider the spread, the weaker the demand. Trends in the inventory level of homes for sale in a neighborhood or community can also be an indicator of market demand. The assumption is that if the inventory of listed homes is growing, demand is falling. The overall trend in inventory can be used as a general indicator of the health of the local housing market (Kahr and Thomsett 2005).

Research suggests that there is a relationship between the built environment and physical activity, and further suggests that there is a market demand for pedestrian-oriented neighborhoods. Yet the evidence is contradictory, particularly regarding the issue of demand. Some studies suggest a healthy demand for walkable neighborhoods that feature highly connected street patterns, close proximity to parks and destinations, and high density development patterns. Yet others suggest that residents of low density suburban neighborhoods may be happy with their neighborhood form, and may resist the dense, mixed use elements of pedestrian-oriented areas. Suburbia, despite its drawbacks, offers quiet, seclusion, and familiar comfort in a park-like setting for residents who grew up in suburban neighborhoods. It is unclear whether or not residents of suburban-oriented cities like Tulsa, Oklahoma place any value on the walkability of their neighborhoods.

My study will be grounded in existing research suggesting that certain elements, like the presence of sidewalks, gridded streets and the proximity to parks and destinations are related to walking behavior of community residents. I will attempt to limit my attribute selection to those built environmental factors that have been shown to be most related to pedestrian activity and that appear to most affect property values, based on existing studies. Furthermore, I will follow the lead of a body of research, for example from Parks and Schofer (2006), Talen (2005), and McGinn et al. (2007) and attempt to choose data that is readily available and methods that are objective and replicable. The use of GIS will facilitate data collection, display, and analysis and will allow for the incorporation of large amounts of data, including over 20,000 parcel records for Midtown Tulsa.

The following methodology section will provide an overview of my methodological approach, justify my choice of approach, explain why other commonly-used approaches were not used, detail the data collection process, explain how the data was incorporated into a GIS and what types of data manipulation were performed, explain the walkability factor rating systems used in this study, and explain the statistical analyses that will be used. Careful attention to the research design is critical in order to assure that the study adequately addresses the research questions and to help insure that the end results will offer real insight into walkability issues in Midtown Tulsa.

CHAPTER III

METHODOLOGY

The purpose of this study is to determine if there is a demand for walkability among residents of Midtown Tulsa. In order to determine demand for pedestrian-friendliness, the study will use home sales prices as an indicator of the value that residents place on selected walkability factors. If residents are willing to pay a premium to live in pedestrian-friendly neighborhoods, there is hope that developers and city government entities will find justification for undertaking new types of walkable neighborhood development projects to make existing neighborhoods more pedestrian-friendly.

As a first step, the project examines factors of the built environment of Midtown Tulsa, Oklahoma to locate and map pedestrian-oriented amenities. Secondly, the study analyzes housing data for Midtown including home sales price and a variety of structural features of homes throughout the study area. Finally, the study examines which factors influence home prices and will attempt to uncover relationships between home prices and walkability. In addition, the project attempts to identify portions of Midtown Tulsa that already have at least some elements of good, walkable urban design that might be good target zones for redevelopment efforts. In general, the data used in this study are obtained from existing sources, derived from existing data, or collected in the field.

Specifically, the research design and methodology used in this study are designed to answer the central research questions which are:

- What are the factors that influence home prices in Midtown Tulsa and is walkability one of these factors?
- Are residents of Midtown Tulsa willing to pay a premium to live in close proximity to pedestrian-oriented amenities?

In order to answer the research questions, a number of preliminary decisions had to be made regarding the nature of the research project. The selection of a study area for this project was an important consideration and was based on several criteria. In order to study and compare different types of residential and commercial areas, a large portion of Midtown Tulsa was selected. The Midtown area was well-suited to the study because it includes both older, traditional residential areas as well as newer and more automobile-oriented residential areas. Furthermore, the Midtown area also includes a mix of traditional, pedestrian-oriented commercial areas like Brookside as well as automobile-focused commercial zones including several large shopping centers and one major mall. An obvious consideration was data availability and it was crucial that parcel-level data were obtainable for any chosen study area. For this study, parcel data were obtained through the Tulsa County Assessor's Office. The precise borders of the study area are defined by the major arterials of Riverside Drive to the west, U.S. Highway 64 to the north and east, and Interstate 44/Skelly Drive to the south and east. The use of these expressways as boundaries offered a straightforward method of delineating the study area and is in keeping with the methodology employed in the Talen (2005) project. In order to allow for an analysis of the expressways as barriers, the study area was allowed to extend slightly beyond the highways in certain areas.

There were a number of potential obstacles to overcome in the early phases of the project. An important initial step was to decide what walkability features of the built environment should be incorporated into the study. The literature on walkability includes a relatively large number of potential attributes that may be related to pedestrian activity. In this study, an attempt was made to use variables that were most likely to be related to walkability based on existing research as well as data that were readily available, that could be created using GIS, or data that could be collected in the field in a reasonable amount of time. Likewise, it was important to find a source of detailed, parcel-level data on home sales prices in Midtown Tulsa and to find a way to tease out the factors related to walkability. Details regarding data acquisition will be covered in a later section of this chapter.

Research Design and Rationale

This study incorporates both exploratory research and statistical analysis. The initial phase of the project was designed to explore the nature of Midtown's real estate landscape, and to determine the location and distribution of various amenities including pedestrian-oriented destinations, sidewalks, and dense intersections. The second phase of the study involved a robust and carefully-designed statistical analysis of the various factors that influence home price. Finally, the analysis results were conveyed in a series of maps.

The methodology selected for this study involves data acquisition, the creation of a project in GIS, statistical analysis, mapping, and interpretation of the results. The primary objective was to answer the research questions, and the study attempted to use data that are widely available and methods that are objective, replicable, and robust. Because of its focus on objectivity, the study did not employ more subjective methods like the use of interviews or questionnaires to uncover resident preferences and attitudes. Although such measures can be useful, especially when used in conjunction with objective methods to provide additional insight into the problem, this particular study is meant to be the first stage in a walkability study (Talen 2005) and is intended to serve as a basis for further analysis, public discussion, and community planning decisions. It is also meant to be used as a model for similar studies in other urban areas.

In order to explore the issue of walkability in Midtown Tulsa, this project uses GIS to store, create, display, and analyze data as well as to conduct statistical analysis. All the data in this project were combined into an ArcMap project that was created using ArcGIS 10.0 (ESRI 2011).

GIS is used to:

- Represent and analyze features of the urban landscape including administrative boundaries, residential and commercial parcels, streets, parks and trails
- Create data by digitizing
- Calculate distances for proximity analysis
- Sort and normalize data
- Conduct statistical analysis
- Display the findings on a series of maps

The problem being studied is inherently spatial in nature, as it involves issues like proximity, distance, clustering, and the distribution of features across the landscape. GIS is well suited to handling the types of spatial operations required to answer the research questions and served as a geographical database to contain the project data.

Data Acquisition

The data used in this project come from a variety of sources. When possible, the project uses widely available, existing data, but in cases where data are not available, the project makes use of data that are derived or created specifically for this project through various geoprocessing techniques. In addition, field data collection techniques are used to obtain most of the sidewalk data.

There are a number of variables that were intentionally not incorporated into this project for various reasons. The variable for school districts was omitted because the entire study area resides within the Tulsa Public Schools district. Measures of socioeconomic factors, building setback, and zoning designations were omitted from this analysis in order to maintain a reasonable level of simplicity in the project and to focus on features of the built environment that have been shown through other studies to be related to pedestrian activity.

Base Layers

Several types of data served as the foundation for the creation of a GIS project. The base layers used in this project were obtained from the Oklahoma Center for Spatial Analysis Website (Center for Spatial Analysis). The vector data from this site is downloadable in shapefile format for easy addition to a GIS project. A Tulsa County boundary layer was downloaded and was included in the project to provide context and positional reference for the study area. Tulsa County streets are an important data element to the project and were acquired from the University of Oklahoma website. The street line layer represents the midpoint of streets and provided positional context, served as a base for digitizing sidewalks, and was used to study street connectivity and density by providing a base on which to digitize street intersections. A highway layer was also added to the project to serve as study area boundaries and incorporated into the project as pedestrian barriers.

Digital imagery was incorporated into the GIS project from the National Agricultural Program (NAIP) and served as an important base layer. The imagery for Tulsa County was downloaded from the University of Oklahoma Center for Spatial Analysis Website. Generated by creating digital quarter quadrangle image title mosaics from natural color aerial film, the imagery for Tulsa County served as a backdrop for digitizing Tulsa area parks, for digitizing and verifying portions of Midtown sidewalks, and for digitizing large parking lots as the parking lot information available from other sources is incomplete. The digital mosaic was rectified to a Universal Transverse Mercator, North American Datum, 1983 coordinate system, which served as the coordinate system for the entire GIS project (Center for Spatial Analysis).

Parcel Data

Completion of this project depended on the acquisition of current parcel-level data containing home sales information and property characteristics. The necessary parcel data was obtained from the Tulsa County Assessor's Office for the entire study area. The raw data included information on 26,352 parcels in Midtown Tulsa and contained a total of 94 different attributes including information on property type, year built, legal description, address, owner's name, neighborhood designation, assessed property value, sales price, date of last sale, zoning, square footage, structural features of the home or business, lot size, and condition of the property. The Midtown Tulsa parcel data served as a critical source of information on residential parcels, commercial parcels, vacant properties, parks, and parking lots. The parcels categorized as "residential" were an important part of the project and were separated out and placed in a separate layer in the GIS project. This "residential" layer contained 22,450 residential parcels.

Throughout the study, the parcel table served as the anchor for the entire project. In order to compare home sales prices to various measures of walkability, it was necessary to add a number of fields to the parcel table. For instance, a field was added for such features as the distances to various amenities, presence of sidewalks, adjusted home sales price. In addition, several fields were created to contain dummy variables related to housing characteristics. For instance, the information related to housing quality and condition were listed with labels such as "good", "very good", "poor", etc. To allow for easier analysis, these nominal variables were converted to an ordinal scale. The end result was a parcel table in which each residential parcel contains information for all the variables in the study. This made it possible to compare the walkability factors with the associated characteristics of each house.

In order to make the parcel data easier to manage, attributes and records that were not needed for this project were omitted from the parcel master table. The original parcel dataset included numerous attributes for addresses and legal descriptions that were not useful to this project and were removed. Also, parcels that were **not** associated with commercial use, residential use, or city/county parks were removed as there were a number of records that contained parcel fragments associated with easements, unplatted roads, and "subdivided rows" that were not needed for this study. Also, there were a number of records that had missing information for key attributes. For instance, any residential areas that had zero values listed for sales price were removed from the database.

Sidewalks

Data for sidewalks were collected throughout the study area primarily by direct observation during the summer of 2010. By driving each of the streets in the study area, sidewalk information was recorded noting the presence or absence of sidewalks along the street. If sidewalks were present, it was noted whether they were present on both sides of the street or only one side. If they were only found on one side, it was noted which side (north, south, east or west) the sidewalk was on. These data were recorded by hand on paper maps. To make sure that the area was covered in a systematic way, the study area was divided into 17 quadrants, a map was printed out for each quadrant, and the area was covered one quadrant at a time. There were a few instances where streets were closed or under construction, and I was unable to drive the length of the street segment. In these cases, area imagery found on Google Earth or Street View was used to determine the location of sidewalks. Imagery was also used to locate sidewalks in a few cases in which street segments were missed in the field and as a way of verifying portions of the study area to see if sidewalk data entered matched the imagery (Google Earth). Once the information was collected in the field, the sidewalk data were digitized into the GIS project. The sidewalk attribute table was set up to indicate if sidewalks were present on one side of the street, two sides, or if there were no sidewalks at all. It was also noted which side of the street had sidewalks. The sidewalk data were coded such that parcels adjacent to streets with no sidewalks were coded with a "0", parcels adjacent to a street with a sidewalk on one side were coded with a "1", and parcels adjacent to a street with a sidewalk on both sides were coded with a "2".

Proximity to Parks, Trails, and Destinations

In order to address the research questions, it was necessary to determine the proximity of residential parcels to several types of destinations including parks, trails, restaurants, and various retail establishments. Data were needed for area parks, pedestrian paths and bicycle trails (referred to as "trails" hereafter), and various commercial destinations.

A layer for parks was created (digitized) in GIS from several different sources. The available parcel data included a few parcels that were identified as parks and these were selected to form the basis of the "parks" layer. But because the parcel data did not identify all the parks, it was necessary to complete the "parks" layer by digitizing park boundaries over aerial imagery while also referring to a paper map of Tulsa. The name of each park was included as part of the associated attribute table. A total of twelve different park polygons were identified in the study area representing eleven different parks.

Data for Tulsa area trails and bicycle paths were created from the City of Tulsa trail map available from the Indian Nations Council of Governments (INCOG) (Indian Council of Governments). The trails were digitized in GIS using the street and parcel layers as guides to placement.

An important part of this project centers on residential proximity to desirable destinations including retail shops and restaurants. The parcel data contain information on various types of commercial establishments. In order to simplify the analysis, and to select the destinations that were most relevant to the study, the destinations were limited to food stores, restaurants, retail stores, and several other miscellaneous types of destinations including churches, banks, theaters, recreation centers, and bars. When choosing which types of commercial destinations to include, an attempt was made to choose destinations that people are likely to visit on foot. This eliminated automobile-oriented destinations such as drive-up banks and restaurants, car washes, automobile service stations, and gas stations (unless listed in "convenience store' categories). I also eliminated healthcare-related categories including daycare centers, nursing homes, medical offices, mortuaries, and veterinary hospitals with the assumption that these establishments are likely not major pedestrian destinations.

