

Walkability and Property Values in Omaha, NE

by

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## **Abstract**

Recent studies have shown that walkability can have a positive impact on a community. Walkability has been associated with better public health (Jensen et al., 2017), lower carbon emissions (Morris, 2009), more taxes per land area, and more transportation options which helps low income residents (Speck, 2012; Forsyth, 2015). Additionally, there have been studies done that show housing in walkable areas commands a price premium (Pivo & Fisher, 2011). This should be a good sign for communities because walkable areas are more likely to get built if a land developer can fetch a higher price for a walkable property. But what exactly is the walkability premium for properties in Omaha, NE if there is one? The studies that have linked walkability to higher property values were done in larger cities and few studies have looked at smaller metros in the Midwest (Hack, 2013; Leinberger & Alfonzo, 2012). This study seeks help to fill in this gap in the research by looking specifically at walkability's correlation to property values in Omaha, NE, a mid-size midwestern city.

This study looked at three different land uses in Omaha, NE to see if there is a correlation between walkability and property value. The three land uses were single-family houses, apartments, and restaurants. Property values were measured using data from the Douglas County, NE assessor's office. The walkability of each parcel was measured using a 1-100 scale as generated from WalkScore.com. A positive correlation between WalkScore and property values was found but only in the eastern part of the city. The correlation was highest in the apartment land use and lower but still positive for single-family houses and restaurants. In the western part of Omaha, there were negative correlations between WalkScore and property value across all three land uses. These results are expected to contribute to walkability literature as a case study on the relationship of walkability to property valuation. It could also be used by municipalities and land developers who are interested in the value of properties they are developing for their communities.

# Table of Contents

List of Figures .....	v
List of Tables .....	vii
Acknowledgements .....	ix
Chapter 1 - INTRODUCTION .....	1
Explanation of Problem .....	1
Description of the Context.....	3
Research Problem .....	5
Delimitations and Assumptions .....	5
Delimitations.....	5
Assumptions.....	5
Definition of Terms .....	6
Importance of the Study.....	6
Chapter 2 - LITERATURE REVIEW .....	8
Introduction to Key Areas Related to the Research Problem .....	8
Walkability.....	8
Concepts.....	8
Measurements .....	9
Urban Design Factors Related to Walkability .....	12
Economic Value of Walkability .....	14
Summary of the Literature .....	16
Chapter 3 - RESEARCH APPROACH .....	17
Theoretical Framework.....	17
Type of Research & Methodology.....	18
Research Question .....	18
Hypothesis.....	18
Methodology .....	18
Study area and sampling frame.....	19
Methods .....	20
Method #1: Measure Walkability .....	21

Method #2: Measure Property Values .....	23
Method#3: Correlations between Walkability and Property Value .....	24
Chapter 4 - FINDINGS .....	25
Single-Family Parcel Value per Square Foot East of 72 <sup>nd</sup> Street .....	26
Single-Family Parcel Values East of 72 <sup>nd</sup> Street .....	28
Single-Family Parcel Value per Square Foot West of 72 <sup>nd</sup> Street .....	30
Single-Family Parcel Values West of 72 <sup>nd</sup> Street .....	32
Apartment Parcel Values per Square Foot East of 72 <sup>nd</sup> Street .....	34
Apartment Parcel Values East of 72 <sup>nd</sup> Street .....	36
Apartment Parcel Values per Square Foot West of 72 <sup>nd</sup> Street .....	38
Apartment Parcel Values West of 72 <sup>nd</sup> Street .....	40
Restaurant Parcel Value per Square Foot East of 72 <sup>nd</sup> Street .....	42
Restaurant Parcel Values East of 72 <sup>nd</sup> Street .....	44
Restaurant Parcel Value per Square Foot West of 72 <sup>nd</sup> Street .....	46
Restaurant Parcel Values West of 72 <sup>nd</sup> Street .....	48
Quantitative Comparisons .....	50
Qualitative Comparison .....	56
Conclusion .....	66
Chapter 5 - DISCUSSION .....	67
Geography .....	67
Property value measurement .....	67
Type of land use .....	68
Tie back to literature .....	71
Community development implications .....	74
Limitations & Future Research .....	76
References .....	77

## List of Figures

Figure 1.1 Major Omaha Urban Developments (Mead & Hunt 2007; Douglas County Historical Society, 2007) .....	2
Figure 2.1 Pittsburgh, PA WalkScores (Bereitschaft, 2017) .....	11
Figure 3.1 Theoretical Framework .....	17
Figure 4.1 Linear Regression - Single-Family Value per square foot East of 72nd Street.....	27
Figure 4.2 Linear Regression - Single-Family Parcel Values East of 72nd Street .....	29
Figure 4.3 Linear Regression - Single-Family Value per Square Foot West of 72nd Street.....	31
Figure 4.4 Linear Regression - Single-Family Parcel Values West of 72nd Street.....	33
Figure 4.5 Linear Regression - Apartment Value per Square Foot East of 72nd Street.....	35
Figure 4.6 Linear Regression - Apartment Parcel Values East of 72nd Street.....	37
Figure 4.7 Linear Regression - Apartment Value per Square Foot West of 72nd Street .....	39
Figure 4.8 Linear Regression - Apartment Parcel Values West of 72nd Street .....	41
Figure 4.9 Linear Regression - Restaurant Parcel Value per Square Foot East of 72nd Street....	43
Figure 4.10 Linear Regression - Restaurant Parcel Values East of 72nd Street.....	45
Figure 4.11 Linear Regression - Restaurant Parcel Value per Square Foot West of 72nd Street	47
Figure 4.12 Linear Regression - Restaurant Parcel Values West of 72nd Street .....	49
Figure 4.13 Pearson’s Correlation Coefficient ( <i>R</i> ) Comparison: Parcel Value per Square Foot vs. WalkScore.....	51
Figure 4.14 Pearson’s Correlation Coefficient Comparison: Parcel Value vs. WalkScore.....	52
Figure 4.15 Average Parcel Value per Square Foot Comparison.....	53
Figure 4.16 Average Parcel Value Comparison .....	54
Figure 4.17 Average WalkScore.....	55
Figure 4.18 Highest Single-Family House WalkScore.....	57
Figure 4.19 Walking path along Dodge Street.....	58
Figure 4.20 Highest WalkScore Single-Family Parcel West of 72nd Street .....	59
Figure 4.21 Highest WalkScore Apartment.....	60
Figure 4.22 Street view of 1316 Jones Street .....	61
Figure 4.23 Highest Apartment Value West of 72nd Street .....	62
Figure 4.24 Highest Restaurant WalkScore.....	63

Figure 4.25 Street view of 324 South 14th Street ..... 64  
Figure 4.26 Restaurant Parcel with Highest WalkScore West of 72nd Street..... 65  
Figure 5.1 Grocery Store walk from 3106 South 116th Street ..... 69  
Figure 5.2 Restaurant San Luis ..... 70

## List of Tables

Table 2.1 People's Tolerance for Walking (Gruen, 1964) .....	9
Table 2.2 WalkScore Descriptions (WalkScore, 2017) .....	10
Table 2.3 Urban Design Factors of Walkability .....	12
Table 3.1 WalkScore Variables .....	22
Table 3.2 Measurements of Property Value .....	23
Table 4.1 Descriptive Statistics - Single-Family Value per square foot East of 72nd Street .....	26
Table 4.2 Pearson's Correlation Coefficient – Single-Family Parcel Value per square foot East of 72nd Street .....	26
Table 4.3 Linear Regression - Single-Family Parcel Value per square foot East of 72nd Street.	26
Table 4.4 Descriptive Statistics - Single-Family Parcel Values East of 72nd Street.....	28
Table 4.5 Pearson's Correlation Coefficient - Single-Family Parcel Values East of 72nd Street	28
Table 4.6 Linear Regression - Single-Family Parcel Values East of 72nd Street .....	28
Table 4.7 Descriptive Statistics - Single-Family Value per Square Foot West of 72nd Street ....	30
Table 4.8 Pearson's Correlation Coefficient - Single-Family Value per Square Foot West of 72nd Street .....	30
Table 4.9 Linear Regression - Single-Family Value per Square Foot West of 72nd Street.....	30
Table 4.10 Descriptive Statistics - Single-Family Parcel Values West of 72nd Street .....	32
Table 4.11 Pearson's Correlation Coefficient - Single-Family Parcel Values West of 72nd Street .....	32
Table 4.12 Linear Regression Single-Family Parcel Values West of 72nd Street .....	32
Table 4.13 Descriptive Statistics - Apartment Parcel Value per Square Foot East of 72nd Street .....	34
Table 4.14 Pearson's Correlation Coefficient – Apartment Parcel Value per Square Foot East of 72nd Street .....	34
Table 4.15 Linear Regression - Apartment Parcel Value per Square Foot East of 72nd Street ...	34
Table 4.16 Descriptive Statistics - Apartment Parcel Values East of 72nd Street .....	36
Table 4.17 Pearson's Correlation Coefficient - Apartment Parcel Values East of 72nd Street....	36
Table 4.18 Linear Regression - Apartment Parcel Values East of 72nd Street .....	36
Table 4.19 Descriptive Statistics - Apartment Value per Square Foot West of 72nd Street .....	38

Table 4.20 Pearson’s Correlation Coefficient - Apartment Value per Square Foot West of 72nd Street .....	38
Table 4.21 Linear Regression - Apartment Value per Square Foot West of 72nd Street.....	38
Table 4.22 Descriptive Statistics - Apartment Parcel Values West of 72nd Street .....	40
Table 4.23 Pearson’s Correlation Coefficient - Apartment Parcel Values West of 72nd Street ..	40
Table 4.24 Linear Regression – Apartment Parcel Values West of 72nd Street .....	40
Table 4.25 Descriptive Statistics - Restaurant Parcel Value per Square Foot East of 72nd Street .....	42
Table 4.26 Pearson’s Correlation Coefficient – Restaurant Parcel Value per Square Foot East of 72nd Street .....	42
Table 4.27 Linear Regression – Restaurant Parcel Value per Square Foot East of 72nd Street ..	42
Table 4.28 Descriptive Statistics - Restaurant Parcel Values East of 72nd Street .....	44
Table 4.29 Pearson’s Correlation Coefficient - Restaurant Parcel Values East of 72nd Street....	44
Table 4.30 Linear Regression - Restaurant Parcel Values East of 72nd Street .....	44
Table 4.31 Descriptive Statistics - Restaurant Parcel Value per Square Foot West of 72nd Street .....	46
Table 4.32 Pearson’s Correlation Coefficient - Restaurant Parcel Value per Square Foot West of 72nd Street .....	46
Table 4.33 Linear Regression - Restaurant Parcel Value per Square Foot West of 72nd Street..	46
Table 4.34 Descriptive Statistics - Restaurant Parcel Values West of 72nd Street .....	48
Table 4.35 Pearson’s Correlation Coefficient Restaurant Parcel Values West of 72nd Street....	48
Table 4.36 Linear Regression Restaurant Parcel Values West of 72nd Street .....	48
Table 5.1 Population Density & WalkScore of Sample Groups.....	73



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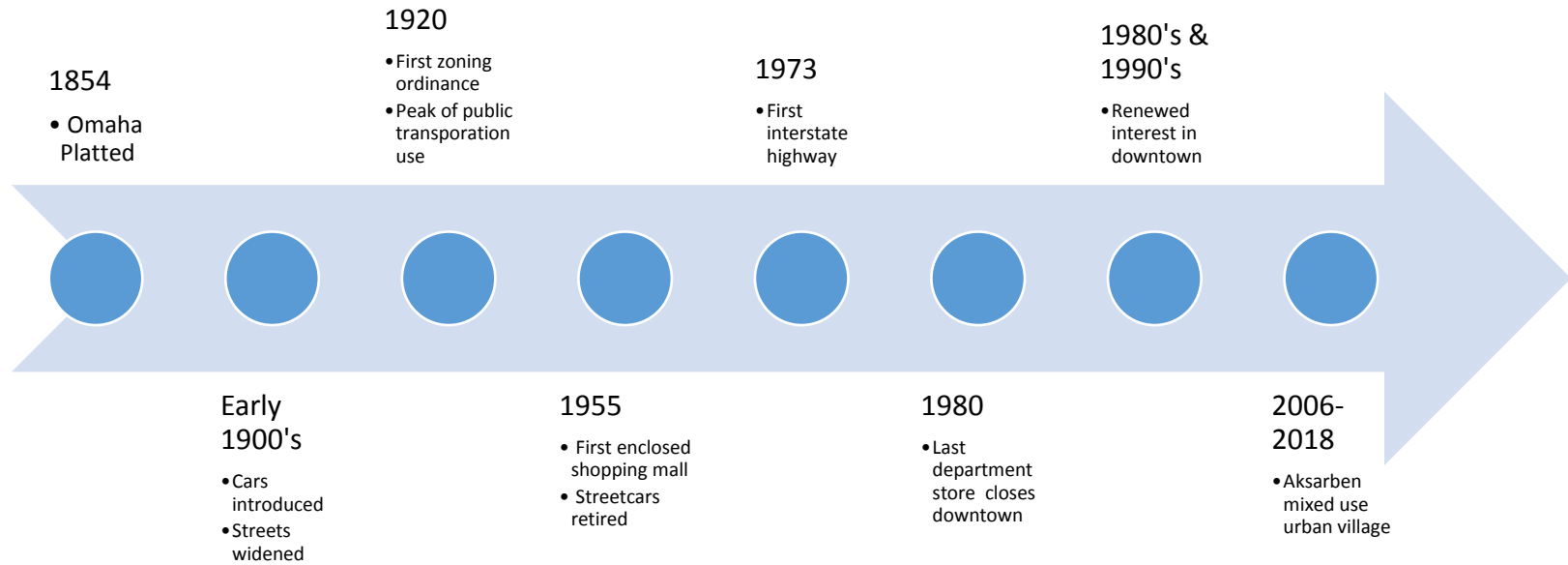
# **Chapter 1 - INTRODUCTION**

## **Explanation of Problem**

The Omaha metropolitan area has become a sprawling city of low density development where the personal auto is required for daily trips. This type of development shifts the burden of transportation to individuals, many of whom have a difficult time paying for their own car or may not even be able to drive (Morris, 2012; Bereitschaft, 2017). Low density, auto-centric cities are also not good for public health because people spend time driving instead of walking or bicycling. There are advantages to a car-centric city if you can afford a car. Cars help people shop and get to work quickly. A person can haul a week's worth of groceries home no matter the weather. People can commute to work far away from where they live. The downside is that when the majority of people choose the car as their transportation, a city's infrastructure becomes decentralized. Auto-centric cities are expensive to maintain because their low density means that fewer people are paying for public services per given area (Morris, 2009). Preference surveys have shown that the majority of Americans like low density urban areas, but these areas are vulnerable financially and socially. If the price of oil goes up it will be more expensive to get around in an auto-centric city, or if middle-class incomes stagnate, low density development will not be as attractive because fewer people will be able to pay for their own auto and maintain a suburban style single-family house (Burchell & Sahan, 2003).