An important part of this project involves the proximity of Midtown homes to a variety of features, including both attractive destinations and unattractive features like busy streets and large parking lots. Using ArcToolbox, distances were measured (in feet) from the centroid of each residential parcel to the edge of the nearest feature in question. The procedure created additional fields in the parcel table to contain measured distances.

Street Connectivity

The density of 4-way intersections was used as a measure of street connectivity. Following the methods used by Parks and Schofer (2006), all 4-way intersections were digitized as a point feature in GIS using the street layer as a base. Then, using the Spatial Analyst feature in ArcGIS, the intersections layer was converted to a raster layer using a cell size of .002 map units with neighborhood settings of 0.001917. The raster layer was classified into three groups, then digitized by category into a vector layer and coded according to whether each parcel was located in an area with highly-connected, moderately-connected, or poorly-connected streets. For this analysis, streets coded with a "1" were considered to be poorly-connected, those coded "2" were considered moderately connected, and a "3" was used to designate streets that are highly connected (i.e. they have an abundance of 4-way intersections).

Barriers to Pedestrian Activity

Three variables were chosen to use in the model because they represent barriers to pedestrian activity following Talen's (2005) suggestion that certain features of the built environment represent "lost space" that can discourage or even eliminate the possibility of pedestrian activity. Highways are considered to be a major barrier to pedestrian activity as they pose real safety hazards to pedestrians and are often completely inaccessible to people on foot. Furthermore, the presence of a busy expressway can be considered noisy and unattractive by neighborhood residents. The Tulsa expressways identified as barriers are highway 64/51 representing the north and northeastern boundary of the study area, and Interstate Highway 44 (Skelly Drive) to the south and southeast. The highway layer was obtained from Tiger Highway data (Center for Spatial Analysis).

Another category of "lost space" is large parking lots, which represent a physical barrier as well as a safety concern for pedestrians. For this study, data for large parking lots were obtained in two ways. The parcel data contain a category for "parking lots" that was used as a starting point for the parking lot data. From the parcels identified as parking lots, and based on LEED guidelines that specify a parking lot of two acres or more as being a barrier to walking, parking lots that were two acres or more in area were selected from the parcel table and saved in a separate layer in the GIS project. Because the parking lot information contained in the parcel data is incomplete, additional large parking lots that appeared to be at least two acres were manually digitized on top of the aerial image of the study area. The resultant layer included in the study contained 25 large parking lots.

Finally, vacant commercial properties were selected from the parcel list so they could be included in the project as potential barriers to pedestrian activity. The “select attributes” feature in ArcGIS was used to find commercial parcels that were labeled as being “vacant”. From the table of total vacant properties, those that were non-residential were selected to be included as “barriers” in the project.

The three variables that are included as barriers in this project (highways, large parking lots, and vacant commercial land) were all coded the same way. If the residential parcel was located within ⅛ mile of a highway, for example, it was assigned a negative code of -1. Otherwise, it was assigned a zero value. The same procedure was followed for each of the three barrier variables, with each lending a value of -1 or 0 to each parcel.

Commercial Destinations

In order to answer the research question regarding residential proximity to commercial destinations, it was necessary to categorize the destinations as walkable and non-walkable. In order to make this distinction, a commercial destination was considered walkable if it was located adjacent to a street with a sidewalk, was located in an area with a high level of street connectivity (coded as “3” or higher on the connectivity scale), and was NOT adjacent to a large parking lot, a vacant commercial lot, or a highway. In total, 46 commercial destinations were classified as “walkable”, while 468 were considered to be in automobile-oriented areas.

Home Sales Data

There were several issues associated with the use of home sales data that needed to be addressed in this study. Specifically, it was necessary to deal with the following issues:

- Are older homes more or less attractive to buyers and how will the study control for this age effect?
- How will the project handle appreciation and depreciation in home prices over time?
- How will the study deal with fluctuations in the housing market?

Age of the Home

There is evidence of a negative relationship between the age of a home and its sales price. One study found that the average price of new homes in southern suburbs are an average of about $75,000 higher than similar homes that are at least 50 years old. When controlling for home and neighborhood characteristics, the spread was still almost $35,000 (Emrath 2002). On the other hand, certain older homes may have vintage appeal and will command a premium in the real estate market, because of their character In order to address these affects, this study will eliminate homes that were built from 2005 to 2010 to remove the effects of new home premiums (a total of 303 records were removed). The remaining home sales (totaling 10,064) represent homes built from 1902 to 2004. The literature suggests that there are two different phenomena occurring with regard to age: a depreciation affect over time and a "vintage" premium that may apply (Clapp and Giaccotto 1998). It may be possible to estimate the vintage effect by modeling time series coefficients of age that become increasingly positive over time. This approach requires data for repeat sales in order to estimate the age coefficients. Because the data used in my project do not include information on repeat sales, I was unable to use this model. However, Clapp and Giaccotto (1998) also point out that "year of construction is associated with quality of construction". In order to capture the value of home age, both positive and negative, this study will include the “quality” variable in the project with the expectation that this will serve as a surrogate for the age of the home and will reflect the well-built qualities of sturdy bungalows as well as the cheaper construction of the 1950’s era mass-produced houses.

Real Estate Appreciation and Fluctuations in the Market over Time

In order to deal with fluctuations in the housing market and real estate appreciation and depreciation, all sales prices were adjusted (deflated) to 2000 dollars. This adjustment will allow for accurate comparisons between home sales during the ten year period from 2000 to 2010. Data from the Federal Housing Finance Agency (FHFA) for the Tulsa Metropolitan Area were used. The FHFA data lists the percentage change in home values for each quarter in relation to the same quarter for the prior year. A yearly average percent change was calculated for 2000 to 2010 and this figure was used to adjust each home sale amount. Generally, the adjustment represented a “deflation” of the sales figure to 2000 levels because (on average) home sales prices in the Tulsa area appreciated each year during this time period.

Conclusions

The methodology used in this project was designed to answer the central research questions using data that are widely available, procedures that are robust and replicable, and tools that are appropriate. Existing data were used when available, and additional data were derived or collected in the field as needed. Careful records were maintained of all fieldwork conducted and data creation procedures. Features of Midtown Tulsa were digitally incorporated into GIS which served as a most useful tool for storing, visualizing, and analyzing the spatial data used in the project. The powerful GIS was indispensable in managing the very large dataset that was used in the project.

Specifically, GIS was used for:

- Digitizing sidewalk data from field notes
- Creating layers for parks, trails, intersections, parking lots, and the Arkansas River by digitizing over aerial imagery
- Normalizing home sales price data
- Cleaning up raw data by removing outliers and adjusting numerical precision
- Converting certain descriptive data into numerical, ranked, or ordered data
- Calculating distances between residential parcels and various features of interest
- Classification and display of home sales data, year built, destinations and other features of interest
- Conducting regression analysis to explore the central research questions about the demand for walkability in Midtown
- Displaying the results of regression analysis using a series of maps

The next phase of the project will involve an in-depth analysis of the data in an attempt to uncover factors that influence home prices in Midtown Tulsa and to see if perhaps residents are willing to pay more to live in walkable neighborhoods. Using ArcToolbox, an ordinary least squares regression analysis will be performed on the dataset in an iterative procedure to identify good models that explain the variation in home prices across the study area. Using the models identified in this global technique as a starting point, a geographically weighted regression (GWR) analysis will be performed in the hope of uncovering spatial variations across the study area. Finally, the results of the local, GWR analysis will be carefully mapped to identify clusters in Midtown in which residents appear to place a value on walkability.

CHAPTER IV

ANALYSIS

The Midtown area of Tulsa contains an assortment of neighborhood types in terms of housing size, lot size, street patterns, quality of housing construction, and neighborhood amenities. Midtown contains "exclusive" neighborhoods that feature big, expensive homes, large lots, curvy streets, and landscaped gardens. But Midtown Tulsa also includes hundreds of small, cheaply-made houses that are lined up in identical rows on small lots. The contrast between these two extremes is sharp, and residents of the lower-end neighborhoods are at a disadvantage in many ways, with at least one exception: their neighborhoods appear to be more walkable.

This study was designed to examine the various factors that influence home prices in Midtown Tulsa, including structural aspects of the homes such as square footage, property size, quality of construction, condition of the property, number of baths, etc. The intent is to discover where in Midtown home prices are impacted (positively or negatively) by selected variables of interest. In particular, this study will ask the question: In which locations is home price impacted by selected variables? Are there pockets of influence and is walkability one of these factors? To address the question of the value of walkability to residents of Midtown, particular attention was given to various measures of walkability, including the proximity to commercial destinations, the proximity to parks and trails, the abundance of sidewalks, intersection density, and features that represent barriers to pedestrian activity. To address the research questions, data for over 10,000 Midtown parcels were examined (Figure 4.1). Analysis began with a simple inspection of spatial patterns in the data, and progressed to more statistically robust procedures. As a beginning step, and with the help of GIS, maps were created for several key variables of interest. Although some of these variables did not prove to be significant in subsequent regression models, they provide useful information, context, and validation for subsequent spatial analysis results.

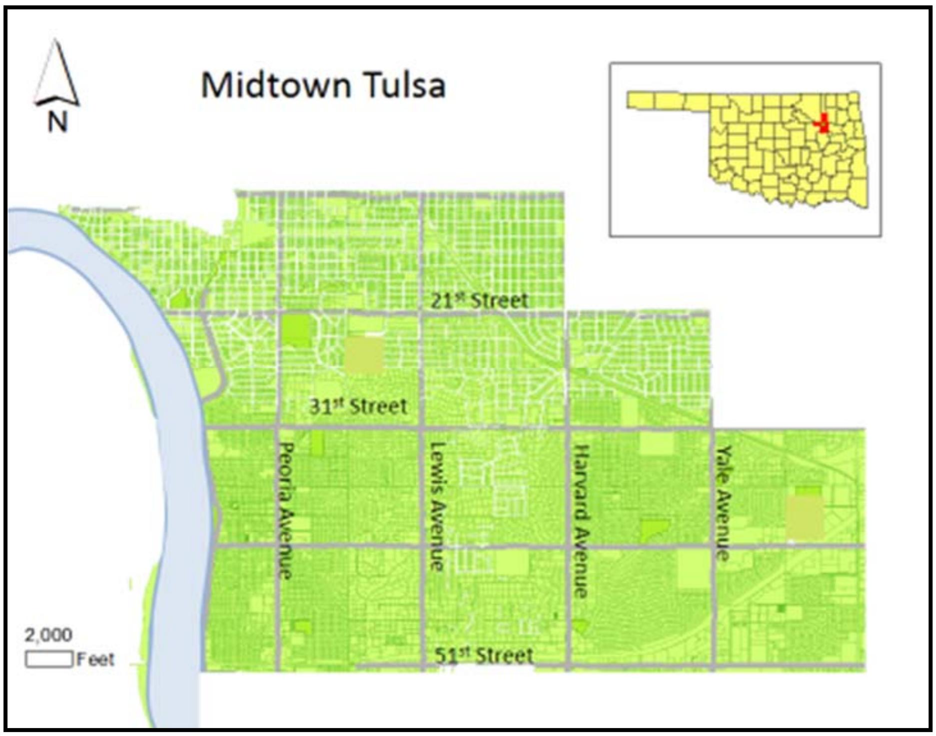


Figure 4.1 Study Area

Home sales price is the dependent variable in this study and serves as a measure of the value that Midtown residents place on various housing characteristics and neighborhood amenities. Home prices were normalized by deflating all values to year 2000 dollars and by eliminating new construction (homes built from 2005 to 2010). Visual inspection of the mapped home sales prices suggests that homes in the central and northwest portions of the study area generally have a higher sales price than other portions of Midtown (Figure 4.2). In general, the

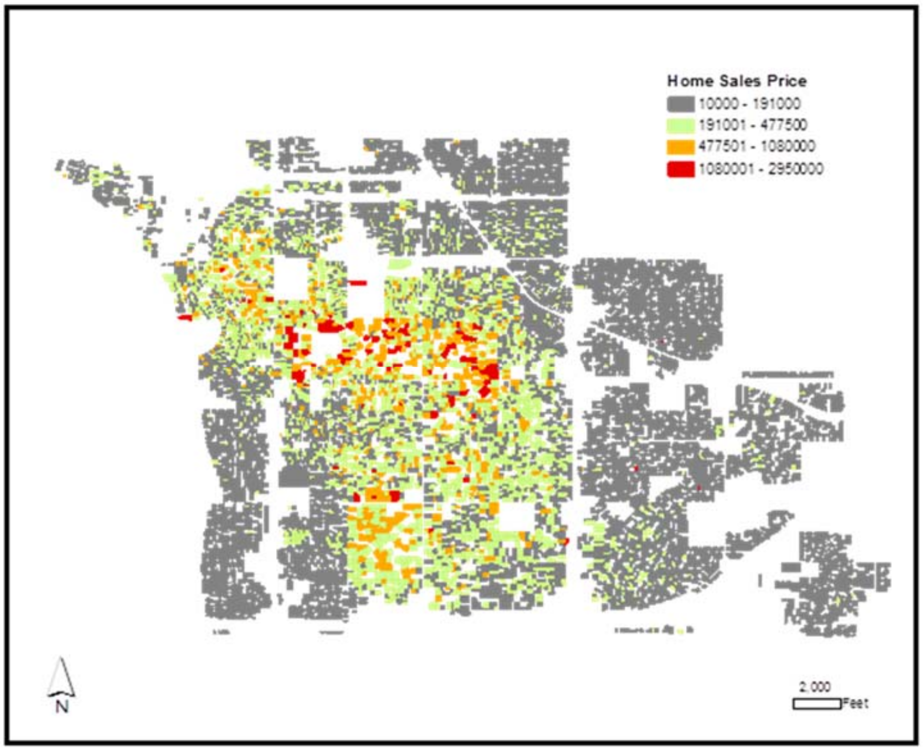


Figure 4.2 Home Sales Price

most expensive neighborhoods are loosely bounded by 21st Street to the north, 36th Street to the south, Peoria Avenue to the west and Delaware Avenue to the east. In addition, the neighborhood known as Bolewood Acres, which is located between 36th and 46th Streets, and between Utica and Lewis Avenues, contains expensive homes that are situated on large lots. In comparison, the least expensive homes are generally located in the neighborhoods to the west (Brookside), the areas to the northeast, and the neighborhoods to the east. These neighborhoods feature smaller, more cheaply constructed homes built on relatively small lots. A map of the age of Midtown homes graphically illustrates the direction of real estate development in Midtown over a period of more than 100 years (Figure 4.3). In general, the homes in Midtown Tulsa were built anywhere from 1900 to 2010 (as of the time of data collection for this project). Generally, the age of homes decreases as you move diagonally from the northwest to the southeast corners of the study area.

A scattering of newer construction including homes built since 1971 is evident throughout the study area but is especially notable in the central portions of Midtown.

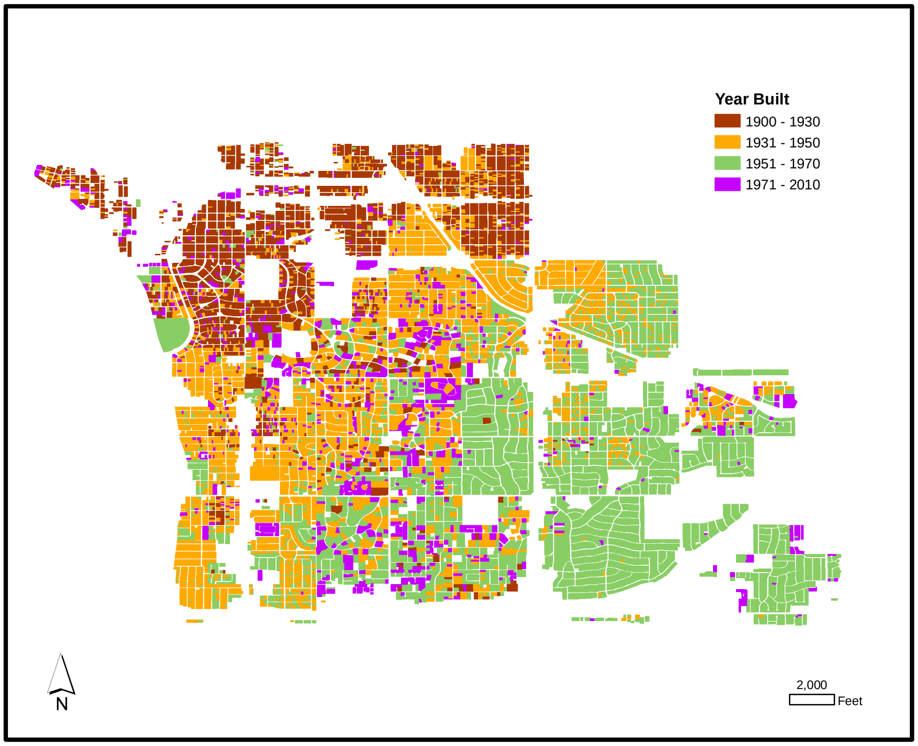


Figure 4.3 Year Built

The study area offers many commercial destinations including restaurants, retail stores, food stores and other establishments, some of which are within walking distance to area residents (Figure 4.4). Yet Midtown residents vary dramatically in their access to these amenities. In total, over 500 commercial destinations were included in the data set. In general, commercial areas are located in "strips" along major streets like Peoria Avenue, 11th Street, Harvard Avenue, and the major shopping area surrounding 41st and Yale Avenue. The character of these retail centers varies dramatically from the pedestrian-oriented shopping districts along Peoria Avenue to the automobile-centered shopping complexes located at 41st and Yale. The quaint shopping district of Brookside, for instance, features on-street parking, sidewalks on both sides of the street, and stores and restaurants that front the sidewalks, making the area appealing to pedestrians. In contrast, the large shopping complex at 41st and Yale features huge parking lots and limited pedestrian accessibility. Furthermore, it appears that residents in the more expensive central sections of the study area have relatively poor access to commercial destinations.

Access to parks varies across Midtown, in ways that differ from access to other amenities. The study area includes eleven parks, the most prominent of which is River Parks to the west, which stretches along the Arkansas River and features miles of continuous bike and pedestrian pathways (Figure 4.4).

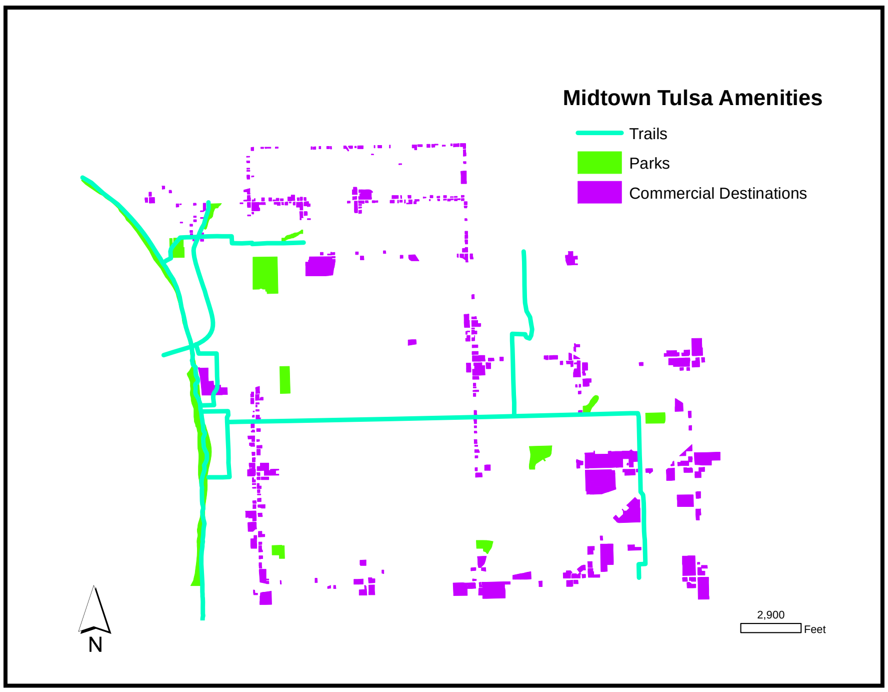


Figure 4.4 Midtown Tulsa Amenities

Nearly 16 percent of all residential parcels in the study area are within ½ mile of River Parks, making it an important recreational resource for Midtown residents. The 34-acre Woodward Park, located at the corner of Peoria Avenue and 21st Street, features walking trails, as do most of the other parks in Midtown. It appears that residents in the western portions of Midtown have good park access, a reflection of the potential importance of the River Parks

System to residents of Midtown Tulsa. To a lesser extent, neighborhoods in the southeast appear to have good access to parks. Residents of the higher-priced neighborhoods in the center have the lowest access to parks, again indicating an overall lack of pedestrian-friendliness in this portion of Midtown.A visual inspection of Midtown sidewalk distribution (Figure 4.5) suggests that most of the sidewalks in the study area are located in the older neighborhoods to the north. While sidewalks are common in these northern neighborhoods, they are a rarity in most of Midtown Tulsa. Their absence or presence appears to be a feature of specific neighborhoods; sidewalks were either designed into residential developments, or they were not.

In general, the following visual patterns are evident:

- The majority of sidewalks in the study area are located in the neighborhoods to the north, primarily north of 21st street. These neighborhoods represent the oldest neighborhoods in the study area.
- The major streets (21st Street, 31st Street, 41st Street, as well as Peoria, Lewis, Harvard and Yale) generally have sidewalks on both sides of the street.
- Very few sidewalks are located in the residential neighborhoods south of 21st street; an area that represents the majority of the study area.
- Sidewalks appear to be located along streets with tighter, gridded street patterns.

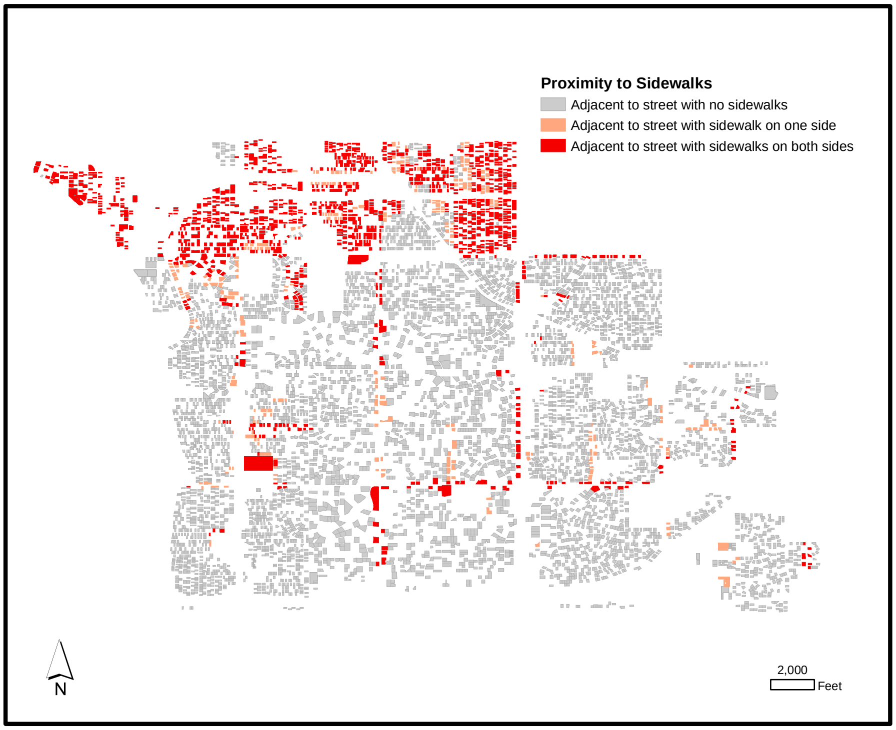


Figure 4.5 Proximity to Sidewalks

Neighborhoods built before 1950 visually appear to have both gridded street patterns and sidewalks, with the exception of Brookside. Intersection density, which is a reflection of gridded street patterns, appears to be higher in the north and northwest, the Brookside area and in several pockets of density to the west. The central portions of Midtown are the least dense, a reflection of the curvilinear street patterns and large lot sizes of the central neighborhoods.

Interestingly, the Brookside neighborhood generally has gridded street patterns but few sidewalks. The reason behind this is unclear. Brookside neighborhoods were mostly developed in the 1950s and may represent a transitional period when sidewalks may have been declining in popularity as increased use of automobiles seemed to make sidewalks more irrelevant. In addition, homes in Brookside are generally lower-end houses, of lower quality, more cheaply made, and smaller than those found in the slightly older neighborhoods to the north. It may be that Brookside developers tried to minimize construction costs by eliminating sidewalks and constructing relatively high-density neighborhoods on a traditional gridded street pattern.

Modeling Variables Related to Home Sales Price

In order to explore relationships between home sales price and a variety of predictor variables a multivariate model was developed at the parcel level using ordinary least squares (OLS) regression. This "global" model specification was a useful first step in the analysis process as it helped with variable selection, allowed for examination of the direction of relationships, and provided a baseline for comparison with a local model.

The Global Regression Model

In global regression analysis, relationships between independent variables and a single dependent variable are estimated resulting in average, or global parameter estimates that are meant to apply to the entire study area (Fotheringham et al. 1998). Using GIS, 30 different variables were entered into an OLS regression procedure, resulting in several candidate models. An attempt was made to find models with high R^2 values and statistically significant variables.

Table 4.1 presents the global regression results for one OLS model in which the variables are all significant at the 0.05 level. While OLS produced several candidate models, a specific model was selected because subsequent local regression analysis targeted this particular variable set. The OLS model is promising in that it explains 73.24 percent of the variance ($R^2 = 0.7324$) in home sales price and the variance inflation factors (VIFs) indicate that multicollinearity among the variables is low.