This study looks at property values and walkability in Omaha, NE to see if there is a correlation between the two. Property values are being studied because the financial performance of a development is often the most important thing to a land developer. Property values should be equally important to a municipality which is left with the maintenance and the social impact of a project long after the land developer is gone. The third stakeholder is the public who spend their lives in the city that others have built before them. If there is a positive correlation between walkability and property values, it would indicate a rare win-win-win scenario where all parties benefit: developers who build walkable places, the city government that depends on their tax base, and the people who live there.

**Figure 1.1 Major Omaha Urban Developments** (Mead & Hunt 2007; Douglas County Historical Society, 2007)



## **Description of the Context**

If a person were to visit Omaha today they would find it to be a sprawling, low-density city, but this has not always been the case. To understand Omaha's development pattern, its history should be considered. Figure 1.1 shows a timeline with highlights of Omaha's urban development. Omaha was platted in 1854 with a conventional street grid. Working class homes were built north and south of downtown so that laborers could walk to work and stores. The wealthy and business owners built houses on the west side of town to avoid the industrial activity downtown and took horse drawn carriages into what is now the city's central business district. The development of the streetcar in the 1880's allowed more people to move away from downtown and commute to work by street car, as downtown was the center of employment and retail activity (Mead & Hunt 2007).

By 1900 there was more than one center of retail activity in Omaha. One such neighborhood is Dundee. Dundee was a desirable place to live, building there required a minimum investment so it attracted a more affluent population. The less desirable but equally booming part of the city was South Omaha. South Omaha was the center of meatpacking activity; it was home to 26,000 people by 1900. Irish or southern and eastern-European immigrants made up a majority of its population (Douglas County Historical Society, 2007).

Transportation affected Omaha's development pattern throughout the 1900s. Cars became popular which required Omaha's streets to be widened to accommodate the traffic. Leavenworth and Dodge streets became major arterials that took people from their homes in the western part of the city to jobs and shopping downtown (Mead & Hunt, 2007).

In 1920 a couple of important things happened; the City of Omaha adopted its first zoning ordinance and the use of public transportation in the city peaked (Douglas County Historical Society, 2007). The power to zone includes the right to regulate the height of buildings, the size of lots, and to specify how densely land is developed (Nebraska § 14-401). Zoning has a direct impact on a city's urban form because of the land uses it allows. Zoning has an indirect impact on walkability because if a city zones extensive areas as low density, the result is a city that does not have the density required for walkable destinations, let alone frequent transit service which complements a walking city. This may have been why public transit use peaked the same year that zoning was introduced in Omaha.

In the 1950's a change in shopping patterns began taking business away from the central business district and out toward Omaha's suburban areas. In 1955 Omaha got its first enclosed shopping mall, The Center Mall, which opened at 42nd and Center streets. In the same year, the city retired its fleet of streetcars due to low ridership. The development of the suburban mall and the discontinuation of streetcars both had a negative impact on the city's walkability.

In 1973 the first segment of interstate highway was completed in the metro area, this aided suburban development on the city's western edge. By the 1970's more shopping had moved to the suburban parts of the city away from the downtown core. This trend was complete by 1980, when downtown's last department store closed (Douglas County Historical Society, 2007). The 1980's and 1990's showed a renewed interest in the downtown, with historic buildings being renovated into commercial and residential uses. In 1996 The Upstream Brewing Company opened in the Old Market which is just one of the many eating and drinking establishments in the historic downtown business district. By the early 2000's the city's regional shopping centers started to decline with Southroads and Center Mall both being repurposed into mostly office space. Crossroads Mall had become a dead mall with the exception of a Target discount store that was built in 2006 (Douglas County Historical Society, 2007).

Today strip malls and neighborhood power centers are the most popular form of retail, while suburban single-family houses and apartment complexes are the most popular form of housing. While there are sidewalks in most housing developments, these places are not very walkable due to a small number of retail and civic destinations within walking distance. Recently the tide seems to have shifted to more walkable developments. Older, more walkable parts of the city like Benson, Dundee, and downtown Elkhorn have had more businesses open. The city's newer malls have been built in a traditional main street style vs. the enclosed shopping centers that were built from the 1950's to 1990's. Examples of outdoor malls include Village Point that opened in 2004 and Aksarben Village which broke ground in 2006 and continues to add commercial, office, and residential space to the site (Douglas County Historical Society, 2007). Omaha has been an auto-dominated city for decades, but preferences seem to be changing based on the most recent projects built in the city.

## **Research Problem**

The research asks if walkability has an impact on property values in Omaha, NE across different land uses and if so, is the relationship positive or negative?

The geographic unit of study are parcels in Omaha, NE. A parcel is a plot of land that is owned by a person or persons and includes the building and any other improvements on the land. Three different types of land use on are included in the study: single-family houses, apartments, and restaurants. A representative sample of each land use was generated from Douglas County GIS records. The GIS records had Assessor's data with the value of each parcel. A walkability score from WalkScore.com was added to each parcel so that property value could be compared to walkability using regression analysis.

## **Delimitations and Assumptions**

### **Delimitations**

1. The study is limited to analyzing the walkability of single-family house, apartment, and restaurant land uses within the city limits and the extraterritorial jurisdiction of Omaha, NE.
2. The study measures walkability by using parcel level walkability scores from WalkScore.com.
3. The spatial unit of the study is the parcel.
4. Single-family house samples range from 500 square feet higher to 500 square feet lower than the median house size in Omaha of 1,860 square feet.
5. Apartment samples are buildings that are three stories or less.
6. Restaurant samples were selected using Douglas County, Nebraska's parcel type description, "Restaurant" which includes casual and fast casual dining establishments.

### **Assumptions**

1. WalkScores from WalkScore.com are an adequate measure of walkability.
2. If a walkability premium exists, it is included in a parcel's assessed value.
3. Samples are representative of their respective categories of land use.

## **Definition of Terms**

Community: A location inhabited by a group of people who share social interactions on matters of common interest (Wilkinson, 1991).

Neighborhood: A specific geographic area demarcated by major streets or other physical barriers (Green & Haines, 2012).

Property Value: Value assigned by Douglas County, NE Assessor (Douglas County Assessor, 2017).

Walkable: Patrons do not have to drive to visit more than one store (Hack, 2013).

Walkable Area: People can travel to destinations by a mode other mode than driving. The environment is welcome for people to stroll, meet others and rest (Hack, 2013).

Walkability: The extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network (Southworth, 2005).

## **Importance of the Study**

Urban land values represent the present value of the expected future net returns attributable to land (Wendt, 1957). This means that land is valuable for its financial utility. A key component of this is location. Urban land is served by utilities and transportation infrastructure, it has police and fire protection, along with thousands of people who can access the land easily. All of these factors add value to the land. Land values are important for urban planning because cities have infrastructure they need to maintain, and higher land values can help cities attract tax paying businesses that will pay for the services they provide.

When new developments are added to a city they can become assets or liabilities depending on how well they are constructed, how many tax dollars they bring in, and how they contribute to the quality of life for people in the community. If property values decrease it can lead to a downward spiral of disinvestment. This can lead to decline in other areas like social capital and jobs. Commercial developments like the Old Market and the Dundee business district in Omaha, NE are examples of walkable areas that have held their value over time perhaps because they were designed with walkable amenities.

In addition to the financial benefits, walkable areas can promote human health and social welfare by reinforcing ties between people and their communities along with being more

environmentally friendly than a strictly auto-dependent city (Easton & Owen, 2009). According to a study done by Active Living Research, 45% of daily trips, are made for shopping and running errands. Since walking is the most common form of exercise, walkable areas could play a role in reducing obesity and improving health (Hack, 2013).

If planners and developers understand the value that walkable areas have for a city's finances, citizen's health, and financial welfare, they may change land development laws to make walkable areas more of the norm rather than the exception.



## **Chapter 2 - LITERATURE REVIEW**

### **Introduction to Key Areas Related to the Research Problem**

The research problem is to measure the walkability of properties in Omaha, NE and compare walkability to their value to see if there is a correlation between them. To do this, the walkability of each property needed to be measured and a value needed to be recorded. The literature on walkability reveals different environmental factors that can make a place walkable, including its density, urban design, speed of traffic, safety, and aesthetics. The study of urban land values considers value to be a bundle of attributes including proximity to destinations, the age of the property, physical characteristics of the site and environmental factors. Recent studies have linked walkability to the economic value of land.

### **Walkability**

#### **Concepts**

In urban planner Jeff Speck's book, *Walkable City*, he discusses what a walkable place is. He explains this by describing the components of a walk. According to Speck, a walk should be useful, safe, comfortable, and interesting. The components of a walk can be encouraged by environmental design. A useful walk means a walk serves a utility, that everyday needs can be met on foot. For example, a drugstore that is close to residential land uses would provide utility for residents because they could shop for necessities within walking distance. Safe means that the street has been designed to prioritize the needs of pedestrians. A safe walk is one where people are not afraid of crime or high-speed traffic. Comfortable means that buildings and landscape provide a human scale. Interesting means that sidewalks are lined by unique buildings and that there are other people using the outdoor space (Speck, 2012).

In addition to design, the human limits of walking must be discussed in the context of walkable places. According to 20th Century architect and planner Paul Ritter, "An average walk is at a speed of 2.5 miles per hour. This converts to 13,200 feet per hour or 220 feet per minute. On this basis, a 5-minute walk would be 1,100 feet and a 10-minute walk would be 2,200 feet." (Ritter, 1964, p.14). A more recent source, The Environmental Protection Agency's smart growth manual suggests that destinations to which we expect people to walk should be no further than 1,320 feet or ¼ of a mile (Ewing, 1999). As a planning assumption, the average distance a person will walk for an errand can be assumed to be anywhere from ¼ to ½ of a mile.

It should also be recognized that walkability depends on the environment through which one is walking as shown in Table 2.1. According to architect and shopping mall designer Victor Gruen, a tolerable walking distance varies from up to 20 minutes in an attractive, weather enclosed space to two minutes in an unattractive, open environment like a parking lot. Consider the difference between an indoor shopping center and a parking lot outside with few amenities. It makes sense that tolerance for walking changes under different conditions.

**Table 2.1 People's Tolerance for Walking (Gruen, 1964)**

Type of Environment	Minutes	Feet
Highly attractive, completely weather-protected environment	20	5,000
Highly attractive environment in which sidewalks are protected from sunshine and rain	10	2,500
Attractive but not weather-protected area during periods of inclement weather	5	1,250
Unattractive environment (parking lot, garage, traffic-congested streets)	2	600

*This table shows an average person's tolerance for walking under different conditions.*

The public's interest in walkable places has been growing in the United States recently. A 2011 national survey of consumer preferences showed that 66% of respondents expressed a preference for "living within walking distance of stores, restaurants and other places in a community." (Spivak, 2011). A 2014 study from the International Council of Shopping Centers looked at retail trends which addressed people's desire for a "third place" away from home or the office for socializing or entertainment. Studies have affirmed the need people have to interact with other people. It stands to reason that such places would have a competitive advantage in the world of retail because they are serving a need people have to connect with others (ICSC, 2014).

## **Measurements**

Walkability is a composite measure of how walkable a place is. Walkability is typically measured with a score that accounts for environmental and demographic criteria that influence the walkability of a place. Tools like the Irving Minnesota Inventory (Day, 2006), the

Neighborhood Environment Walkability Survey (Saelens & Sallis, 2002) or WalkScore.com’s walkability index (WalkScore, 2017) have been used to measure walkability.

WalkScore was launched in 2007. It is a private company that maintains a website where it creates a numerical WalkScore on a map. Walkscores range from 0 to 100. The higher the value the more walkable the environment according to WalkScore’s algorithm. WalkScore awards points based on the distance to amenities in each category. Amenities within a 5-minute walk (.25 miles) are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30-minute walk. WalkScore also measures pedestrian friendliness by analyzing population density, block length, and intersection density. WalkScore uses the scale as shown in Table 2.2.

**Table 2.2 WalkScore Descriptions (WalkScore, 2017)**

WalkScore	Description
90-100	“Walker’s Paradise” (Daily errands do not require a car)
70-89	“Very Walkable” (Most errands can be accomplished on foot)
50-69	“Somewhat Walkable” (Some errands can be accomplished on foot)
25-49	“Car Dependent” (Most errands require a car)
0-24	“Car-Dependent” (Almost all errands require a car)

WalkScore’s methodology has been validated by research, particularly at the one-mile range. Below this range, at ¼ to ½ of a mile, it has been found that the WalkScore algorithm misses certain variables that would influence walkability like safety, neighborhood aesthetics, and does not differentiate between crossing a highway and a local road. Additionally, WalkScore uses straight line distances as opposed to network walking distance which are different based on the available walking network (Duncan et al., 2011). There can be great qualitative differences in the built environment among locations with the same WalkScore as noted by Dr. Brad Bereitschaft’s 2017 *Equity in Neighborhood Walkability* study. The images in Figure 2.1 are from Pittsburgh, PA. These places have the same WalkScore but are qualitatively different

environments. The image on the left has boarded up businesses where the image on the right has an active street life including people eating outside and pedestrians (Bereitschaft, 2017).

**Figure 2.1 Pittsburgh, PA WalkScores (Bereitschaft, 2017)**



The Irvine Minnesota Inventory (IMI) is an audit tool that was designed to measure built environment features that are potentially linked to active living, especially walking. IMI was developed in a partnership between the University of California – Irvine and the University of Minnesota in 2005. The inventory is divided into four categories: accessibility (62 items), pleasurable (56 items), perceived safety from traffic (31 items), and perceived safety from crime (15 items). There are 162 items in the full inventory. The scores for each category are calculated based on the absence or presence of specific built environment features. Scoring for aesthetics, for example, include questions about the presence or absence of: attractiveness, views, and outdoor dining. Safety questions include the presence or absence of graffiti, litter, and windows with bars. Once an inventory is done, an overall walkability score is generated. The advantage to the IMI is that one can tell why an area is walkable or not based on which categories scored higher than others. If an area has parks and is safe, it doesn't necessarily mean it is a walkable place because it may score low on connectivity or proximity to shopping (Day, 2006). The IMI is a useful tool but it would take a large amount of data and time to collect.