Table 4.1. Global regression of home sales price

Independent Variable	**Coefficient**	**t-value**	**VIF**
Gross Acres	91,851.91	16.22	1.91
Building Square Footage	71.83	55.70	2.91
Proximity to Dense Intersections	6,310.68	6.86	1.14
Condition of Property	3,059.43	6.58	1.20
Quality of Construction	24,276.18	40.84	2.37
Proximity to Large Parking Lots	1.38	2.89	1.29
Proximity to Trails	-2.37	-5.45	1.08
Proximity to Commercial Destinations	3.70	3.45	1.49
Zoning	-2,773.84	-7.96	1.10

All variables significant at the 0.01 level, N = 10,049

Adjusted R^2 = 0.732437, AIC = 253,885.67

The results provide useful information regarding the direction and strength of relationships. As expected there is a positive relationship between home price and lot size, building square footage, quality of construction, condition of property, number of baths, and story height. The three variables related to walkability in this model suggest that home prices are weakly related to walkability factors and sometimes in unexpected directions. For instance, if residents placed a value on living near destinations such as restaurants and other retail establishments, we would expect to find a negative relationship between home price and the "Proximity to Commercial Destinations" variable, meaning that higher home prices are associated with shorter distances to destinations. Instead, the global regression results produce a small positive coefficient of 3.70 suggesting that higher home prices are associated with greater distances to destinations.

The variable "Proximity for Large Parking Lots" is intended to represent a barrier to walking and we would expect to find higher home prices in areas further away from large parking lots. The global regression model does suggest such a positive relationship. Likewise, the model suggests a small negative relationship between home prices and the proximity to trails, suggesting that higher home prices are associated with closer proximity to trails.

While the global OLS model is useful, especially as an initial exploratory tool, it fails to account for local variations in the relationships between the predictor variables and home sales price, a shortcoming that can reduce the explanatory power of the global model. This weakness, inherent in global models, is particularly troublesome when analyzing data that is inherently spatial, like the parcel data involved in this project. In a study of crime pattern data at the block group level, for example, a global OLS model was found to mask important local variations in the data. Furthermore, the researchers found that using a local, geographically weighted regression procedure strengthened the global findings while illuminating anomalies in the data, allowing for educated speculation on why results varied across space (Cahill and Mulligan 2007).

A Local Regression Model

In order to explore local variations in the data and to look for "pockets of influence" in the study area where home prices might be related (perhaps in previously undiscovered ways) to the explanatory variables, a geographically weighted regression (GWR) analysis was performed on the same variable set that performed well in the global model. It should be emphasized that the global model was used as a starting point for the GWR procedure and served as a baseline for comparison with local regressions results. However, in order to test a wide variety of potential models, GWR was conducted using an iterative procedure, beginning with a model that incorporated 30 independent variables. Most of the variable combinations failed to execute due to "severe model design problems". During the model selection process, an attempt to find an appropriate bandwidth that maximized the model's explanatory power in terms of R^2 while also minimizing the AIC value. The Akaike Information Criterion (AIC) is an estimate of the measure of fit of a statistical model, the goal being to find a model that minimizes the AIC value (Akaike 1974). Various bandwidths were tested to find an optimal model before selecting a final bandwidth of 1550 feet. Using this bandwidth, the GWR model produced a model with an adjusted R^2 value of 0.6828 and an AIC value of 250.07. (In comparison, the AIC values were over 250,000 for some global models). The results indicate that the GWR model provides somewhat less explanatory power than the global model (which had an adjusted R^2 of 0.7324); however, the GWR provided important information about spatial variations in variable relationships that were obscured in the global model.

Mapping the Results of Geographically Weighted Regression

Maps play a central role in interpreting the results of GWR. In local regression analysis, separate parameter estimates are calculated for each observation and care was taken to create a series of maps that would communicate these findings clearly and effectively using techniques borrowed from Mennis and others (Mennis 2006; Cahill and Mulligan 2007). For each explanatory variable, the class breaks were shifted to distinguish positive from negative parameter estimates. Interval boundaries were adjusted to have equal magnitude to allow for direct comparison of estimates. A diverging color scheme was used to distinguish positive from negative parameter estimates by hue, while also expressing increasing magnitudes using increased color saturation. In some cases, a neutral gray color was used for medium range estimates, to assure that extreme positive and negative values would clearly stand out.

In order to meaningfully interpret the results of GWR, spatial distribution of the parameter estimates must be presented together with maps showing the significance of estimates

(Mennis 2006). Using the Cluster and Outlier Analysis (Anselin Local Moran's I) in ArcGIS, maps of Z-values were produced and show spatial clustering of high or low parameter values and revealing which areas have statistically significant estimates.

The Z-value maps display significance levels as follows:

HH = statistically significant (0.05 level) cluster of high values

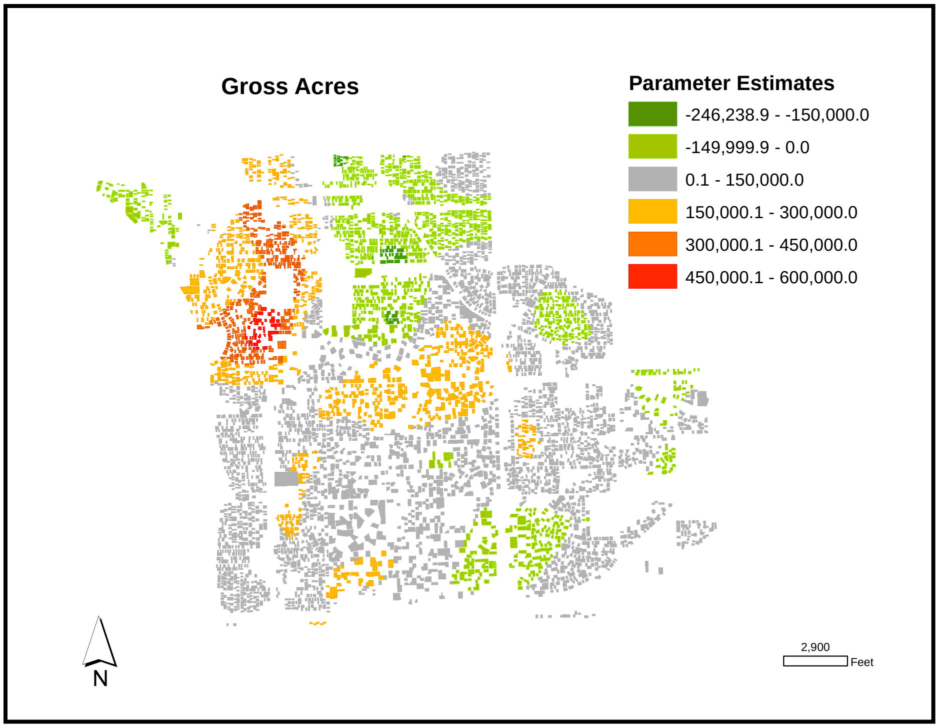
HL = a high value surrounded by features with low values

LH = a low value surrounded by features with high values

LL = statistically significant (0.05 level) cluster of low values

The variable "Gross Acres" showed a very strong positive relationship with home sales price in the global regression model, as we would expect. Clusters of significant positive values were indeed identified in the GWR map (which closely matches the significance pattern found in the associated z-value map) in the central areas and the northwest (Figure 4.6). There are certainly more parcels that display a positive relationship than negative, however a closer look reveals that only around 18 percent of the parcels display a **significant** positive relationship. Most of the smaller positive parameter values are insignificant showing up as large gray areas on both maps. Furthermore, the GWR results also reveal clusters of significant negative values in the north as well as smaller negative pockets in the northeast and southeast. Around 24 percent of the parcels are clustered in pockets of significantly low parameter estimates representing areas where there is a negative relationship between home price and gross acres. The reason for this lack of significant relationships and for the clusters of negativity is unclear. An obvious explanation is that lot size does not always reflect the size and quality of the structure that sits on the lot. In some cases, large homes sit on relatively small plots of land while smaller, mass-produced homes have surprisingly large yards. Homes in the northern portions of the study are in the midst of early-stage gentrification, in which older, relatively modest-sized homes on small lots are becoming attractive (and more expensive) because of their character and charm. Furthermore, there appears to be a trend toward building very large houses on relatively small lots. In such cases, the size of the lot may or may not influence the home price in the expected positive direction.

In the global model "Square Footage" suggests a positive relationship between home price and square footage, which we would expect. Virtually all the parcels studied exhibit a positive relationship between home price and square footage, although almost half of these relationships are not significant (Figure 4.7). Clusters of significance appear at the extremes, for parcels with high parameter values or those with low (but still positive) values. Most of these high positive relationships are located in the central and northwestern portions of the study area and closely resemble the pattern of home price across the study area. The square footage of more expensive homes appears to strongly influence their sales price, more so than in lower priced areas.



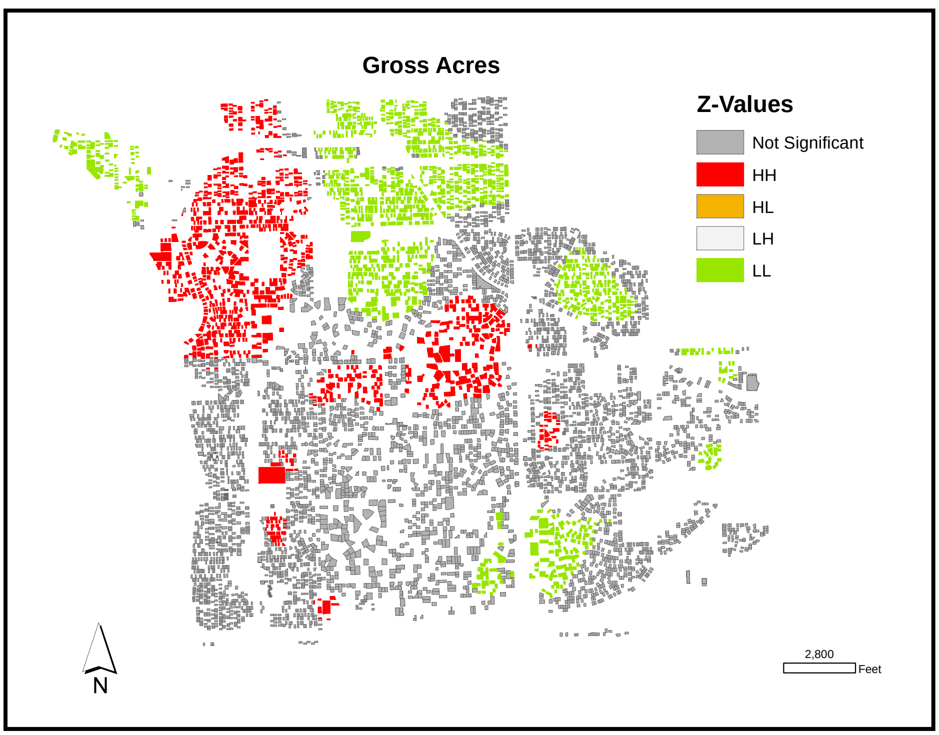
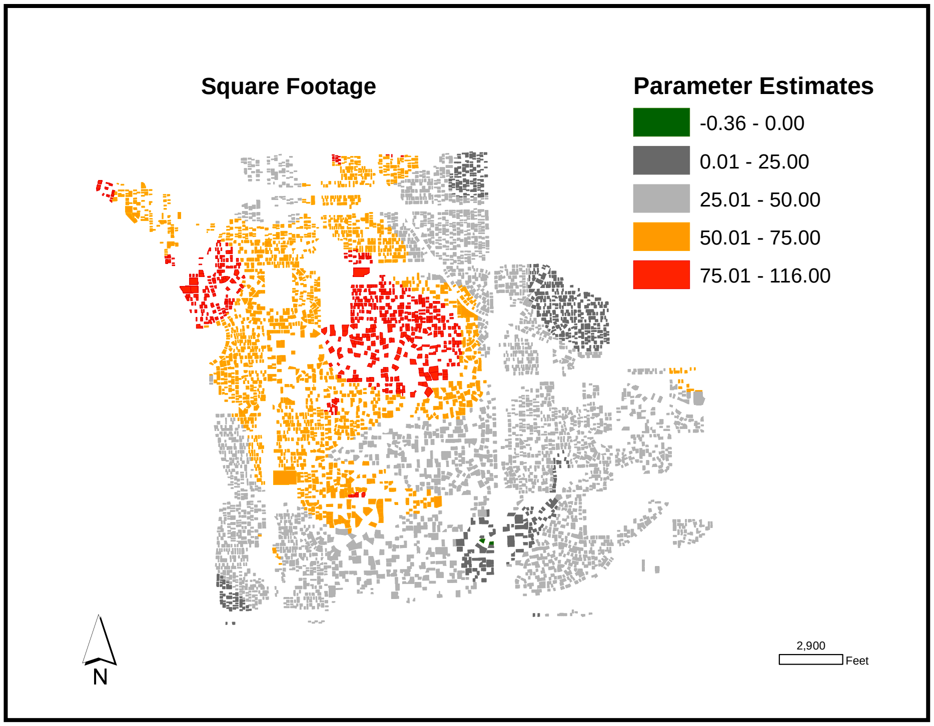