The Neighborhood Environment Walkability Survey or 'NEWS' is a 98-question instrument that assesses a neighborhood's perceived walkability. There is also a 54-question abbreviated version, NEWS-A, that according to planning literature is widely used (Jensen et al., 2017). NEWS was developed in 2002 by Dr. James Salis, a professor of family medicine and public health at the University of California – San Diego. NEWS measures the perception of

neighborhood design features. The survey is intended to be used by researchers who want to know how people in a neighborhood perceive different aspects of their neighborhood that relate to walkability. Questions are related to physical activity, residential density, land use mix, street connectivity, infrastructure for walking/cycling, neighborhood aesthetics, traffic and crime safety, and neighborhood satisfaction. For example, residents are asked how common different housing types are in their neighborhood, how close different categories of stores are from their house, and how much shopping they can do within walking distance (Saelens & Sallis, 2002).

### **Urban Design Factors Related to Walkability**

The literature identifies different factors that correlate to walkability. Population density, urban design, traffic speed, links to other modes of transit, and safety. These correlations have been tested and validated through the studies. A summary of the different factors and the direction of their relationship to walkability are shown in Table 2.3.

**Table 2.3 Urban Design Factors of Walkability**

Variable	Description	Relationship to Walkability (+ or -)	Study
High population density	20 households / acre or more	+	Holtzclaw, 1991 Rand, 2007
Low population density	Less than 20 households per acre	-	Holtzclaw, 1991
Gridded, short blocks	Short blocks are less than 300'	+	Southworth, 2005
Curvilinear, long blocks	Long blocks are greater than 300'	-	Southworth, 2005
High Traffic Speed	Greater than 35mph. More accidents, pedestrians feel unsafe.	-	CDC, 2013
Low Traffic Speed	Less than 35mph. Fewer fatalities, pedestrians feel safer.	+	CDC, 2013
Links to Other Modes of Transit	Frequent bus or train service allow people to get to more place when walking is combined with transit.	+	Lawrence, 2006 Accuardi, 2017
Safety	Well lit, low crime	+	Cozens, 2007

*Urban design factors of walkability and the direction of the relationship to walkability, positive or negative.*

Density is an important part of walkability because the more people there are in a given area, the more services will be within walking distance. In 1991 John Holtzclaw working for the Sierra Club studied twenty-eight California cities to look at the relationship between residential density and driving miles. The study found that residential density is the most effective variable in predicting auto ownership and driving. The next most effective variable is the amount of public transit followed by pedestrian and bicycle friendliness. Holtzclaw's study found there is a relationship between annual vehicle miles traveled and the density of households per acre. As the number of miles driven decreases the households per acre increases (Holtzclaw, 1991).

Jeff Speck cites the Holtzclaw study in his 2012 book *Walkable City*. Speck describes 10-20 households per acre as traditional urbanism where one would find apartments and row houses along with single-family houses (Speck, 2012). This density range was further corroborated by the nonprofit RAND corporation. RAND did a study in 2007 that was published in the *American Journal of Preventive Medicine*. The study surveyed residents in 10 major U.S. cities about their walking habits and compared the walking habits to characteristics of the environment where they lived. Researchers found only when the population density got up to 14 units per acre or more, the number of walking trips increased (RAND, 2007).

The design of an urban area is another aspect of walkability. The length of blocks, speed of traffic, the presence of trees, the layout and connectivity of streets can all affect walkability. Walkable environments are inviting to people because they provide richly connected paths that get people to where they need to go. Streets in walkable parts of a city are safe and easy to cross, they can be navigated by young and old alike. The character of walkable places includes a variety of building types, there might be street trees, site furnishings, and outdoor cafes. Urban design can make places more walkable. Even if it takes a few minutes longer, walking may be preferred over driving because of the quality of the walking experience in a place with good urban design (Southworth, 2005).

Traffic speed is correlated to walkability because the slower the traffic, the more walkable an area will be. Conversely, the higher the speed of traffic, the more dangerous an area becomes for people walking. In 2013 there were 4,735 pedestrians killed by collisions with autos in the United States. Additionally, more than 150,000 pedestrians were treated in emergency rooms for non-fatal crash-related injuries (CDC, 2013). A major risk factor is the speed of traffic which has been found to correlate with the likelihood of a pedestrian getting killed and the

severity of the injury (Rosen, 2009). There are comparatively fewer pedestrian-vehicle collisions in Europe where improvements have been made to signage, traffic calming, and enforcement (Federal Highway Administration, 2003).

People like to walk in areas that feel safe. High speed traffic can make a person feel unwelcome in an urban environment but so can crime. Crime can be thought of as a mirror of the quality of the social environment and an indicator of community well-being. Evidence of high crime include buildings in disrepair, bars over windows, a high number of alcohol outlets, and trash (Cozens, 2007). Crime is included as a factor of walkability in both the NEWS and IMI inventories. Walkscore.com uses crime as one of its variables as well.

Links to bicycle, bus, and other forms of transportation add to walkability because they allow people to switch modes to make longer trips. Walkability has been shown to have a positive link with active transportation like bicycling (Lawrence, 2006) and other forms of transportation like street cars and bus rapid transit. A 2016 report from the Transit Center, a transportation advocacy group, highlighted the importance of walkability for those who take public transportation regularly. The report is based on a study of 3,000 transit riders from 17 different US cities. It found that as the frequency of respondents' transit use increased, so did the amount of walking (Accuardi, 2017).

### **Economic Value of Walkability**

The value of urban land has been studied for the last 100 years in the United States. There is agreement that urban land is valuable because of its proximity to people. People living in an area give urban land utility, where the best sites become scarce and therefore more valuable. In 1926 Robert Haig wrote a theory of urban land value that considered the location of different sites. His model assumed accessibility to the center was the dominant aim. Rational actors looking to reduce their transportation costs would make location decisions that reduce their site rent and transportation costs, making properties in the center of the city the most valuable (Haig, 1926). This theory was shown to be inadequate by the 1950's when roads were built that allowed more people to move to suburbs. This inverted the land value paradigm that had existed before and increased property values on the edge of cities. In response to changing valuation, Paul Wendt theorized new ways to value urban land using revenue, the capitalization rate, and the competitive pull of the urban area (Wendt, 1957).

By the 1970's urban land began to be thought of as a bundle of characteristics. William Stull observed that "it has become customary to think of a single-family parcel as a bundle of characteristics" that can be classified into four "mutually exclusive and exhaustive" categories including accessibility (distance to work and shops), physical site characteristics (building quality and age), environmental (social and physical features around the parcel), and public-sector factors like taxes and services (Stull, 1975). According to professors Gary Pivo and Jeffrey Fisher, walkability fits within Stull's theory of land value except that its factors include two of Stull's categories. The number of destinations within walking distance falls within the "accessibility" category, while factors such as path connectivity and safety would fit under "environmental" category (Pivo & Fisher, 2011).

The Brookings Institution, a Washington DC think tank, did a study on the links between economic performance and walkability of neighborhoods in the Washington DC metropolitan area. The study included 201 neighborhoods which were ranked by the online app WalkScore to establish a baseline of walkability. Walkability scoring was done based on environmental metrics using the Irvine Minnesota Inventory (IMI). Once neighborhood walkability scores were generated using the IMI inventory, they were compared against economic performance metrics to see if there was a relationship. Economic performance variables included: retail rents, office rents, retail sales, residential price per square foot, and capitalization rate for commercial buildings. The study found that walkable places performed better economically and that average office rent, retail rent, retail sales, residential rent and home value per square foot were all higher in walkable urban areas (Leinberger & Alfonzo, 2012).

A 2009 study was done by Joe Cortright for CEOs for Cities. The study used a large sample group of 90,000 recent home sales in 15 different housing markets around the US. These were major metro areas on the east and west coast and the south. A positive correlation between WalkScore and housing prices was found in 13 of 15 markets studied. There were two cities for which there was no correlation, Las Vegas, NV (negative) and Bakersfield, CA (not significant). The study found overall that one WalkScore point was associated with a \$700 - \$3,000 increase in home values. Additionally, the property value increase was found to be higher in more populous urban areas (Cortright, 2009).

In 2013 the Robert Wood Johnson Foundation sponsored a report "Business Performance in Walkable Shopping Areas" to examine the performance of businesses in walkable shopping



areas. It was a meta-analysis of 70 different studies and articles on walkability. The author of the report also conducted an exploratory study of 15 walkable shopping areas. These areas are included as case studies in the report to add some qualitative information of what a walkable shopping area looks like. The meta-analysis was accompanied by interviews with retail experts, developers, and residents of urban and suburban areas. The consensus was that there is increasing interest in these types of developments, and that walkable shopping areas are most successful when they reach a critical mass, cater to diverse needs, or have access to transit service and have a supermarket as an anchor. Successful walkable shopping areas can command higher rents for their space per an analysis that used WalkScore and National Association of Real Estate Investment Trust data. Walkable retail is on the upswing per the report. Given the positive financial outcomes for cities the number of these developments should grow over the next decades (Hack, 2013).

### **Summary of the Literature**

Walkability is a multi-faceted concept that differs in definition, but in general it means that a place is favorable to walking. There are human constraints to walkability based on the distance the average person will walk. These vary according to the type of environment in which they are walking (Ritter, 1964). Factors like population density, the directness of route, traffic speed and the aesthetics of the built environment can all play a role in how walkable a community is (Speck, 2012). Recent studies have shown that walkability is something people are interested in although land development laws are not favorable to building walkable urban areas (Hack, 2013).

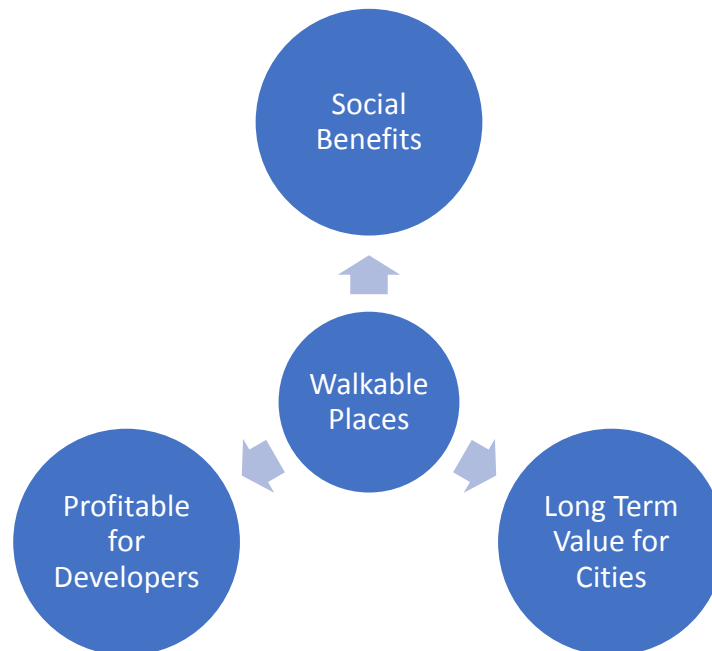
Walkability has been linked not only to positive social and environmental outcomes but to economic ones as well. Walkable areas have the best financial outcomes when clustered together. Connections to transit are important as are providing amenities that make walking safe, comfortable, and interesting. The higher the population density the more people will be within walking distance of local businesses (Holtzclaw, 1991). Studies that have shown a link to higher rents and building values should be of interest to both property developers and cities (Leinberger & Alfonzo, 2012). Property developers are interested in stable investments while city governments are interested in the same thing because a new development can become a community asset or liability depending on how well it performs financially over time.

## Chapter 3 - RESEARCH APPROACH

### Theoretical Framework

The theoretical framework as shown in Figure 3.1 is based on the idea that walkable places can benefit developers, city governments, and society at large. Social benefits include more exercise and a greater amount of social capital. Walking is the most common form of exercise so people who live in walkable places get more exercise which leads to positive health outcomes. These places can also have emotional benefits. Humans are social animals and walkable areas can help create more fine-grained social interaction so that people get to know their neighbors and have chance encounters that add to the social capital of the community (Easton & Owen, 2009).

**Figure 3.1 Theoretical Framework**



*The theoretical framework of walkable places includes financial, and social benefits*

Walkable areas have fiscal benefits because they are profitable for the developers who build them. This is because not as much land is used for parking in walkable areas so more money can be made on rent vs. parking facilities that do not generate as much income. Walkable places have long term benefits for a city government too because the theory is they will generate

more taxes per unit of land and they will maintain their value better over time, becoming a community asset vs. a liability (Forsyth, 2015).

Although it is not a focus of this study, it is worth noting that walkable places have other benefits besides the financial and social. Walkable places are good for the environment because they consume fewer resources. Walkable places have higher population densities which means that less land is needed for people and more land can be used for farming and natural resources. There are also fewer carbon emissions in walkable places because people take fewer trips in their cars vs. people who live in car-centric cities (Morris, 2009). In addition, walkable places are usually more aesthetically pleasing than non-walkable places because they are designed at the human scale.

## **Type of Research & Methodology**

### **Research Question**

The research question asks if walkability has an impact on property values in Omaha, NE across different land uses and if so, is the correlation is positive or negative?

### **Hypothesis**

The hypothesis of the study is that walkability has a positive correlation to economic values across three different land uses: single-family houses, apartments, and restaurants. The value of properties is hypothesized to be less in car-centric parts of Omaha because people in these areas would not value walking because driving is very easy in these areas. But since recent national surveys have shown 2/3 of people would prefer living in a walkable area, this should be expressed in the increased value of properties in more walkable parts of the city (Saelens & Sallis, 2002; National Association of Realtors, 2011).

### **Methodology**

This study is a cross-sectional study because it analyzes data taken from a population, at a specific point in time. The study seeks to identify a correlation between property values and walkability in Omaha, NE. The population being studied are single-family houses, apartments, and restaurants from the year 2016. Property values are the key exploratory variable for the correlation analysis while walkability is the independent variable being analyzed to see if it affects values.

The study uses two different measures of value: the value per square foot of a given parcel and the total value. The value per square foot is calculated by taking the total land value plus building value divided by the size of the parcel. The total value is the value of the land plus building(s) and does not consider the size of the parcel.

### **Study area and sampling frame**

The unit of analysis for the study is the parcel. A database of parcels from the Douglas, County, NE GIS Department was used. The database has 202,977 parcels but not all of them were within the study area, as some were outside Omaha's city limits. Douglas County's database includes land use types which made it possible to select samples based on land use. Samples of single-family houses, apartments, and restaurants were made using a selection by attributes on the parcel database in ArcGIS. A sample calculator was used to determine how many sample points would be needed to achieve a confidence level of 95% for each land use (Survey System, 2017). The land uses were narrowed down further by their characteristics so that an apple to apples comparison could be made. Selections were made using a random selection tool in ArcGIS (Buja, 2012).

During the course of analysis, it was discovered that the walkability of parcels varied significantly from the eastern to the western part of the city, so the city was divided into east and west along 72<sup>nd</sup> Street. This street roughly divides the pre-World War II higher density development pattern in the east from the post-World War II lower density development pattern in the western part of the city. Two polygons were drawn in GIS, 'east' was given the number 1 and 'west' was given the number 2. These numbers were joined to each parcel in the study using the join by spatial location tool in ArcGIS and the samples extracted into separate groups by their east – west variable.

The selection for single-family houses in Omaha returned 177,339 parcels classified as different types of single-family houses in Douglas County database. In order to eliminate unusual properties, the size of the houses was taken into consideration. Houses 500 square feet larger or smaller than the median house size in Omaha (1,860 square feet) were taken out of the group. Next, the value of the properties was taken into consideration, eliminating parcels worth less than \$50,000. The reasoning is that houses at the extreme lower end of the value spectrum may be abandoned. Finally, the size of lots was controlled to eliminate single-family houses on lots greater than .5 acres. The intent of the study is to include urban parcels not ex-urban style large

lots. There were 37,947 parcels that met the criteria. A sample of these parcels were distributed evenly throughout the city with 263 east of 72<sup>nd</sup> Street and 276 west of 72<sup>nd</sup> Street.

A selection of apartments was made for a group of apartments three stories high or less. This was thought to be a more homogeneous group and would enable better comparisons across the apartment land use. A random sample of this group provided 308 apartments out of 1218 in Douglas County database, 210 of the samples were from east of 72<sup>nd</sup> Street while 98 samples came from west of 72<sup>nd</sup> Street. There were fewer samples west of 72<sup>nd</sup> Street which makes sense because, there are larger apartment complexes in the western part of the city that have multiple buildings on a single parcel. This results in fewer samples in the western part of the city but more apartment buildings per parcel.

A selection of restaurants was made using the description of the parcel in the Douglas County GIS database. This resulted in 175 records. According to the 2012 US Economic Census there were 382 full service restaurants and 362 limited service restaurants in Omaha. Considering the smaller number of restaurants, all 175 of the Douglas County records were used as samples. By examining the parcels on the map, they were distributed throughout the city with 107 east of 72<sup>nd</sup> Street and 67 west of 72<sup>nd</sup> Street.

## **Methods**

A three-step data analysis workflow was used to evaluate the hypothesis. In the first step, walkability was measured through the WalkScore rating system. The second step was finding the property values using the City of Omaha Tax Assessor records. Third, the strength of the correlation between walkability and property value was gauged using Pearson's correlation coefficient.

## **Method #1: Measure Walkability**

Walkscores are a composite score from 0-100. WalkScores were recorded by looking up each parcel's address on walkscore.com and adding the information to a new integer field in the parcel data set in ArcGIS. WalkScore has some limitations on the micro-level but the advantage is that the scores are publicly available on the web and can be used as a common measure by other researchers.

WalkScore provides a walkability measure of any address in the United States using its patented scoring system. This system analyzes walking routes to nearby amenities like retail destinations, schools, and parks. Points are awarded based on the distance to each amenity. A retail store, for example within a 5-minute walk (.25 miles) of an address is given the most points while stores that are further away are given fewer points with the idea that fewer people would walk to a destination that is far vs. one that is close. A decay function is used to account for this, with no points given after a 30-minute walk (2 miles). WalkScore takes into account other factors that are positively associated with walking including population density, block length, and intersection density (WalkScore, 2017). A summary of WalkScore's variables are shown in Table 3.1.

**Table 3.1 WalkScore Variables**

Variable	Unit Measured	Source of Data	Type of Variable	Range
Average Block Length	Meters	Open Street Map	Continuous	0 - infinite
Intersection Density	Intersections per square mile	Open Street Map	Continuous	0- infinite
Population Density	Households per acre	US Census Block Groups	Discrete, unbounded	0 - infinite
Errands	Number within walking distance	Google, Localeze	Continuous, bounded	0-100
Culture	Number within walking distance	Google	Continuous, bounded	0-100
Grocery	Number within walking distance	Google, Localeze	Continuous, bounded	0-100
Park	Number within walking distance	Google	Continuous, bounded	0-100
Dining and Drinking	Number within walking distance	Google, Localeze	Continuous, bounded	0-100
School	Number within walking distance	Education.com	Continuous, bounded	0-100
Shopping	Number within walking distance	Google, Localeze	Continuous, bounded	0-100

*This table shows the variables used to generate a WalkScore.*

## Method #2: Measure Property Values

Property values were used to measure the value of each parcel in the study. Some scholars may criticize the use of property values based on assessor’s data as county appraisers may be influenced by politics or the values may not keep up with recent sales. These are valid points; however, the availability of the data is also a consideration, and in Omaha properties are assessed using professional mass appraisal methods which take into account recent comparable sales, and in the case of businesses, the earning potential of a property. Another advantage to using property values from the Douglas County Assessor is that the data is already joined with parcels in a GIS layer that includes attributes like category of land use, land area, and the property owner (Douglas County Assessor, 2017).

Table 3.2 shows the property values that are included in the study: building value and land value which are added to get the total property value, and value per square foot which is generated from the total property value divided by the property’s size.

**Table 3.2 Measurements of Property Value**

Measure	Unit Measured	Source of Data	Type of Variable	Range
Building	Total	Douglas County, NE Assessor	Continuous	0 - infinite
Land	Total	Douglas County, NE Assessor	Continuous	0 - infinite
Value per SF	Square Foot	Calculated from Assessor Records	Continuous	0 - infinite

*Data sources for property values*

The value per square foot serves as a control so that as building types change, there is a common unit of measurement. The value each property should be important to local government who has to provide infrastructure like roads and sewers and services like police, fire, and schools over the lifecycle of the property.



### **Method#3: Correlations between Walkability and Property Value**

Each measure of property value was compared with its WalkScore to determine if there was a correlation between the two variables. The Pearson correlation coefficient, known as the Pearson R test, was used to measure the strength and direction of a linear relationship between two variables. The correlation coefficient ( $R$ ) value can range between negative 1.00 and a positive 1.00. A perfectly positive relationship is one where the  $r$  value = 1. A perfectly negative relationship is where the  $R$  value is -1.

A Pearson's Correlation test and a linear regression model was done on each land use: single-family houses, apartments, and restaurants. Models were done using two different measures of land value, total value and value per square foot. The models were broken out further into sample groups east and west of 72<sup>nd</sup> street. Stastix software was used to perform a Pearson's correlation coefficient test and a linear regression test for each group. Microsoft Excel was used to create the linear regression charts as shown in this report.

The Pearson's correlation coefficient test was used to describe the strength of correlation between parcel value and WalkScore for each group. The strength of the positive and negative correlation was evaluated using the Evans (1996) guidelines. The following would indicate strength of correlation for the absolute value of  $R$ .

0.00-.19 "very weak"

0.20-.39 "weak"

0.40-.59 "moderate"

0.60-.79 "strong"

0.80-1.0 "very strong"

A linear regression model was done for each group. A linear regression model attempts to predict the direction of effect one variable has on another. The model has a set of points plotted along a  $x$  and  $y$  axis, WalkScore along the  $x$  axis and parcel value along the  $y$  axis. Points are plotted on the chart at the intersection of their WalkScore and corresponding parcel value. A line is created through these points so that half of the points are below the line and half of the points are above the line. The line is described by the formula  $y = mx + b$ . Where  $y$  is the predicted value,  $m$  is the beta coefficient or slope of the line,  $x$  is an independent variable, and  $b$  is the  $y$  intercept, where the line crosses the  $y$  axis (Glen, 2017).

## Chapter 4 - FINDINGS

The following is a summary of the findings comparing WalkScore to parcel values for the three land uses in the study: single-family houses, apartments, and restaurants. Results are shown for each land use, broken out by how parcel value was measured (total value or square foot) and which group of samples (east or west of 72<sup>nd</sup> street). Descriptive statistics are shown for each group with the high, low, and average WalkScores and parcel values. Results from a Pearson's correlation coefficient test and linear regression model are shown for each group.

The equation  $y=mx+b$  is used to predict a rise or fall in property value (Y) when the WalkScore (X) goes up by one unit. If the beta coefficient, b is positive it would indicate that WalkScore has a positive effect on parcel value, and if it is negative, it would indicate a negative effect on parcel value.  $R^2$  measures the ratio of explained variation to the total variation in the model. This can be used to describe how much total variance the model explains and how well the data fits the model

A quantitative comparison follows the results which is used to show differences between the groups. Finally, a qualitative comparison examines some factors that may not have been captured with the statistics like the site layout and relationship of the buildings to their available walking paths.

## Single-Family Parcel Value per Square Foot East of 72<sup>nd</sup> Street

**Table 4.1 Descriptive Statistics - Single-Family Value per square foot East of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Parcel Value per SF	258	\$18.60	\$1.55	\$56.34
WalkScore	258	53.93	1	87

Table 4.1 provides descriptive statistics for the sample of single-family houses and their WalkScores east of 72<sup>nd</sup> Street where the value is measured per square foot of parcel. The average WalkScore for this group was 53.93. The low WalkScore was 1 while the highest WalkScore was 87. Of the 258 parcels sampled, the mean value per square foot was \$18.60. The lowest parcel value per square foot for this group was \$1.55 and the highest was \$56.34.

**Table 4.2 Pearson’s Correlation Coefficient – Single-Family Parcel Value per square foot East of 72nd Street**

Direction of correlation	positive
Correlation Coefficient ( <i>R</i> )	0.357***
p-value	<0.000

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

The Pearson’s correlation coefficient test between WalkScore and property value per square foot east of 72<sup>nd</sup> street showed a weak positive correlation as shown in Table 4.2. The results of this test were statistically significant as the p-value was less than 0.001.

**Table 4.3 Linear Regression - Single-Family Parcel Value per square foot East of 72nd Street**

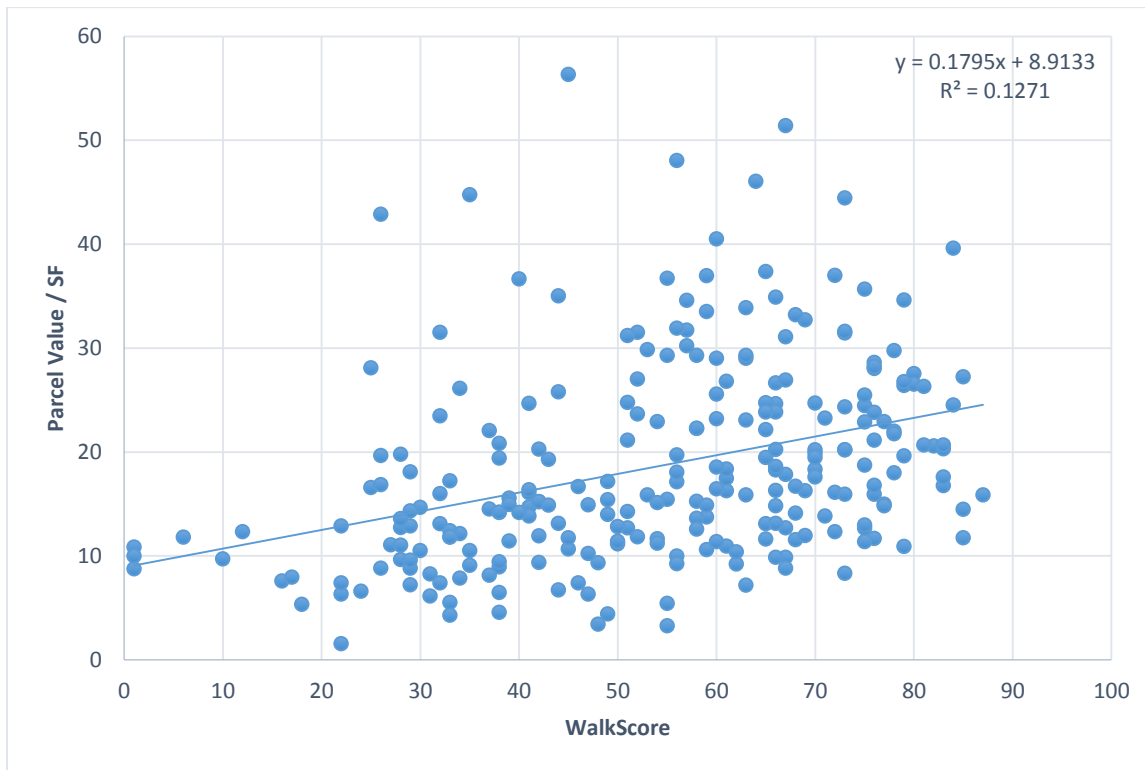
Direction of correlation	positive
Beta Coefficient	0.1795
P-value	<.0000
F-value	37.29
R <sup>2</sup>	0.1271

*X = WalkScore (independent variable)*

*Y = Parcel value per square foot east of 72nd Street (dependent variable)*

Table 4.3 shows the results of a bivariate linear regression between WalkScore and property value per square foot east of 72<sup>nd</sup> street. This test showed a positive beta coefficient or slope of the line. For every change in WalkScore, the value per square foot would be predicted to rise .1795 in value. The p-value of the test was less than .05, meaning the results are significant. R<sup>2</sup> was 0.127, meaning that the bivariate regression model can explain 12.7% of the total variance in the data.

**Figure 4.1 Linear Regression - Single-Family Value per square foot East of 72nd Street**



*The figure shows the parcel value per square foot on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

The linear regression chart in Figure 4.1 shows the WalkScore on the x axis and the parcel value per square foot on the y axis. The line is sloping upward which indicates a positive correlation between the variables. According to the model, a parcel would be predicted to gain nearly 18 cents per square foot in value for every one point increase in WalkScore.

## Single-Family Parcel Values East of 72nd Street

**Table 4.4 Descriptive Statistics - Single-Family Parcel Values East of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	258	\$136,478	\$50,800	\$385,000
WalkScore	258	53.93	1	87

Table 4.4 provides descriptive statistics for the parcel values of single-family houses east of 72<sup>nd</sup> Street. The WalkScore statistics are the same as the group that compared parcel value per square foot, but in this comparison total parcel value is being used instead of the parcel value per square foot. The average parcel's value was \$135,510.89. The lowest parcel value was \$50,800 and the highest was \$385,000.

**Table 4.5 Pearson's Correlation Coefficient - Single-Family Parcel Values East of 72nd Street**

Direction of correlation	positive
Correlation Coefficient ( <i>R</i> )	0.1040
p-value	0.0956

*Significance: \*\*\* $p \leq .001$ , \*\* $p \leq .01$ , \* $p \leq .05$ , + $p \leq .10$*

Table 4.5 shows the direction of correlation between WalkScore and parcel value was in a very weak positive direction, but the p-value of the correlation between was higher than 0.05, meaning the results are not significant at the 0.05 level (marginally significant at the 0.1 level) and the correlation could be due to chance.