Figure 4.6 Gross Acres



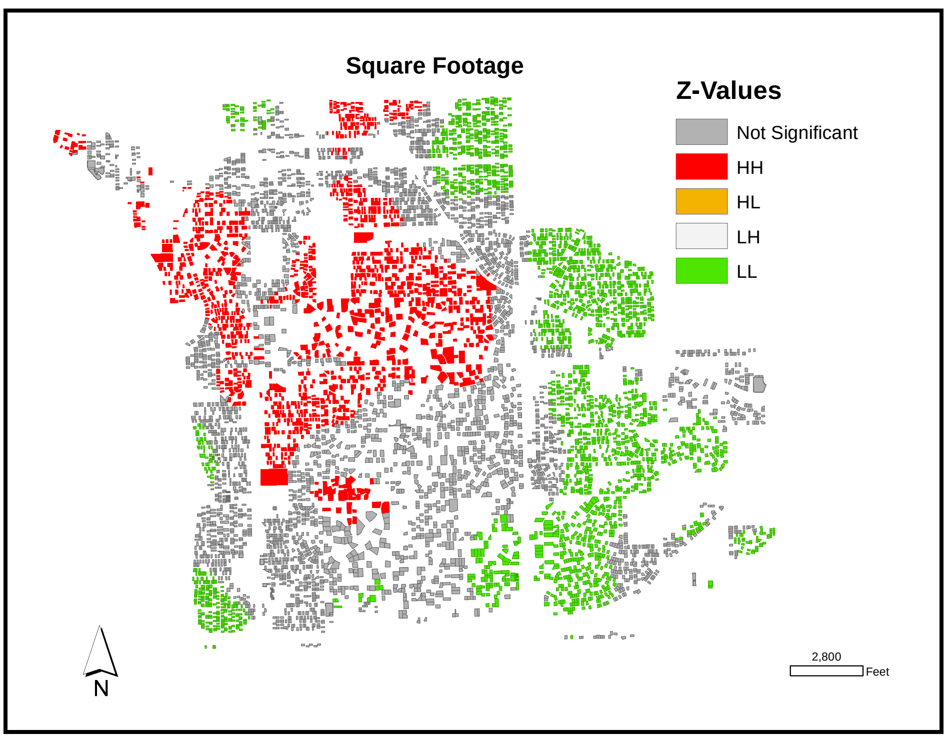
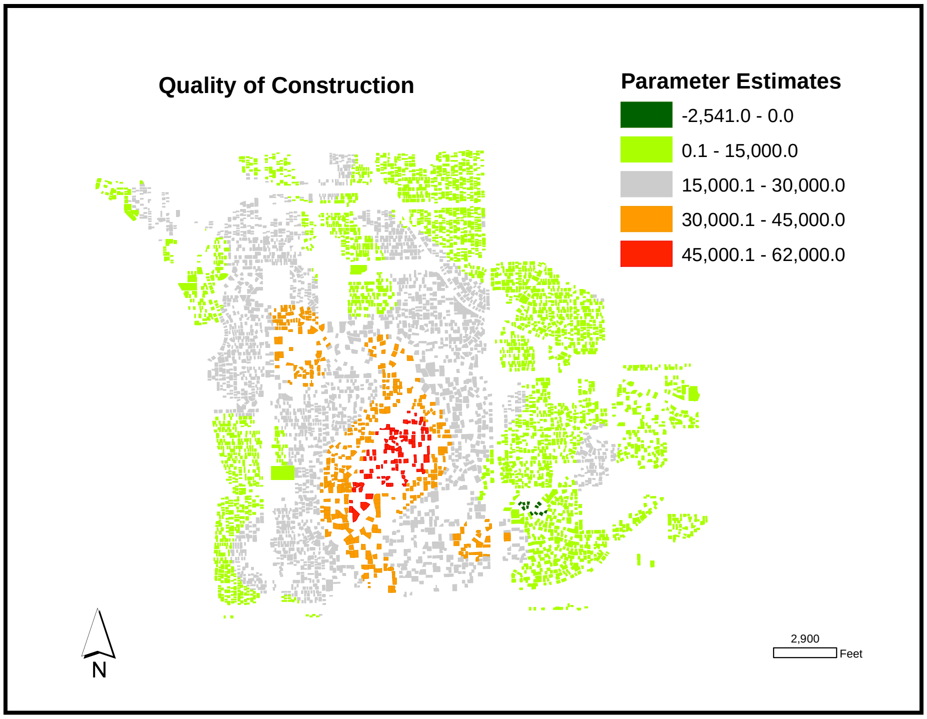


Figure 4.7 Square Footage

“Quality of Construction” shows a strong positive relationship in the global model, as expected. Likewise, in the GWR model, the parameter estimates are almost exclusively positive suggesting that home prices are a reflection of the quality of construction (Figure 4.8). Clusters of particularly high estimates are located in the central portions of the study area, while approximately one third of the study area in the east represents a significant cluster of low positive values. It is worth noting that about 58 percent of the parcels display an insignificant relationship between quality and home price, a phenomenon that occurs around the periphery of the study area.

The variable that represents the ”Condition of the Property” exhibits a strong positive relationship in the global model, and this is the expected direction of the relationship. The GWR results support these findings as most parcels in the local model show significant positive parameter estimates. However, the GWR model uncovers several pockets where parameter estimates are significantly negative in the south and west portions of the study area and small pockets in the north and northwest (Figure 4.9). These pockets of negativity were obscured in the global model and invite speculation as to why there are clusters in which home sales prices are negatively related to the condition of the property. There are a number of possible reasons for these unexpected relationships. The map of home sales price (Figure 4.2) suggests that the homes in these negative pockets sell for a relatively low price, which suggests the possibility that these homes sell for less than their condition warrants, particularly in the south and west. There are different dynamics involved in the northern parcels. Homes in the north and northwest were built before 1930 and come with character and renovation potential suggesting that even homes that are in relatively poor condition may command an unexpectedly high price as historic properties or money-making projects.



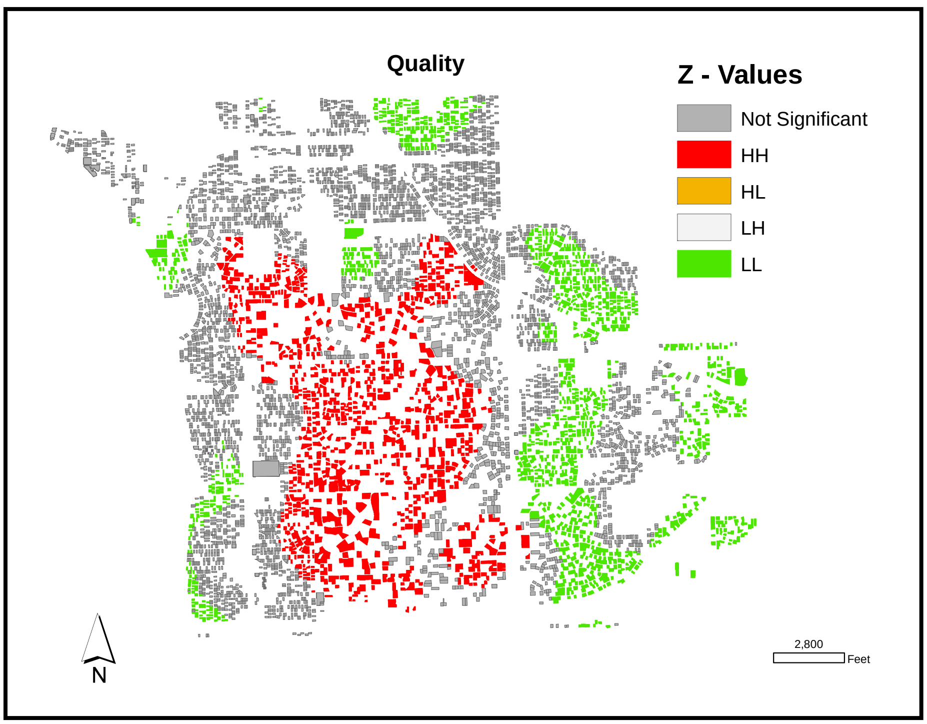
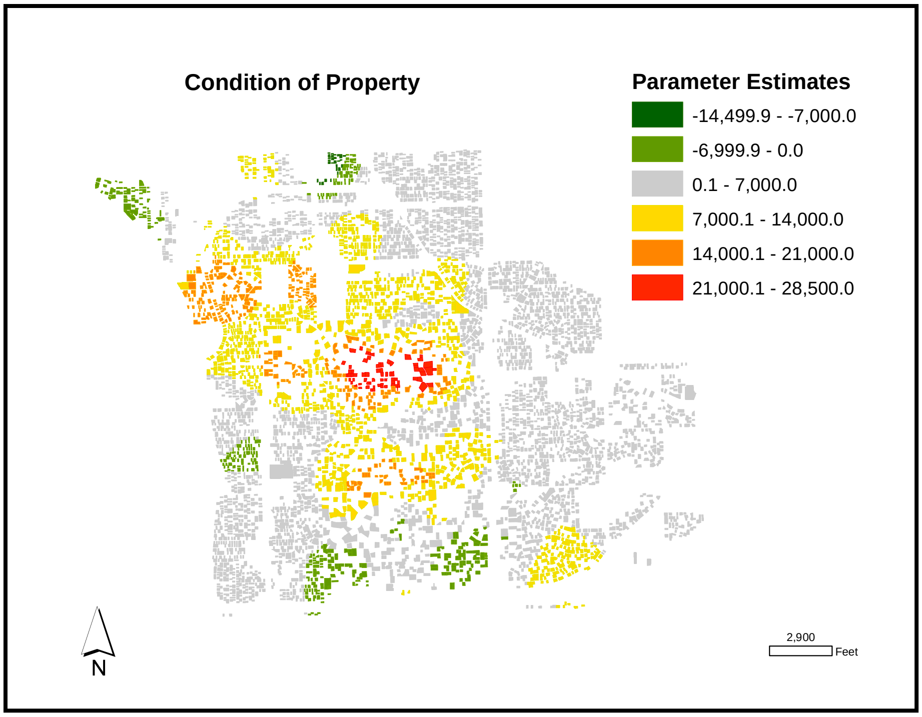


Figure 4.8 Quality of Construction



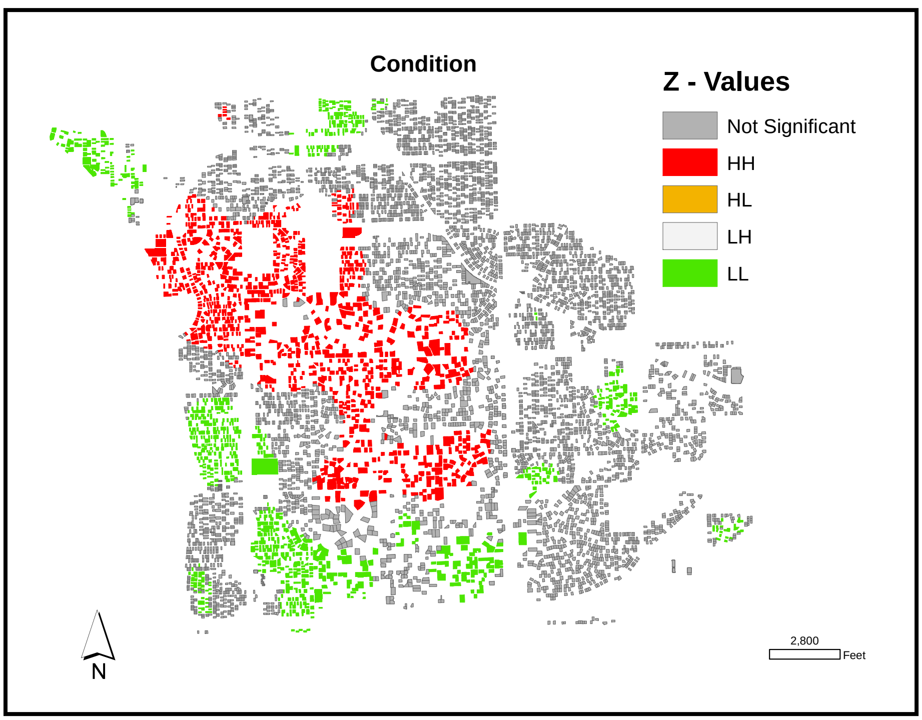
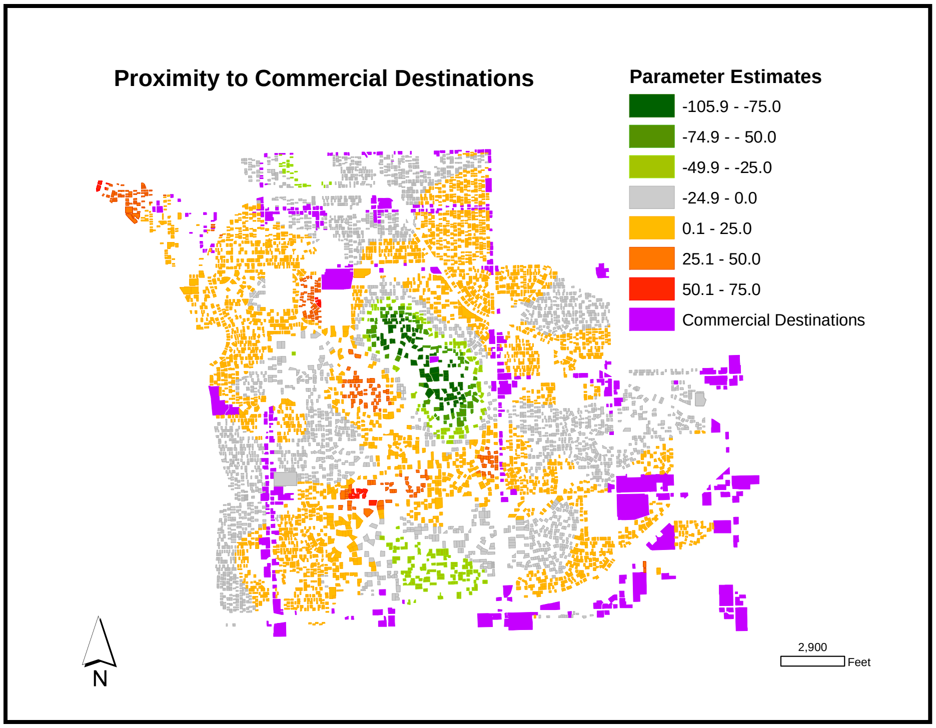


Figure 4.9 Condition of Property

One of the walkability variables that factors into both the global and local models is the "Proximity of Parcels to Commercial Destinations" (Figure 4.10). The global model suggests a weakly positive relationship between home price and distance to destinations, a result that is unexpected if residents place a value on living close to destinations like shopping and restaurants. However, the local model uncovers spatial variations in the parameter direction and suggests that the results are not uniform across the study area. In the local model, there are large areas in which the parameter estimates are not significant, but there are also clear clusters of significantly high and low values. The most interesting finding is that there appear to be significant pockets of negative parameter values in the central and south central portions of the study area suggesting that home prices in these areas are influenced by their proximity to commercial destinations. These negative pockets are most surprising, and were completely masked in the global model. It is particularly interesting to find these pockets of influence in some of the more pricey neighborhoods in the central portions of the study area that are somewhat isolated from retail and commercial amenities. We do not expect residents who live in these secluded neighborhoods to value being in close proximity to commercial areas. At face value, residents would appear to be seeking an escape from commercial busyness. Other dynamics may be taking place in the south central and small western pocket of negative influence, as these neighborhood contain low priced homes. The south central pocket is relatively distant from commercial amenities, yet the small western cluster of significance represents neighborhoods that are in relatively close proximity to commercial destinations. It is unclear whether this finding represents a demand for walkability.

Another walkability-related variable that was included in the models is the "Residential Proximity to Trails" (Figure 4.11). The global model shows a weak negative relationship between home price and the proximity to trails, the direction we would expect to find if residents place a value on living close to trails. However, the GWR results suggest a more complicated



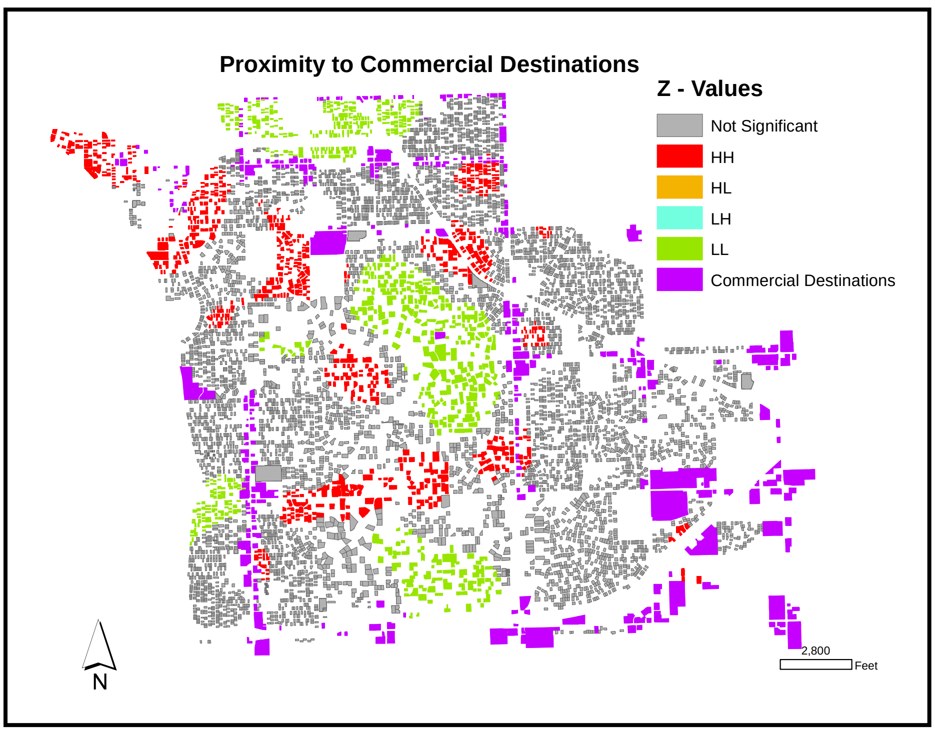
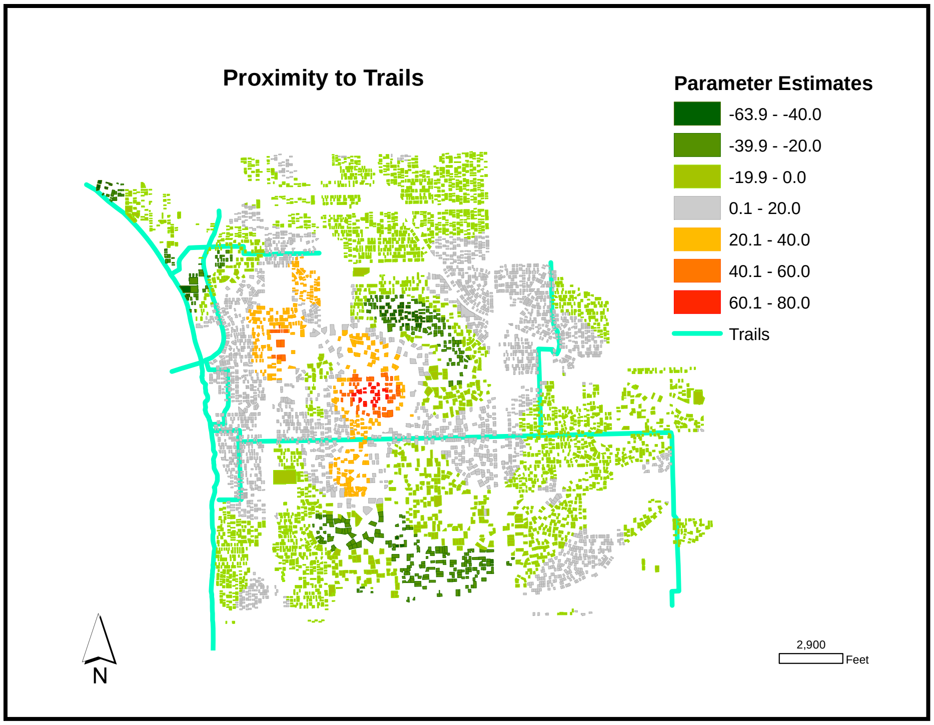


Figure 4.10 Proximity to Commercial Destinations



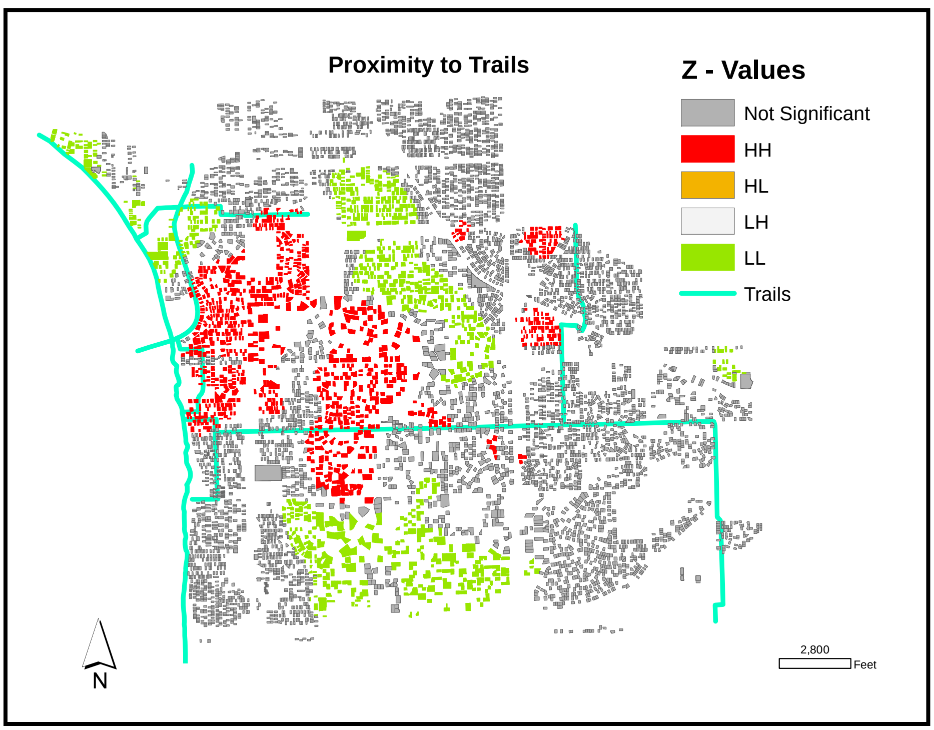


Figure 4.11 Proximity to Trails

spatial pattern of relationships and the weak global coefficient is likely a result of a relative balance of positive and negative parameter values for this variable. There are clear pockets of significant negative relationships in the central portions of the study area and in the south. However, there is a large cluster of positive estimates spanning the west central portion of Midtown. The results seem to indicate that central clusters containing more expensive homes are somewhat sensitive to the proximity of trails, while curiously, homes located near the River Parks trail system are influenced in an opposite direction. It is possible that other factors are at work and that the trail system in Midtown has little real impact on home prices. For one thing, the River Parks Trail is overwhelmingly dominant in Midtown as the other trails are less visible and likely much less used. It is likely that clusters of influence in the central portion of the study area reflect this region's close proximity to lesser trails, while ignoring other influences on home price, rather than reflecting any strong influence by nearby trails. Strangely, the strong cluster of **positive** parameter estimates in the central area, adjacent to the negative cluster, represents an anomaly that cannot be easily explained, especially because this cluster of positivity is actually closer to River Parks and the east-west trail.

The neighborhoods adjacent to the Arkansas River display a weak but significant **positive** relationship between home price and proximity to trails. It is hard to imagine that home prices for areas in close proximity to the River Parks Trail System might actually be positively influenced by the park as River Parks is an important draw in the Midtown area. There are several possible explanations for these findings including the following:

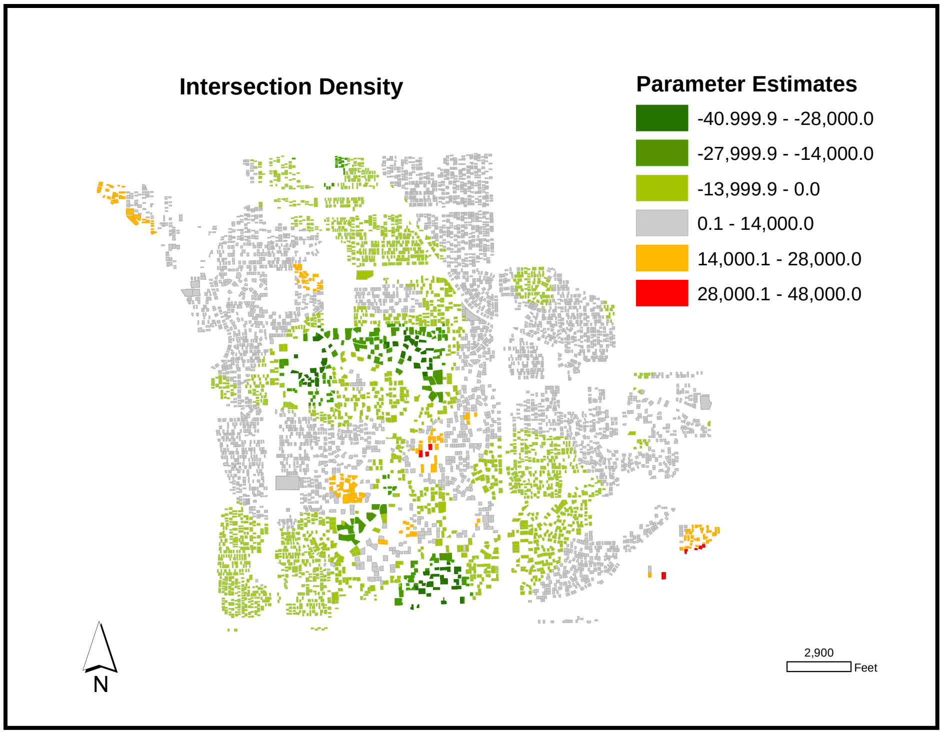
- Riverside Drive, the busy, four-lane road that parallels the Arkansas River serves as a barrier to pedestrians and effectively isolates residents that live in close proximity to the trail system.
- Visitors to River Parks are likely driving or bicycling from areas that are not directly adjacent to the park.

- The neighborhoods along the Arkansas River generally contain lower-priced homes that have not seen any widespread trend toward re-development or neighborhood revitalization.
- Users of the trail system likely tend to come from higher income areas than those adjacent to the river.

Again, these results, particularly the negative results that suggest clusters of influence, are somewhat suspect, while the River Parks Trail System does not appear to have the expected influence on home prices.