**Table 4.6 Linear Regression - Single-Family Parcel Values East of 72nd Street**

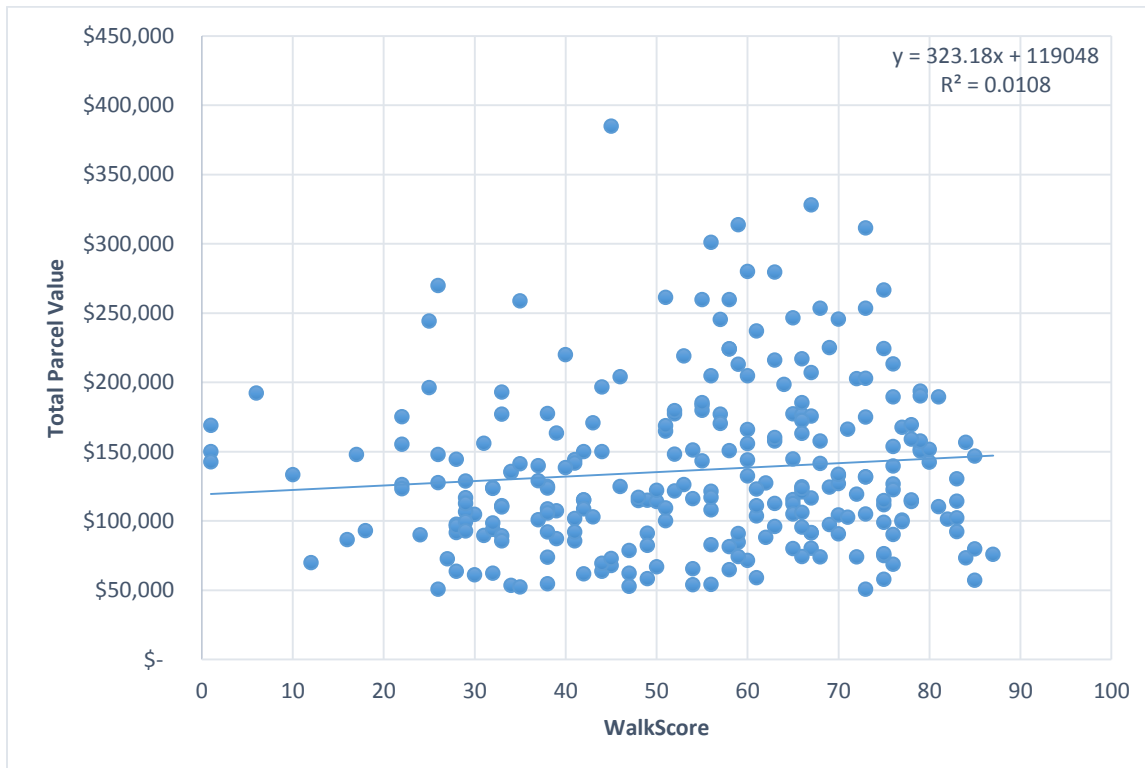
Direction of correlation	positive
Beta Coefficient	323.177
P-value	0.0956
F-value	2.80
R <sup>2</sup>	0.0108

*X = WalkScore (independent variable)*

*Y = Total parcel value east of 72nd Street (dependent variable)*

The bivariate linear regression as shown on Table 4.6 revealed a very weak correlation between WalkScore and parcel value. The p-value was greater than 0.05 meaning the results are not significant.  $R^2$  was 0.0108 meaning that the bivariate regression model can explain only 1.08% of the total variance in the data.

**Figure 4.2 Linear Regression - Single-Family Parcel Values East of 72nd Street**



*The figure shows the total parcel value on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.2 shows the total value of the parcel for single-family houses east of 72<sup>nd</sup> Street. The WalkScore is on the x axis and their total value of parcels are on the y axis. The line is sloping slightly upward, but the p-value was not high enough to be significant.

## Single-Family Parcel Value per Square Foot West of 72<sup>nd</sup> Street

**Table 4.7 Descriptive Statistics - Single-Family Value per Square Foot West of 72<sup>nd</sup> Street**

Variable	N	Mean	Minimum	Maximum
Parcel Value per SF	270	\$21.07	\$6.67	\$61.88
WalkScore	270	29.92	0	73

Table 4.7 provides descriptive statistics for the sample of single family houses west of 72<sup>nd</sup> Street when measured as value per square foot. The mean or average WalkScore for this group was 29.22. The low WalkScore was 0 while the highest WalkScore was 73. Of the 270 parcels sampled, the mean value per square foot was \$21.07. The lowest parcel value per square foot for this group was \$6.67 and the highest was \$61.88 per square foot.

**Table 4.8 Pearson's Correlation Coefficient - Single-Family Value per Square Foot West of 72<sup>nd</sup> Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.2346***
p-value	0.0001

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.8 shows a weak negative correlation between WalkScore and the parcel value per square foot west of 72<sup>nd</sup> street. The results of this test were statistically significant as the p-value was less than 0.001.

**Table 4.9 Linear Regression - Single-Family Value per Square Foot West of 72<sup>nd</sup> Street**

Direction of correlation	negative
Beta Coefficient	-0.09817
P-value	0.0001
F-value	15.61
R <sup>2</sup>	0.0551

*X = WalkScore (independent variable)*

*Y = Parcel value per square foot west of 72<sup>nd</sup> Street (dependent variable)*

Table 4.9 shows a negative beta coefficient or slope of the line. For every one-point change in WalkScore, the value per square foot would be predicted to fall .09817 in value. The p-value of the test was less than .05, meaning the results are significant. R<sup>2</sup> was 0.0551 meaning that the bivariate regression model can explain 5.5% of the total variance in the data.

**Figure 4.3 Linear Regression - Single-Family Value per Square Foot West of 72nd Street**



*The figure shows the parcel value per square foot on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.3 shows the value of parcel per square foot for single-family houses west of 72<sup>nd</sup> Street. The WalkScore is on the x axis and the parcel value per square foot of parcels are on the y axis. The line is sloping downward which indicates a negative correlation between the variables. According to the model, a parcel would be predicted to lose nearly ten cents of value per square foot for every one point gain in WalkScore.



## Single-Family Parcel Values West of 72<sup>nd</sup> Street

**Table 4.10 Descriptive Statistics - Single-Family Parcel Values West of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	270	\$209,965.19	\$87,500.00	\$499,800.00
WalkScore	270	29.92	0	73

*Single-Family parcels west of 72<sup>nd</sup> Street and their WalkScores*

Table 4.10 shows summary statistics for parcels with single-family houses west of 72<sup>nd</sup> Street in Omaha, NE. The average parcel value was \$209,965.19, the lowest value parcel value of the group was \$87,5000 while the highest was \$499,800.

**Table 4.11 Pearson's Correlation Coefficient - Single-Family Parcel Values West of 72nd Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.1980**
p-value	0.0011

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.11 shows a negative linear association between the variables parcel value and WalkScore on single-family parcels west of 72<sup>nd</sup> Street. The correlation was found to be weak and is significant because the p-value is less than .05.

**Table 4.12 Linear Regression Single-Family Parcel Values West of 72nd Street**

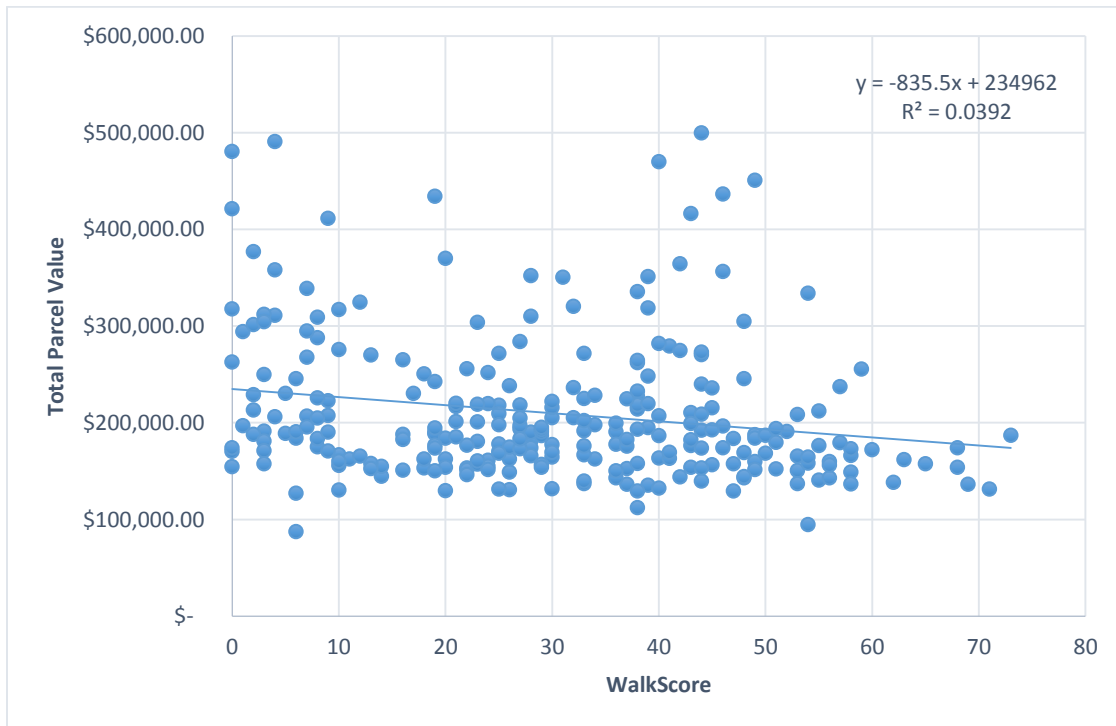
Direction of correlation	negative
Beta Coefficient	-835.496
P-value	0.0011
F-value	10.94
R <sup>2</sup>	0.0392

*X = WalkScore (independent variable)*

*Y = Total parcel values west of 72nd Street (dependent variable)*

Table 4.12 shows a negative beta coefficient or slope of the line. For every one-point increase in WalkScore, the value would be predicted to fall \$835.49 in value. The p-value of the test was less than .05, meaning the results are significant. R<sup>2</sup> was 0.0392 meaning that the bivariate regression model can explain 3.9% of the total variance in the data.

**Figure 4.4 Linear Regression - Single-Family Parcel Values West of 72nd Street**



*The figure shows the total parcel value on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.4 shows the total value of the parcel for single-family houses west of 72<sup>nd</sup> Street. The WalkScore is on the x axis and their total value of parcels are on the y axis. The line is sloping downward which indicates a negative correlation between the variables. As the WalkScore increases, the parcel value is predicted to fall.

## Apartment Parcel Values per Square Foot East of 72<sup>nd</sup> Street

**Table 4.13 Descriptive Statistics - Apartment Parcel Value per Square Foot East of 72<sup>nd</sup> Street**

Variable	N	Mean	Minimum	Maximum
Parcel Value per SF	210	\$31.56	\$1.41	\$208.49
WalkScore	210	67.35	15	92

Table 4.13 shows descriptive statistics for the sample of apartments east of 72<sup>nd</sup> street where the value was measured per square foot. This means the value of the building and land divided by the parcel size. There was a wide range of values per square foot. The lowest was \$1.41, the highest was \$208.49 per square foot, while the average was \$31.56.

**Table 4.14 Pearson’s Correlation Coefficient – Apartment Parcel Value per Square Foot East of 72<sup>nd</sup> Street**

Direction of correlation	positive
Correlation Coefficient ( <i>R</i> )	0.4439***
p-value	0.0000

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.14 shows a moderate positive correlation between the variables at .4439. This finding is significant because the p-value was lower than .001, meaning the linear association between parcel value per square foot and WalkScore is significant.

**Table 4.15 Linear Regression - Apartment Parcel Value per Square Foot East of 72<sup>nd</sup> Street**

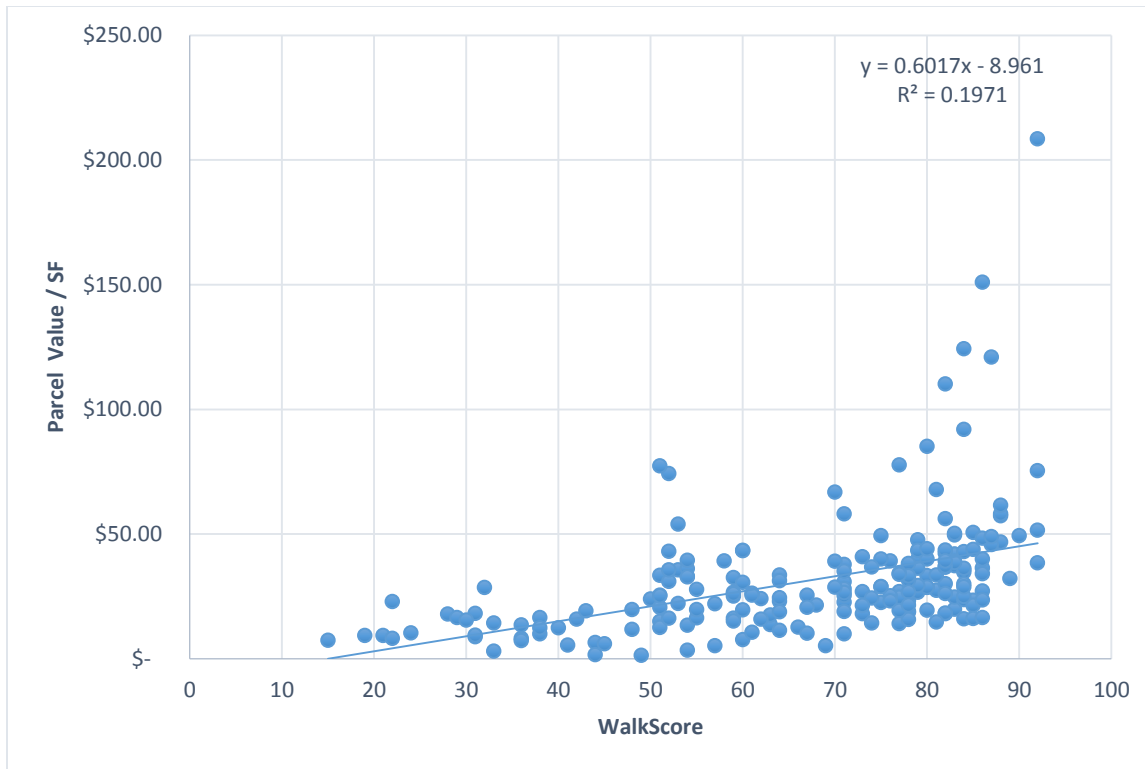
Direction of correlation	positive
Beta Coefficient	0.6016
P-value	0.0000
F-value	51.06
R <sup>2</sup>	0.1971

*X = WalkScore (independent variable)*

*Y = Parcel value per square foot east of 72<sup>nd</sup> Street (dependent variable)*

Table 4.15 reveals a positive correlation between WalkScore and parcel value. The beta coefficient of this test is 0.6016. This represents a sixty cent positive change in parcel value per square foot with each increase in WalkScore point. The result is significant because the p-value is less than .0001.  $R^2$  was 0.1971 meaning that the bivariate regression model can explain 19.7% of the total variance in the data.

**Figure 4.5 Linear Regression - Apartment Value per Square Foot East of 72nd Street**



*The figure shows the parcel value per square foot on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.5 shows parcel values per square foot and their corresponding WalkScores plotted on a graph with a line of regression drawn through the points to show the best fitting line to the data. The beta coefficient, or slope of this line is a positive .6016 which means that for every one-point increase in WalkScore the parcel value per square foot is predicted to rise .60 cents.

## Apartment Parcel Values East of 72<sup>nd</sup> Street

**Table 4.16 Descriptive Statistics - Apartment Parcel Values East of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	210	\$695,041.3	\$50,000	\$20,910,300
WalkScore	210	67.35	15	92

Table 4.16 shows descriptive statistics for the sample of apartments east of 72<sup>nd</sup> Street where the value is measured as the total value which includes the building and land. The highest value apartment east of 72<sup>nd</sup> Street is located in the Aksarben Village mixed-use development at 2225 South 64<sup>th</sup> Plaza. Its total value was \$20,910,300 with a WalkScore of 70. The lowest parcel value of the group was \$50,000. The average WalkScore of the group was 67.35.

**Table 4.17 Pearson's Correlation Coefficient - Apartment Parcel Values East of 72nd Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.0819
p-value	0.2374

*Significance: \*\*\* $p \leq .001$ , \*\* $p \leq .01$ , \* $p \leq .05$ , + $p \leq .10$*

Table 4.17 shows showed a very weak negative correlation between the variables. However, the p-value was higher than 0.05, meaning the results are not significant and the correlation could be due to chance.

**Table 4.18 Linear Regression - Apartment Parcel Values East of 72nd Street**

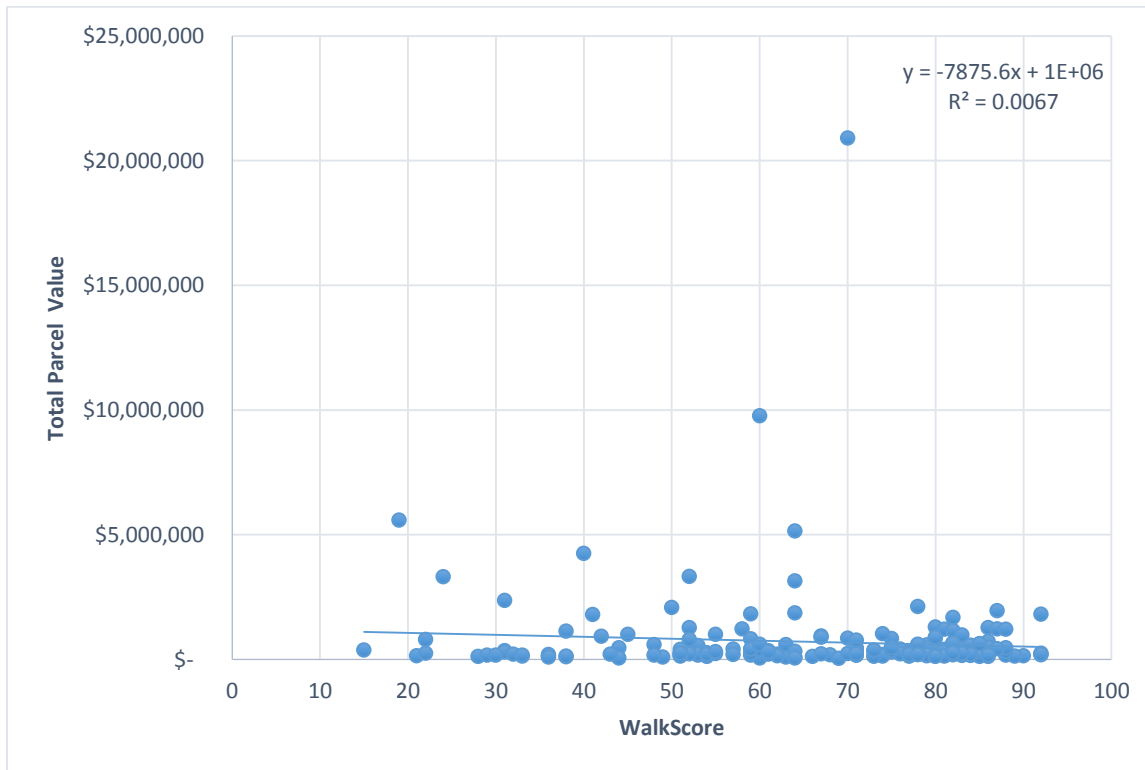
Direction of correlation	negative
Beta Coefficient	-7875.55
P-value	0.2374
F-value	1.40
R <sup>2</sup>	0.0067

*X = WalkScore (independent variable)*

*Y = Total parcel value east of 72nd Street (dependent variable)*

Table 4.18 reveals a negative correlation between WalkScore and parcel value, but the p-value was a high .23 which is greater than the 0.05 cut-off for significant results, meaning it is not significant.  $R^2$  was 0.0067 meaning that the bivariate regression model can explain less than 1% of the total variance in the data.

**Figure 4.6 Linear Regression - Apartment Parcel Values East of 72nd Street**



*The figure shows the total parcel value on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.6 shows the total value of the parcels for a sample of apartments east of 72<sup>nd</sup> Street. The WalkScore is on the x axis and the total value of parcels are on the y axis. The line is sloping slightly downward, but the results of this regression are not significant because of the high p-value.

## Apartment Parcel Values per Square Foot West of 72<sup>nd</sup> Street

**Table 4.19 Descriptive Statistics - Apartment Value per Square Foot West of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Parcel Value per SF	96	\$21.81	\$2.34	\$44.34
WalkScore	96	46.38	11	79

Table 4.19 shows descriptive statistics for the sample of apartments west of 72<sup>nd</sup> Street where the value is measured per square foot. The average WalkScore of this group was 46.38 while the average value was \$21.81 per square foot. There was a wide range of values per square foot with the lowest value at \$2.34 and the highest at \$44.34 per square foot.

**Table 4.20 Pearson's Correlation Coefficient - Apartment Value per Square Foot West of 72nd Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.2006*
p-value	0.0500

*Significance: \*\*\* $p \leq .001$ , \*\* $p \leq .01$ , \* $p \leq .05$ , + $p \leq .10$*

A Pearson's correlation coefficient test was run on the sample of WalkScores and apartment values west of 72<sup>nd</sup> street with the value measured per square foot. Table 4.20 shows the direction of correlation was found to be weak and negative. The result is border-line significant because the p-value was 0.05.

**Table 4.21 Linear Regression - Apartment Value per Square Foot West of 72nd Street**

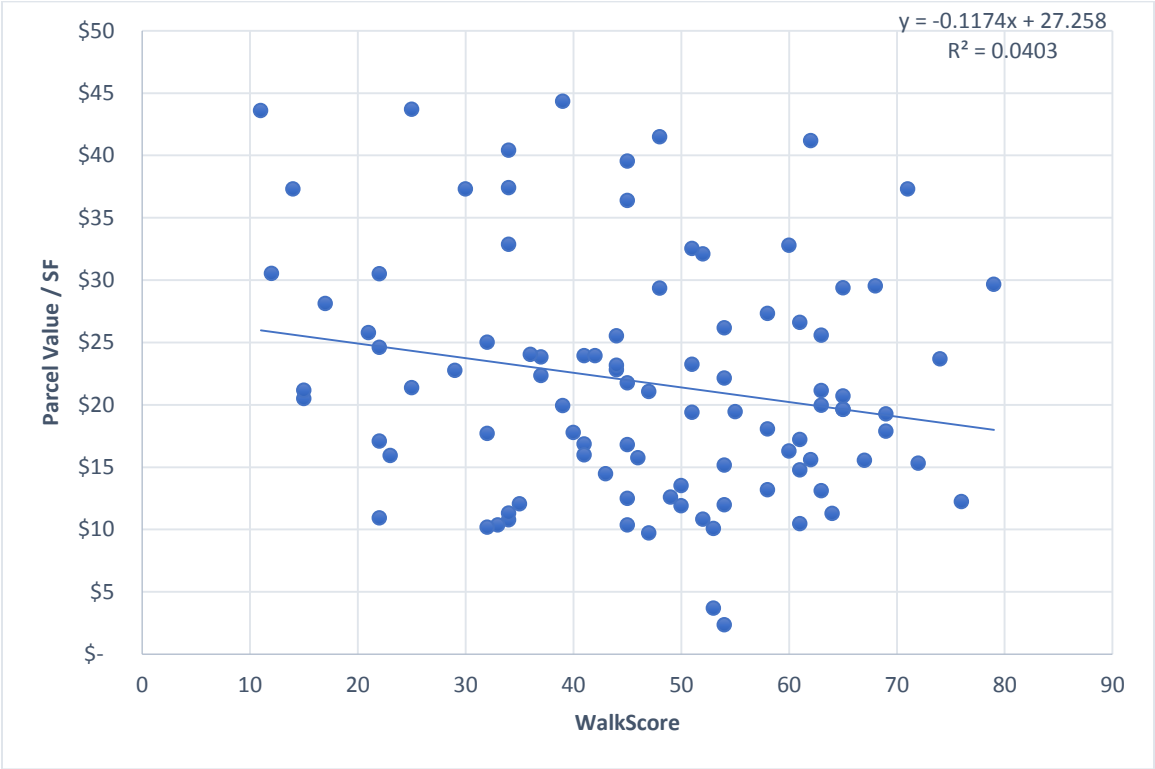
Direction of correlation	negative
Beta Coefficient	-0.11740
P-value	0.0500
F-value	3.94
R <sup>2</sup>	0.0403

*X = WalkScore (independent variable)*

*Y = Parcel value per square foot west of 72nd Street (dependent variable)*

A bivariate linear regression model was created to determine if the values per square foot could be correlated to their WalkScores. Table 4.21 shows a -0.1174 Beta coefficient. The result is border-line significant. R<sup>2</sup> was 0.0403 meaning that the bivariate regression model can explain less than 4.0% of the total variance in the data.

**Figure 4.7 Linear Regression - Apartment Value per Square Foot West of 72nd Street**



*The figure shows the parcel value per square foot on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.7 shows apartment values per square foot vs. WalkScore for properties west of 72<sup>nd</sup> Street. The line of regression is meant to predict the value per square foot based on WalkScore. There is a negative slope to the line but the points are widely dispersed, making a prediction of value difficult to predict.



## Apartment Parcel Values West of 72<sup>nd</sup> Street

**Table 4.22 Descriptive Statistics - Apartment Parcel Values West of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	96	\$5,823,248	\$177,900	\$26,480,900
WalkScore	96	46.38	11	79

Table 4.22 shows apartment values west of 72<sup>nd</sup> Street where the value includes land and buildings on the parcel. The average value was over \$5.8 million while the lowest value parcel was \$177,900 and the highest was \$26.4 million.

**Table 4.23 Pearson’s Correlation Coefficient - Apartment Parcel Values West of 72nd Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.0235
p-value	0.8201

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.23 shows the results of a Pearson’s correlation coefficient test that was run on a sample of WalkScores and apartment values west of 72<sup>nd</sup> street. The direction of correlation was found to be a very weak negative correlation. However, the result is not significant because of the high p-value.

**Table 4.24 Linear Regression – Apartment Parcel Values West of 72nd Street**

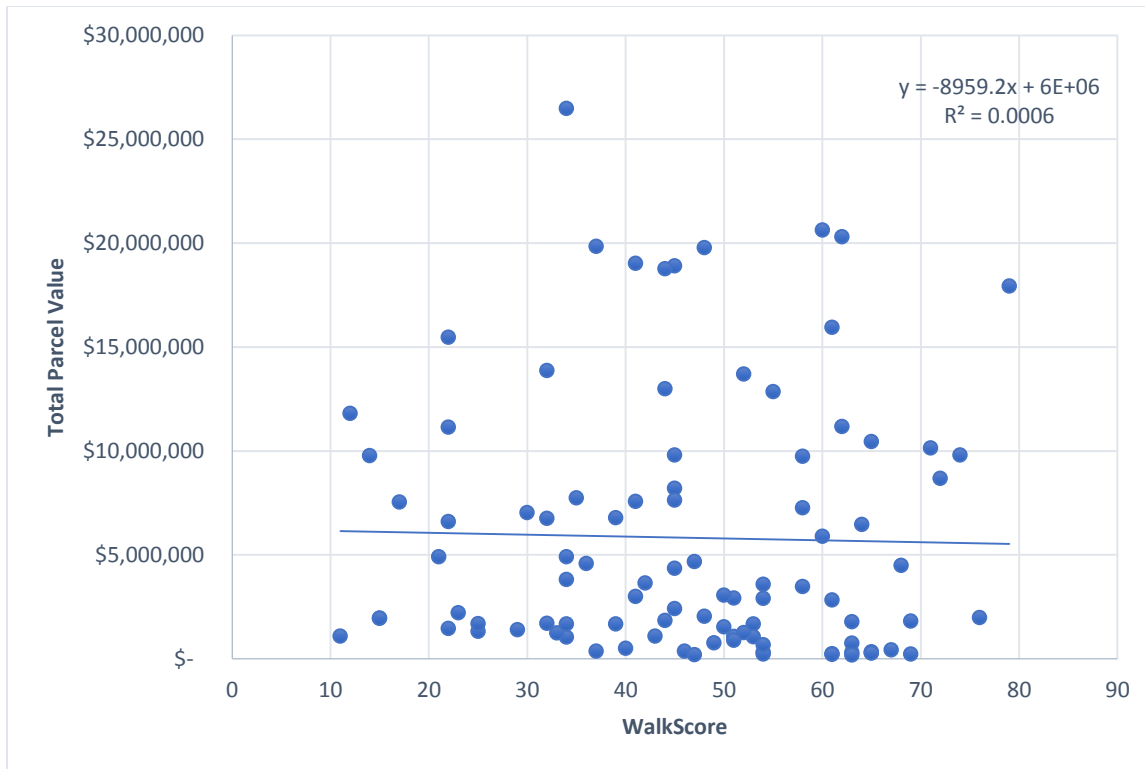
Direction of correlation	negative
Beta Coefficient	-8959.22
P-value	0.8201
F-value	0.05
R <sup>2</sup>	0.0006

*X = WalkScore (independent variable)*

*Y = Total parcel value west of 72nd Street (dependent variable)*

A bivariate linear regression model was created to determine if the values are correlated to WalkScores. Table 4.24 shows the resulting beta coefficient as -8959.22. But with the high p-value the results are not statistically significant and could be due to chance.  $R^2$  was 0.0006 meaning that the bivariate regression model explains less than 1% of the total variance in the data.