The variable that represents the ”Proximity to Dense Intersections” (Figure 4.12) is intended to measure the residential closeness to street patterns that are conducive to pedestrian activity including short street segments and multiple right-angle intersections. In the global regression model, there is a fairly strong positive relationship between home sales prices and the proximity to dense intersections. This suggests that higher home prices tend to be associated with greater distances from dense intersections, not what we would expect to find if residents value a more traditional street pattern. Again, the local model suggests that the relationship is more complex and varies spatially across the study area. There appear to be significant clusters of negative parameter values in the central and south portions of the study area.

The variable that represents the “Proximity to Large Parking Lots” (Figure 4.13) is intended to represent a barrier to pedestrian activity: the presence of large, concrete parking lots that make walking difficult and dangerous. In the global model, this variable had a very small positive coefficient suggesting that higher home prices are associated with greater distances to larger parking lots, a finding that we would expect. The local model suggests that there are some significant clusters of positive values as well as pockets of negative values. The central area of Midtown stands out as having significant high parameter values.



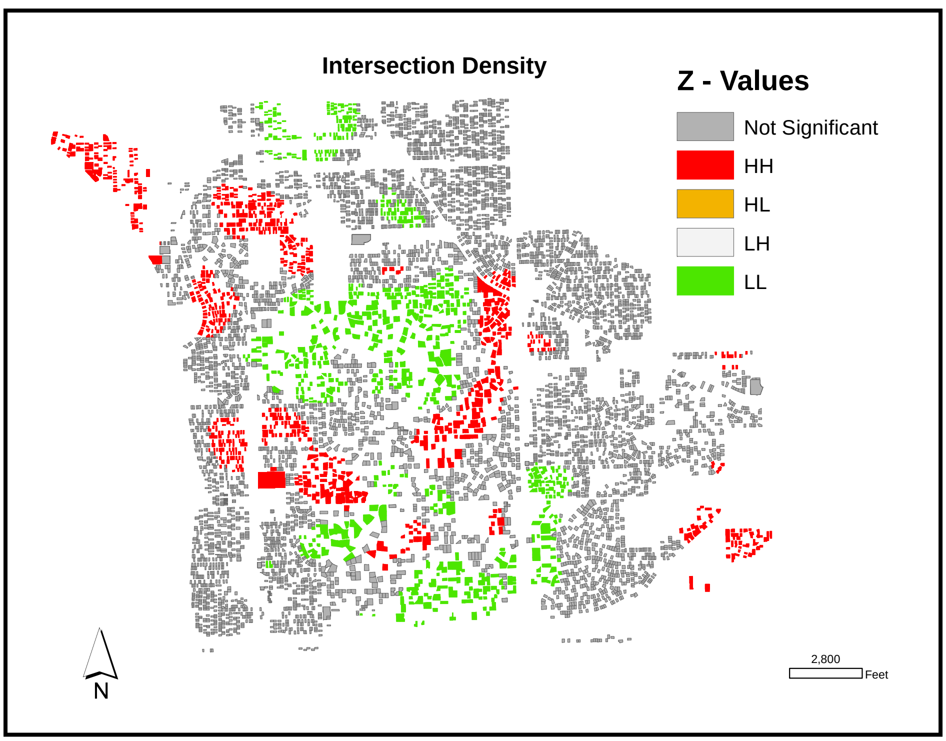
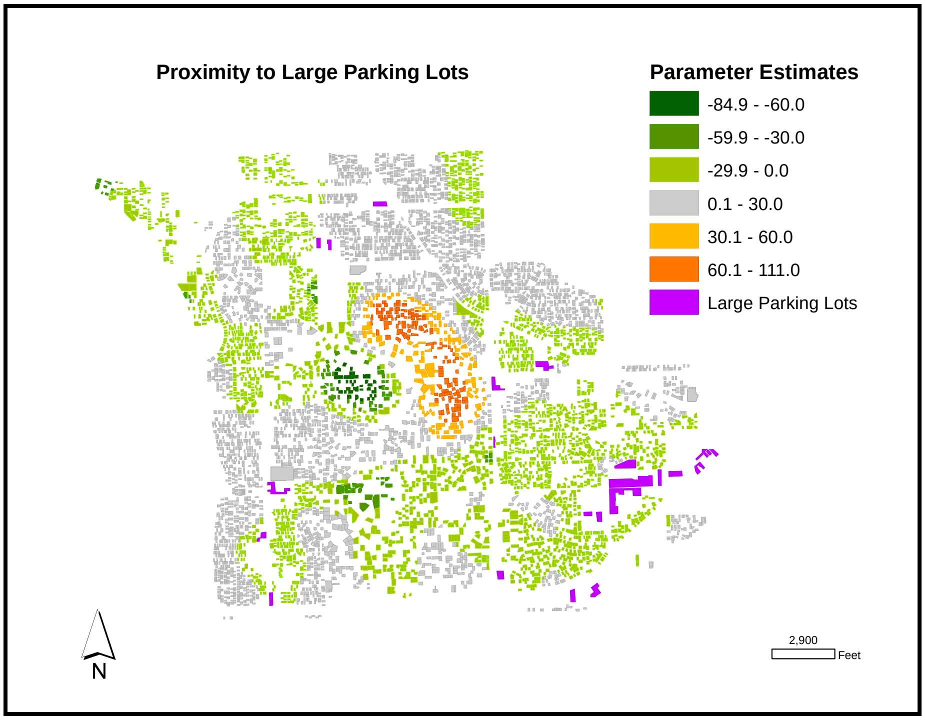


Figure 4.12 Proximity to Dense Intersections



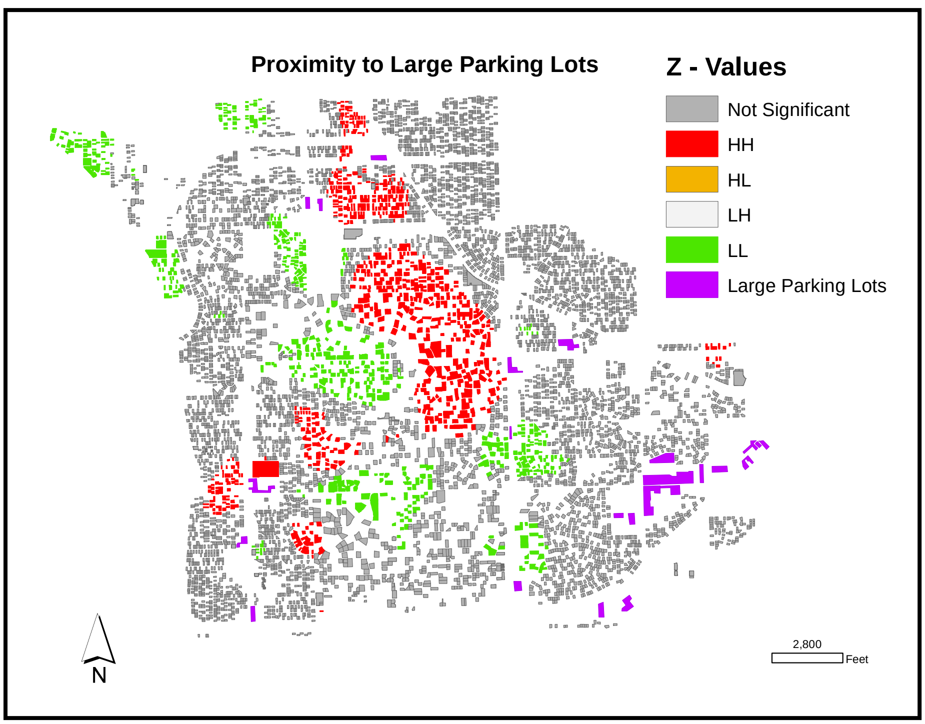


Figure 4.13 Proximity to Large Parking Lots

Discussion

The results of this analysis suggest that home prices in Midtown Tulsa are influenced by certain structural features of the properties and, to some extent, by factors related to walkability. For this study, over 10,000 residential parcels in Midtown Tulsa were analyzed using both ordinary least squares (OLS) regression and a localized GWR analysis. The conventional global OLS regression procedure provided guidance as to an appropriate model to be used in GWR and served as a baseline for comparison of the two approaches. When the results of GWR were mapped, it became clear that there are clusters of influence in the study area that are invisible in the global model. And despite the global findings, it became evident that the relationship between home sales price and each of the explanatory variables is clearly positive in some places and negative in others.

Certain regions of Midtown repeatedly show up in the local analysis as being significantly clustered in the way they relate to home sales price. The central portions of Midtown stand out in the GWR and Z-Value maps as being distinct from other sections of the study area and this central region shows up as a significant cluster more often than any other single area of Midtown. In this central pocket, high home prices appear to be significantly positively related to lot size, square footage, quality of construction and house condition. These results are not surprising and are supported by the global model. However, home prices in this central cluster also appear to be influenced by the proximity to commercial destinations and the proximity to trails. Likewise, home prices appear to be sensitive to the proximity of large parking lots.

There are several other clusters that stand out as being unique. For instance, home prices in the north central portion of Midtown are negatively related to the "gross acres" variable, a surprising and unique finding that suggests that perhaps higher home prices are related to smaller lot sizes. Certain anomalies also exist in the south central and western sections of the study area where clusters appear that suggest that home prices are negatively related to the condition of the property. This negative relationship between home price and condition was also found in a small pocket in the west.

In terms of how selected variables are related to home sales price, Midtown Tulsa is clearly not uniform across the entire study area. The global regression results uncover complex spatial patterns in the data that provide insight into the research questions regarding the factors that influence home prices. The GWR results hint at a possible relationship between home prices and certain walkability factors, and that some Midtown residents may place a value on walkability, but only in certain residential pockets. The implication is that we cannot generalize about resident attitudes and values across the study area as a whole. Tentative conclusions can be reached only if we dig deeper and respect the spatial variation inherent in the data.

CHAPTER V

CONCLUSION

This study examined the walkability of Midtown Tulsa and whether or not residents place a value on neighborhood elements that make it easy and convenient to walk. Home sales price was used as a proxy measure of value and served as the dependent variable in regression analyses that incorporated variables related to both neighborhood walkability and structural features of Midtown homes. The intent of the analysis was to develop a model that explained which factors influence home prices and to try to determine if walkability is one of those factors.

Data for over 10,000 Midtown parcels were obtained in GIS shapefile format from the Tulsa County Assessor's Office. This dataset provided a wealth of information on Midtown properties, including home sales price, structural features of homes, property ownership, zoning, and the category of parcel use. Additionally, data layers were created for parks, trails, and intersection density. Fieldwork was conducted in the summer of 2010 to record the location of sidewalks along all streets in the study area and this information was added to the GIS database. Ultimately, a GWR analysis was conducted using variables that performed well in global (OLS) regression models.

Major Findings

The results of the statistical analysis suggest that there are indeed residential clusters in Midtown Tulsa where home prices appear to be influenced by walkability factors. In particular, the GWR analysis provides clear evidence that relationships between home prices and selected variables are not uniform across the study area and that such relationships are varied and complex. Maps of the GWR results display clustered groupings, sometimes of significant positive relationships, sometimes of negative relationships for any given variable. The results raise questions about the nature of the built environment in Midtown Tulsa and the nature of residents, who may or may not place a value on living in a walkable place.

This study has illustrated the complex mix of factors that influence home prices in Midtown Tulsa and has suggested the possibility that walkability might factor into the equation, at least in some pockets.

The major finding of this project are:

- There is no evidence for widespread, uniform demand for walkability across Midtown Tulsa.
- Home prices are mostly influenced by structural features of the home.
- Demand for walkability appears to exist in certain clusters within the study area.
- Residents do not appear to pay more to live in close **proximity to trails**, particularly to the dominant River Parks Trail System.
- **Lot size** (gross acres) is generally positively related to home price, although lot size does not necessarily reflect the size, quality, and desirability of the home.
- **Square footage** is generally positively related to home sales price, as expected.
- **Quality of construction** is positively related to home price, as expected.

- **Condition of properties** is generally positively related to home price, with a couple of exceptions. The extreme north and northwestern portions of the study area display significant negative parameter values which may be an indication of demand for quality, older homes and a possible trend toward gentrification in these areas. There are also pockets of negativity in the lower-priced south and southwest, suggesting that homes in these clusters are priced lower than their condition warrants, possibly due to high crime rates in these areas, or general neighborhood decline.
- The variable representing **proximity to commercial destinations** has a small positive influence on home price in the global model, an unexpected finding. However, there are localized pockets of significant negative values suggesting that in some clusters, residents may place a value on living in close proximity to destinations like shops and restaurants.
- There may be neighborhoods scattered throughout the study area that are good candidates for revitalization efforts, particularly areas with good existing infrastructure. For example, the Brookside area provides close proximity to both a walkable commercial district and a major trail system along the Arkansas River.

Significance of the Findings

This project makes a unique contribution to the existing body of research and literature on the subject of walkability and the demand for pedestrian-friendly neighborhoods, both in terms of the methodology employed, the data used and the results. The study area itself is an unusual choice for this type of walkability study because of its location in the south central region of the United States. Tulsa, particularly the Midtown area, has no obvious new urbanism dynamic, and has no widespread infill development or gentrification underway. Parts of Midtown Tulsa show the beginnings of a new urban vibe, but the trend is subtle, isolated, and fragile. Consequently, the study area provides insight into a part of the country that is under-studied and neighborhoods that haven't changed much structurally since they were first platted back in 1950 or 1961.