**Figure 4.8 Linear Regression - Apartment Parcel Values West of 72nd Street**



*The figure shows the parcel values on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.8 is a graphic representation of the bivariate linear regression model shown above. The figure shows apartment values vs. WalkScore for properties west of 72<sup>nd</sup> Street. The points are widely distributed on the chart. West Omaha has high value apartment parcels with many over \$10 million total value. WalkScores also vary from low to high but with no apparent correlation to property values. The slope of the line is close to zero indicating no correlation between WalkScore and value of the parcels when measured as total value west of 72<sup>nd</sup> street.

## Restaurant Parcel Value per Square Foot East of 72<sup>nd</sup> Street

**Table 4.25 Descriptive Statistics - Restaurant Parcel Value per Square Foot East of 72<sup>nd</sup> Street**

Variable	N	Mean	Minimum	Maximum
Parcel Value per SF	107	\$25.53	\$3.14	\$191.23
WalkScore	107	68.91	13	93

Table 4.25 shows restaurant values east of 72<sup>nd</sup> Street where the value is measured as the value of the building and land divided by the lot size. The average value was \$25.53 per square foot while the lowest value parcel was \$3.14 and the highest was \$191.23 per square foot.

**Table 4.26 Pearson’s Correlation Coefficient – Restaurant Parcel Value per Square Foot East of 72<sup>nd</sup> Street**

Direction of correlation	Positive
Correlation Coefficient ( <i>R</i> )	0.3716***
p-value	0.0001

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.26 shows the results of a Pearson’s correlation coefficient test that was run on the sample of WalkScores and restaurant values east of 72<sup>nd</sup> street. The direction of correlation was found to be weak and positive. This result is significant because of the low p-value, meaning the result has a low probability that it is due to chance.

**Table 4.27 Linear Regression – Restaurant Parcel Value per Square Foot East of 72<sup>nd</sup> Street**

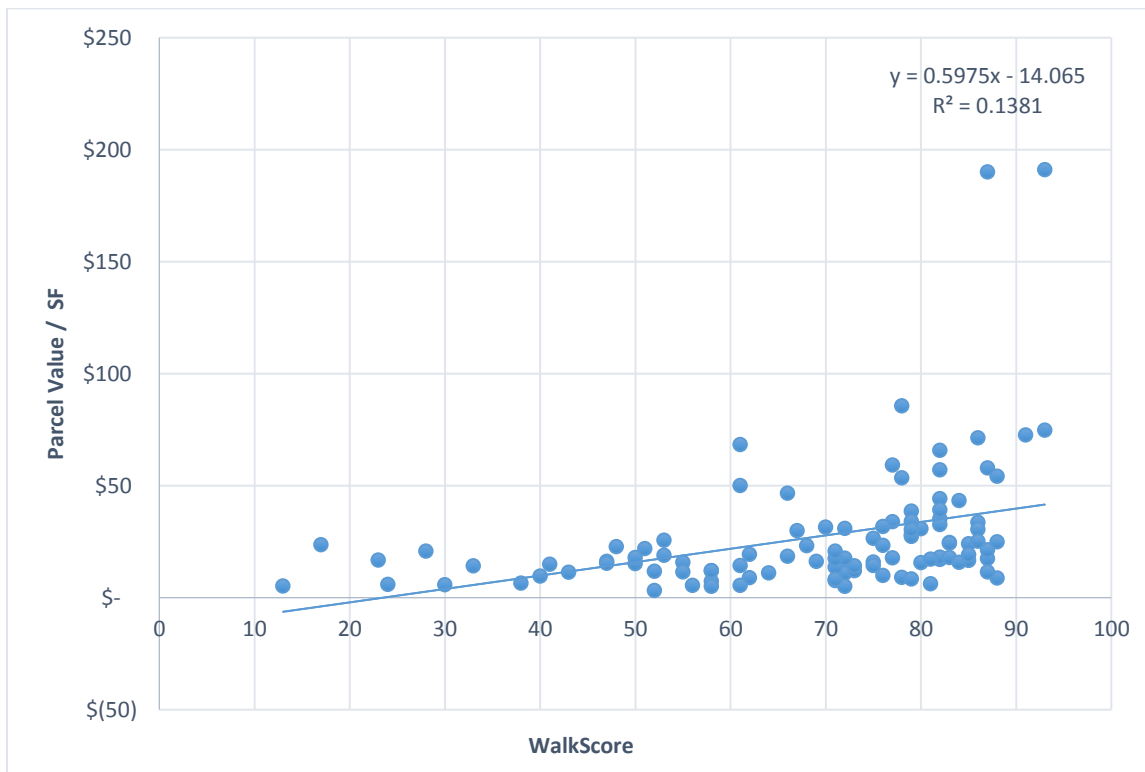
Direction of correlation	positive
Beta Coefficient	0.59749
P-value	0.0001
F-value	16.82
R <sup>2</sup>	0.1381

*X = WalkScore (independent variable)*

*Y = Parcel value per square foot east of 72<sup>nd</sup> Street (dependent variable)*

Table 4.27 shows the results of a linear regression test on the sample of restaurants east of 72<sup>nd</sup> street. The test reveals a positive correlation between WalkScore and parcel value per square foot. The p-value was less than 0.001 meaning the results can be considered significant. R<sup>2</sup> was 0.1381 meaning that the bivariate regression model explains 13.8% of the total variance in the data.

**Figure 4.9 Linear Regression - Restaurant Parcel Value per Square Foot East of 72nd Street**



*The figure shows the parcel value per square foot on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.9 shows the WalkScore on the x axis and the value per square foot of parcels on the y axis. The line is sloping upward which indicates a positive correlation between the variables. The beta coefficient of the equation is 0.5975. This implies that for every one-point increase in WalkScore, the value per square foot of a parcel is predicted to increase nearly sixty cents.

## Restaurant Parcel Values East of 72<sup>nd</sup> Street

**Table 4.28 Descriptive Statistics - Restaurant Parcel Values East of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	107	\$327,510.28	\$23,900	\$2,662,900
WalkScore	107	68.91	13	93

Table 4.28 shows restaurant values east of 72<sup>nd</sup> Street where the value is measured in total value of building and land on the parcel. The average value was \$327,510.28 while the lowest value parcel was \$23,900 and the highest was \$2,662,900. The average WalkScore of this group was 68.91.

**Table 4.29 Pearson's Correlation Coefficient - Restaurant Parcel Values East of 72nd Street**

Direction of correlation	positive
Correlation Coefficient ( <i>R</i> )	0.0418
p-value	0.6688

*Significance: \*\*\* $p \leq .001$ , \*\* $p \leq .01$ , \* $p \leq .05$ , + $p \leq .10$*

Table 4.29 shows the results of a Pearson's correlation coefficient test that was run on a sample of WalkScores and restaurant values east of 72<sup>nd</sup> street. The direction of correlation was found to be very weak positive. However, the result is not significant because of the high p-value, which was greater than the .05 cutoff for significance.

**Table 4.30 Linear Regression - Restaurant Parcel Values East of 72nd Street**

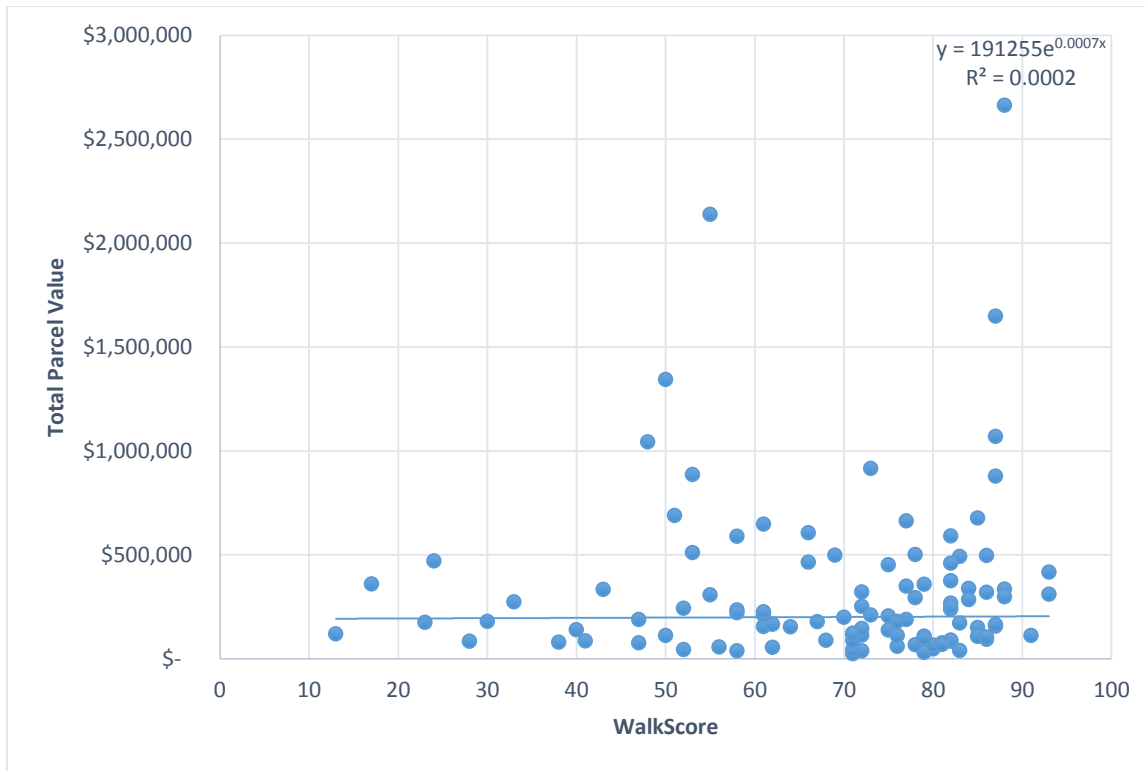
Direction of correlation	positive
Beta Coefficient	953.488
P-value	0.6688
F-value	0.18
R <sup>2</sup>	0.0018

*X = WalkScore (independent variable)*

*Y = Total parcel value east of 72nd Street (dependent variable)*

Table 4.30 shows the results of a bivariate linear regression test done on restaurant parcel values east of 72<sup>nd</sup> street. The test reveals a positive correlation between WalkScore and parcel value. However, the p-value was higher than .05 meaning the results are not significant. R<sup>2</sup> was 0.0018 meaning that the bivariate regression model explains less than 1% of the total variance in the data.

**Figure 4.10 Linear Regression - Restaurant Parcel Values East of 72nd Street**



*The figure shows the parcel value on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.10 shows the value of parcels for a sample of restaurants east of 72<sup>nd</sup> Street. The WalkScore is on the x axis and the value of parcels are on the y axis. The line is sloping flat which indicates no correlation between the variables. As the WalkScore changes, there is no corresponding predictable change in parcel value according to the model.

## Restaurant Parcel Value per Square Foot West of 72<sup>nd</sup> Street

**Table 4.31 Descriptive Statistics - Restaurant Parcel Value per Square Foot West of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	68	\$23.15	\$8.84	\$63.64
WalkScore	68	55.17	17	80

Table 4.31 shows restaurant values west of 72<sup>nd</sup> Street where the value is measured as value of the building and land divided by the lot size. The average value of this sample group was \$23.15 per square foot while the lowest value was \$8.84 and the highest was \$63.64.

**Table 4.32 Pearson's Correlation Coefficient - Restaurant Parcel Value per Square Foot West of 72nd Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.2485*
p-value	0.0410

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.32 shows the Pearson's correlation coefficient test that was run on a sample of WalkScores and restaurant values west of 72<sup>nd</sup> street, the direction of correlation was -0.2485 which is a weak negative result. The result is statistically significant because the p-value is 0.0410 which is less than 0.05 cutoff level for significance

**Table 4.33 Linear Regression - Restaurant Parcel Value per Square Foot West of 72nd Street**

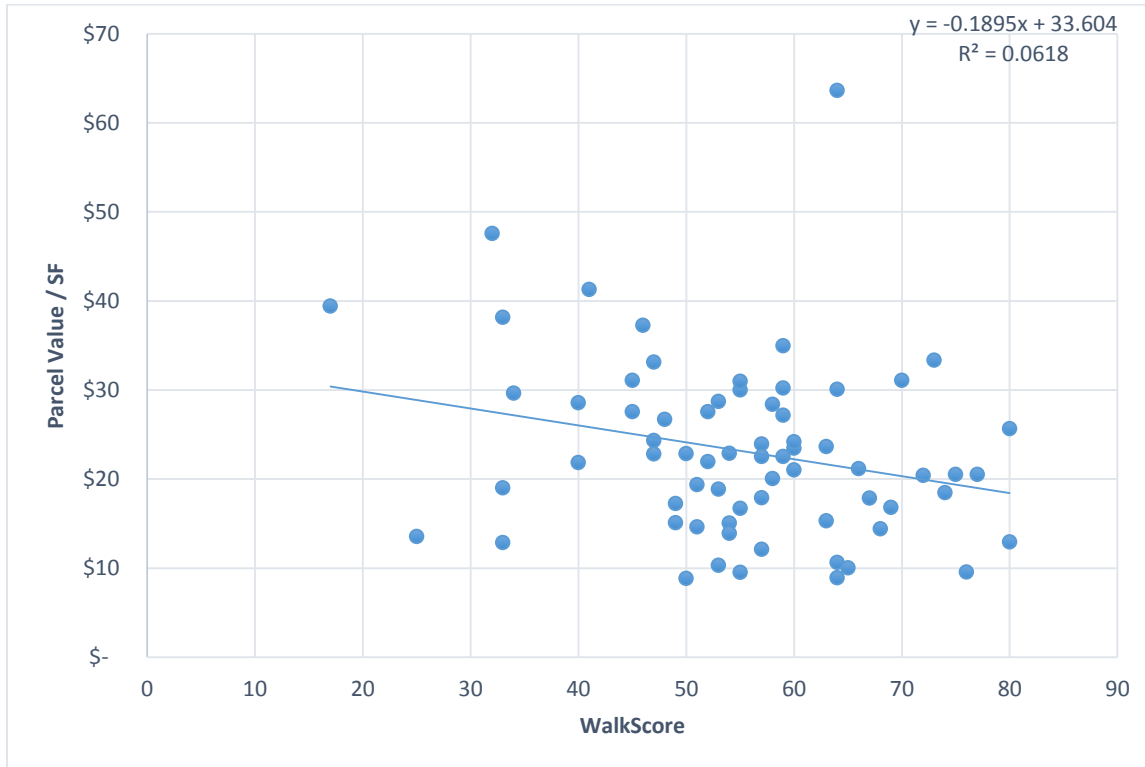
Direction of correlation	negative
Beta Coefficient	-0.18954
P-value	0.0410
F-value	4.35
R <sup>2</sup>	0.0618

*X = WalkScore (independent variable)*

*Y = Parcel value per square foot west of 72nd Street (dependent variable)*

Table 4.33 shows the results of a bivariate linear regression. The result also shows a negative correlation between WalkScore and parcel value and p-value was less than .05 meaning the results are significant.  $R^2$  was 0.0618 meaning that the bivariate regression model explains less than 6.1% of the total variance in the data.