Another distinguishing feature of this study is the nature and size of the dataset that was acquired from the Tulsa County Assessor's Office. The table of raw data contained information on 26,352 parcels in Midtown including 94 different attributes related to property characteristics. The final cleaned-up dataset of residential parcels contained over 10,000 records, an extremely robust sample size that provided a firm foundation for statistical analyses. The fortunate acquisition of this robust dataset was essential to the success of the project.

The study is somewhat unique in the selection of variables used and statistical methods employed. The use of home price as a proxy for demand is not uncommon; however, the independent variables related to walkability were carefully chosen based on existing studies on good urban form, walkability, and smart growth. The huge parcel dataset provided the opportunity to test a variety of variables before settling on a final model. The selected model was based on the variables' significance in an ordinary least squares regression procedure, and further refined using geographically weighted regression.

The use of advanced GIS techniques was essential to the success of this project. While GIS has been used in other studies related to the built environment and physical activity, or in studies involving property values, this study is somewhat unique in its use of multiple, sophisticated GIS techniques. GIS was used to create digitized layers of amenities including sidewalks, parks, trails and street intersections, normalize home prices, calculate distances, perform statistical analyses, and create a series of maps. Meticulous attention was paid to display and classification properties when mapping the results of geographically weighted regression in order to glean information from the data. While the basic research questions involved in this project were fairly simple, the project required a very specialized set of technical skills.

This project contributes to the existing body of knowledge in several ways. Importantly, the study highlights the importance of uncovering local variations in certain types of spatial data. Every variable included in the GWR model showed variations across the study area that were hidden in the global regression model. The implication is clear: a traditional regression analysis may not tell the whole story when analyzing spatial data. Taking the time to pursue a localized method can tease out interesting variations across space.

The existing literature is somewhat lacking in terms of projects that study the demand for walkability. A number of studies look at the relationship between the built environment and obesity or physical activity. There are also studies that examine how the proximity to parks influences property values, but the focus on demand for pedestrian-oriented places with demand measured in terms of home prices is relatively unique. The findings that point to pockets of influence in Midtown Tulsa suggest that there may be unmet demand for walkability in Tulsa, Oklahoma, and perhaps in other similar cities throughout the United States.

Overall, the project was a success, in that it provides a greater understanding of walkability, sustainability, and green-related issues in the Central United States. While some studies suggest that homeowners will pay more to live in walkable areas, and that newer walkable developments, like New Urbanist communities, command higher sales prices, this study suggests that other dynamics may be at work. What makes a medium-sized, Midwest city different from larger cites on the east coast, or Florida, or California? In areas of the country that are successfully adopting redevelopment practices and promoting neighborhood walkability, there is perhaps a convergence of factors that has yet to reach Tulsa, Oklahoma: a strong interest in sustainable lifestyles; a green-focused population that values alternatives to suburban, automobile-centered living; a healthy, young population that prefers to commute to work by bicycle or by walking to a nearby transit station.

Implications

The results of this project could potentially be useful to Tulsa city planners in targeting areas that are worthy of investment in neighborhood improvement projects. In particular, the study might help to refine Tulsa's current comprehensive plan by pinpointing specific neighborhoods that have good potential for successful redevelopment with the goal of putting limited funds into "pockets of opportunity" where at least some of the elements of good urban form already exist. A number of neighborhoods are promising candidates for neighborhood improvement campaigns. A walkable infrastructure is already present in a number of sections of Midtown Tulsa and these areas are ripe for redevelopment efforts. On the surface, the Brookside area between Peoria Avenue and Riverside Drive appears to be an intriguing prospect for rejuvenation efforts. These neighborhoods offer a traditional shopping district along Peoria Avenue and a major recreational attraction in River Parks to the west. Yet these neighborhoods lack sidewalks and are currently in a state of decline, particularly the neighborhoods in the southern portions of Brookside between 41st Street and 51st Street. These 1950s homes lack the quality and character of neighborhoods built in earlier years, which makes the area difficult to market to the middle class. Furthermore, there is the danger that redevelopment efforts, if successful, would price lower income residents out of the market.

This study raises questions about which features of the built environment are most important for encouraging residents to walk and promoting a healthy lifestyle. The Midtown area contains few neighborhoods that are a complete package, in terms of having attractive neighborhoods, desirable destinations within walking distance, and sidewalks that allow residents to walk places without walking in the street. Obviously, no existing neighborhood can be redesigned to include every possible amenity. City planners would be wise to focus on areas with existing fixed infrastructure like traditional shopping districts, sidewalks, fairly dense, gridded street patterns and neighborhood parks.

Unfortunately, in spite of a few pockets of hope, this study uncovers an apparent lethargy in Midtown, specifically a lack of strong, widespread interest in walkability. In much of the study area, there appears to be little demand for walkability based on variations in home prices. Furthermore, visual inspection of the streets of Midtown reveals very few interesting areas with walkable infrastructure that could be easily redeveloped into pedestrian-friendly places. Peoria Avenue is an exception. The Cherry Street area to the north is an exception. But most of Midtown is strongly automobile-oriented and full of unremarkable residential subdivisions and car-centered shopping centers. Other possible explanations for an apparent lack of interest in walkable neighborhoods is that residents of Tulsa are just beginning to see the benefit of physical activity and the advantages of pedestrian-friendly places. It could be that Tulsans aren't quite ready yet, at least on a large scale, to adopt different patterns of living.

Limitations of the Study

There were a number of problems or issues that had to be addressed during the course of the study, although none were insurmountable. There were issues of missing data and extreme outliers in the parcel data set that had to be dealt with; parcel records that were missing sales price were removed. While a table of metadata was available from the Tulsa County Assessor's Office for reference, the metadata information was incomplete and unavailable for some attributes, leaving some of the attributes undefined. This, coupled with missing data, made some of the records or attributes unusable in the analysis.

There were other minor issues associated with data acquisition or creation. The sidewalk data were collected in the field by physically driving along every street in the study area and recording the presence or absence of sidewalks. In some cases, sidewalk data were not directly observed in the field for certain street segments because of researcher oversight, or because the street was closed due to construction. During the summer of 2010, when the sidewalk fieldwork was conducted, there was extensive construction underway in the Tulsa area, particularly to expressways and associated side streets and access roads. To fill in the gaps in sidewalk information, aerial imagery was used to detect the presence of sidewalks.

Home sales price may not be the best indicator for the demand for walkability. Certainly it is difficult to isolate walkability factors in terms of their influence on home prices. Structural features of the home are generally more important factors, especially in places like Tulsa, that lack clearly-defined New Urbanist districts where pedestrian-friendly living is more visible and popular. An alternative proxy for demand might have been the "days to sell" or the time that a property stays on the market before it sells.

Certain characteristics are fairly uniform across the study area and this might be a weakness in the study. For instance, Midtown Tulsa is generally composed of suburban neighborhoods with several strips of shopping districts. It might have been useful to either incorporate an urban area like downtown Tulsa into the study, or to include two quite different study areas for comparison. Midtown might be lacking what Talen calls "urban intensity" that would make it a better candidate for New Urbanist-style development (Talen 2005).

The study did not incorporate certain categories of data that might have been useful. For instance, the use of socioeconomic data could have provided additional and maybe important insight. Crime data could have been incorporated to help understand certain barriers to development in sections of Midtown. It would also be interesting to include health measures in the project to measure the effects of the built environment on the health of residents. In addition, the study did not look at the public transit system in Midtown, or consider job sites or schools as destinations. Furthermore, there are other options for walking that this study did not consider. For instance, shopping malls, office parks, college campuses, schools, tracks, gyms, and certain common areas can provide places to exercise. Indoor walking options are particularly important for those who are concerned about safety, darkness, and weather extremes. Other pedestrian-oriented features including crosswalk type, street lighting, traffic calming measures, and building setbacks were not considered.

This study excluded socioeconomic factors like age, ethnicity, gender and income, yet it is likely that demand for walkability is not uniform across the socioeconomic landscape. For instance, low income residents may need sidewalks and access to healthy, reasonably-priced food more than trendy, expensive restaurants and pricey boutiques. Such individuals may depend on walking for transportation more than higher income residents. In a study of walking behavior in African American neighborhoods, those without access to a motor vehicle were more likely to walk to neighborhood stores and restaurants out of necessity, if not by choice (Miles et al. 2008). And while lower income residents have a practical need for walkable neighborhoods, they also need reasonably-priced housing, and neighborhood revitalization efforts may have the detrimental effect of raising home prices to the extent that lower income individuals, including renters, are forced into other, less expensive neighborhoods. It is likely that only people with money can afford to pay a premium to live in specific neighborhoods.

Different age groups have different requirements in terms of neighborhood amenities yet both the very young and the very old share certain common needs involving walkable places. Small children need safe places to play, while older children need safe, walkable routes to school. The elderly, who may be unable to drive, depend on walking and public transportation to conduct the everyday business of life. Thus, the issue of walkability is of utmost practical importance to these groups.

A Vision for the Future

Building and re-building walkability into urban neighborhoods is increasingly important as a way to encourage more physical activity among increasingly obese populations. There is mounting evidence that city planners need to work with health professionals to promote policies that will make all neighborhoods as “activity friendly” as possible. Furthermore, studies indicate that people are more likely to partake in physical activity when they have a variety of assessable destinations near their homes (Frank et al. 2005). Making cities more pedestrian-friendly won’t guarantee that people will be more physically active, but doing so can help remove barriers to walking outside, and give residents attractive, pedestrian-oriented destinations. Oklahomans in particular desperately need to incorporate more physical activity into their daily lives, as Oklahoma is near the bottom of all states in terms of health and physical activity level. In a 2010 report on physical activity published by the Centers for Disease Control, 31 percent of Oklahoma residents reported getting no leisure-time physical activity at all. The only state that fared worse was Mississippi. (U.S. Department of Health and Human Services 2008).

There are many benefits to living and working in walkable communities. Communities can potentially enjoy energy savings and less reliance on automobiles when residents are able to walk places. There are potential gains in terms of air quality and quality of life. Furthermore, walkable neighborhoods give residents options in terms of lifestyle and exercise. Finally, building walkable neighborhoods can be expected to have **relatively permanent effects** in contrast to physical activity promotion programs that usually have short-term effects (Frank et al. 2005).

It may be inaccurate to conclude that Tulsa residents do not want walkable neighborhoods. However, it is possible that residents are not willing to be pioneers and forge a new life in older neighborhoods where houses are small and need updating, where crime rates appear to be high, and homes and yards are in various stages of neglect. At least that may be the perception among middle class home buyers. If existing walkable neighborhoods are going to be in demand, there must be a strong pull factor, and fewer barriers (perceived or real) to moving there. Potential home buyers have a wide range of housing options in the Tulsa metro area and districts to the east like Jenks and Broken Arrow offer newer homes, good schools, and middle class comforts.

In July 2010, the Tulsa Metropolitan Area Planning Commission adopted an initiative called PLANiTULSA. The plan was unanimously approved by the Tulsa City Council on July 22, 2010 and represents an extensive update to Tulsa's Comprehensive Plan. The lengthy document outlines an ambitious vision for Tulsa's future. Among the key tenets of future planning efforts are to make Tulsa a "leader in sustainability and efficiency" and to allow Tulsans to "get where they need to go by driving … but also by walking, biking or using public transit." New development efforts are outlined in the plan that will focus on creating "pedestrian-friendly, mixed-use places" in the Tulsa Metro Area. (City of Tulsa Planning Department 2010).

Below is an excerpt from the PLANiTULSA Comprehensive Plan:

> Among the biggest changes that will take place are thousands of small but important improvements to the city's walking infrastructure. Many neighborhoods, which today are dangerous places for all pedestrians, will be improved with safer sidewalks, better-designed intersections, and other features that alert drivers to pedestrians. The city will continue to develop and expand its network of paths and trails. Bikes will be a popular way to get around town when the weather is nice. Bicyclists may make up a significant percentage of travel, especially for the short one-to two-mile trips.
>
> (City of Tulsa Planning Department 2010).

The plan for Tulsa is visionary and ambitious, but more importantly, it suggests that city leaders and residents see the value in making Tulsa a more walkable community. However, for the most part, the initiatives outlined in PLANiTULSA have yet to be implemented and are still in a planning stage. Yet there are signs of revitalization in Midtown. On 41st Street, just east of Peoria Avenue, there is a Whole Foods Market that attracts shoppers from all over Tulsa. The store is expensive, trendy, extremely popular, and situated in the middle of Brookside in the midst of neighborhoods that were designed in the 1950s. Directly across the street from the market is a newly-constructed apartment/condominium complex that advertises “loft” living. These are new features on the landscape of Midtown and perhaps an indicator of future trends.

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VITA

Victoria Lightfoot

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE VALUE OF WALKABILITY IN MIDTOWN TULSA

Major Field: Geography

Biographical:

Personal: Born in Tulsa, Oklahoma; the daughter of Wilburn and Dorothy Harris

Education:

Completed the requirements for the Doctor of Philosophy/Education in Geography at Oklahoma State University, Stillwater, Oklahoma in May, 2014.

Completed the requirements for the Master of Business Administration at Oklahoma State University in 1986.

Completed the requirements for the Bachelor of Science in Education at Oklahoma State University, Stillwater, Oklahoma, United States in 1980.

Experience: Employed by Oklahoma State University as Manager of Research Support Services for the College of Arts and Sciences

Professional Memberships: Phi Kappa Phi, Gamma Theta Upsilon, Association of American Geographers