**Figure 4.11 Linear Regression - Restaurant Parcel Value per Square Foot West of 72nd Street**



*The figure shows the parcel value per square foot on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.11 shows the value of parcels for a sample of restaurants west of 72<sup>nd</sup> Street. The WalkScore is on the x axis and the value per square foot is on the y axis. The line is sloping downward which indicates a negative correlation between the variables. As the WalkScore increases, the value would be predicted to decrease based on the model, however this result is suspect because of the high p-value so it cannot be considered statistically significant.



## Restaurant Parcel Values West of 72<sup>nd</sup> Street

**Table 4.34 Descriptive Statistics - Restaurant Parcel Values West of 72nd Street**

Variable	N	Mean	Minimum	Maximum
Total Parcel Value	68	\$1,181,883.82	\$102,900	\$3,157,900
WalkScore	68	55.17	17	80

Table 4.34 shows restaurant values west of 72<sup>nd</sup> Street where the value is measured as the total value of building plus the land. The average value of this sample group was \$1.1 million while the lowest value parcel was \$102,900 and the highest was \$3.1 million.

**Table 4.35 Pearson's Correlation Coefficient Restaurant Parcel Values West of 72nd Street**

Direction of correlation	negative
Correlation Coefficient ( <i>R</i> )	-0.2931*
p-value	0.0153

*Significance: \*\*\* $p \leq .001$ , \*\*  $p \leq .01$ , \*  $p \leq .05$ , +  $p \leq .10$*

Table 4.35 shows the results of a Pearson's correlation coefficient test on a sample of WalkScores and restaurant values west of 72<sup>nd</sup> street. The correlation coefficient was found to be -0.2931. This negative direction of correlation is significant at 0.05 p-value.

**Table 4.36 Linear Regression Restaurant Parcel Values West of 72nd Street**

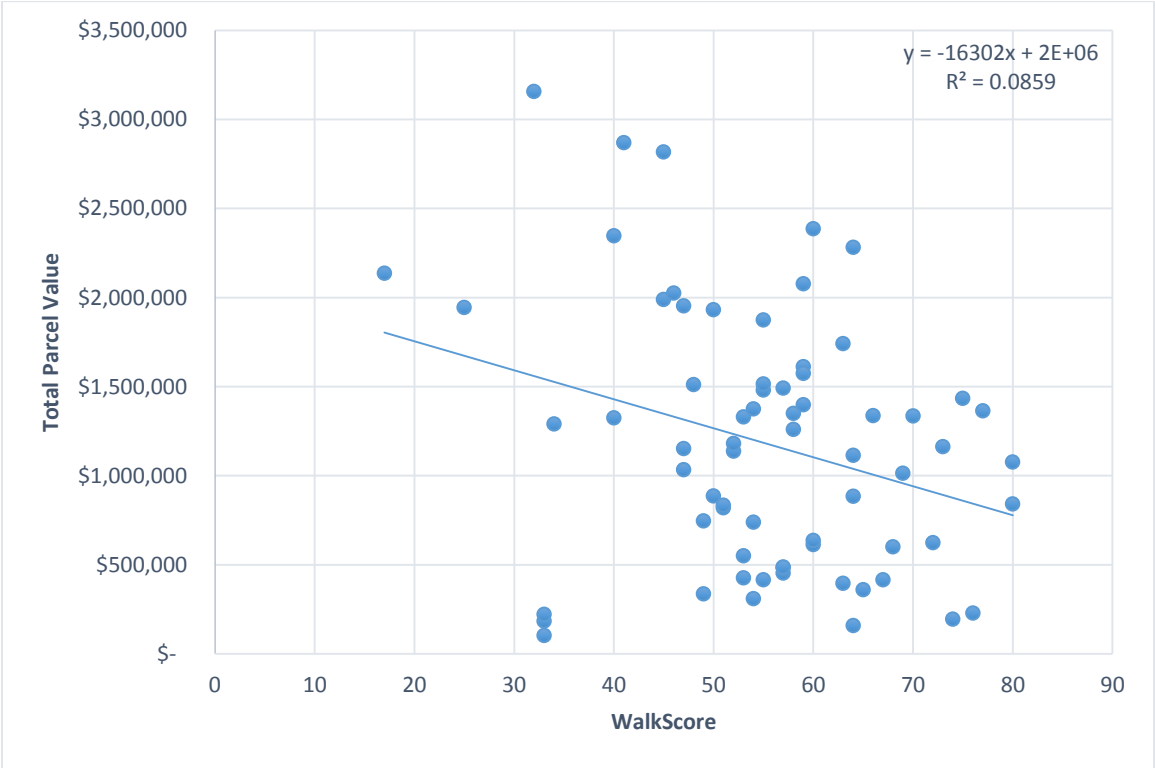
Direction of correlation	negative
Beta Coefficient	-16301.8
P-value	0.0153
F-value	6.20
R <sup>2</sup>	0.0859

*X = WalkScore (independent variable)*

*Y = Total parcel value west of 72nd Street (dependent variable)*

Table 4.36 shows a bivariate linear regression on the variables that also revealed a negative correlation between WalkScore and parcel value. The beta coefficient was -16301.8 meaning that the total parcel value would be expected to drop more than \$16,301.80 for every one-point increase in WalkScore. The results can be considered significant to the 0.05 level. R<sup>2</sup> was 0.0859 meaning that the bivariate regression model explains less than 8.5% of the total variance in the data.

**Figure 4.12 Linear Regression - Restaurant Parcel Values West of 72nd Street**



*The figure shows the parcel value on the y axis (Douglas County, 2017). The WalkScore is shown on the x axis (WalkScore, 2017).*

Figure 4.12 shows the value of parcels for the sample of restaurants west of 72<sup>nd</sup> Street. The WalkScore is on the x axis and the total value of parcels are on the y axis. The line is sloping sharply downward which indicates a negative correlation between the variables. As the WalkScore increases, the value of a restaurant in west Omaha would be predicted to decrease based on the model.

## Quantitative Comparisons

The research question asks if walkability has an impact on property values in Omaha, NE across different land uses and if so, is the correlation positive or negative? The hypothesis of the study is that walkability would have a positive correlation to economic values across different land uses because in national surveys and in other studies, a majority of people say they value walkability. However, it was also hypothesized the value of walkability would be tempered and that the value of walkability would be less in auto-centric parts of the city because they are designed around cars which makes auto-centric transportation the easiest and most convenient way to get around. Why would someone value walkability in the suburbs if driving is easier than walking?

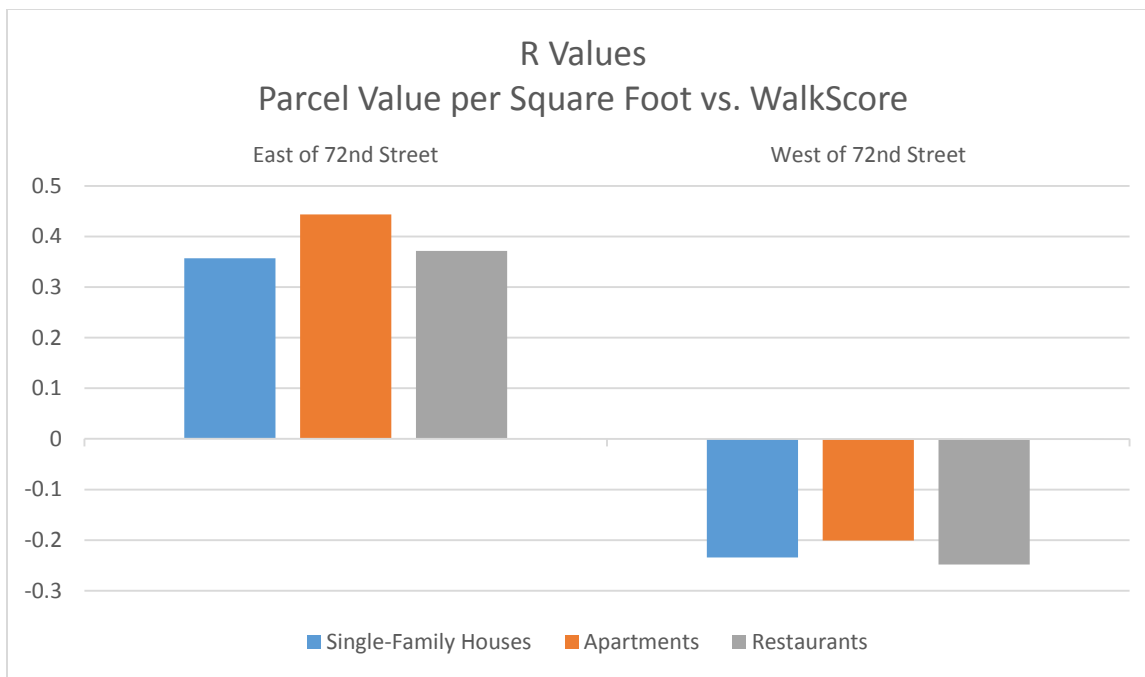
An attempt was made to answer the hypothesis by using parcel values from the Douglas County, NE Assessor's records and walkability scores from WalkScore.com. Parcels from three different classes of land use: single-family houses, apartments, and restaurants were randomly selected using GIS and analyzed using regression models charting their parcel value vs. the WalkScore. Parcel value was measured two different ways. The first was a total value which includes the building and land. The second was a value per square foot which took the total value divided by the size of the parcel. When it was discovered that there were significant differences between west Omaha and east Omaha parcels, a variable was added "east or west of 72<sup>nd</sup> Street" and parcels divided into groups by this geography.

It was evident from the Pearson's correlation coefficient that some land uses had a stronger correlation than others. In some cases, the correlation was negative or non-existent. The following is a review / comparison of the differences in WalkScore vs. parcel values that were looked at in this study.

Figure 4.13 below summarizes the R values of parcels when measured as value per square foot. An R value of 1.0 would be a perfect correlation between parcel value and WalkScore. The R values were not close to 1.0, but there were stronger correlations in some land uses than others. The correlation was found to vary by geography with stronger correlations occurring east of 72<sup>nd</sup> Street in the older part of Omaha vs. negative correlations west of 72<sup>nd</sup> Street in the newer, more suburban part of Omaha.

The group on the left side of Figure 4.13 are land uses east of 72<sup>nd</sup> Street. The group on the right side of the figure are the land uses west of 72<sup>nd</sup> Street. Each land use west of 72<sup>nd</sup> Street had a negative correlation between the square foot value of parcels and their WalkScores while the land uses east of 72<sup>nd</sup> Street had positive correlations between their parcel value per square foot and WalkScore.

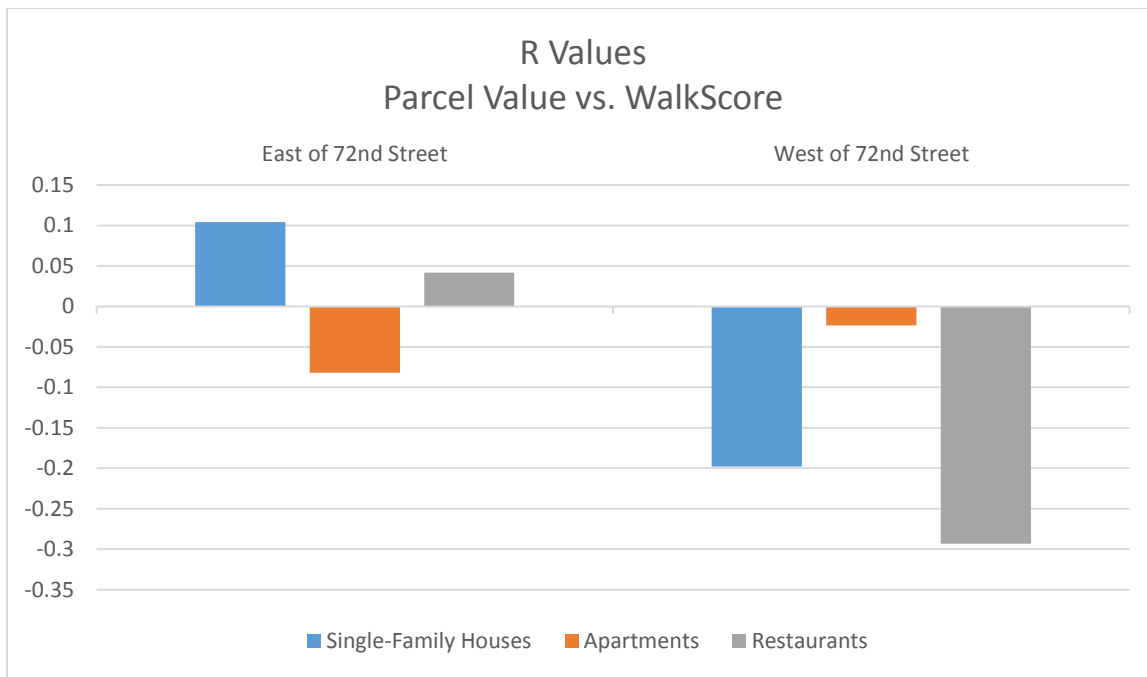
**Figure 4.13 Pearson’s Correlation Coefficient (R) Comparison: Parcel Value per Square Foot vs. WalkScore**



*Comparison of R values: parcel value per square foot vs. WalkScore*

Figure 4.14 compares the R values of total parcel value to WalkScore for each land use included in the study. The values east of 72<sup>nd</sup> Street had very small to negative correlations. Parcel values west of 72<sup>nd</sup> Street show zero or negative correlations between total parcel value and WalkScore. The data indicates there is not a relationship between parcel value and WalkScore, at least when the value is measured as total value of the building plus land.

**Figure 4.14 Pearson’s Correlation Coefficient Comparison: Parcel Value vs. WalkScore**

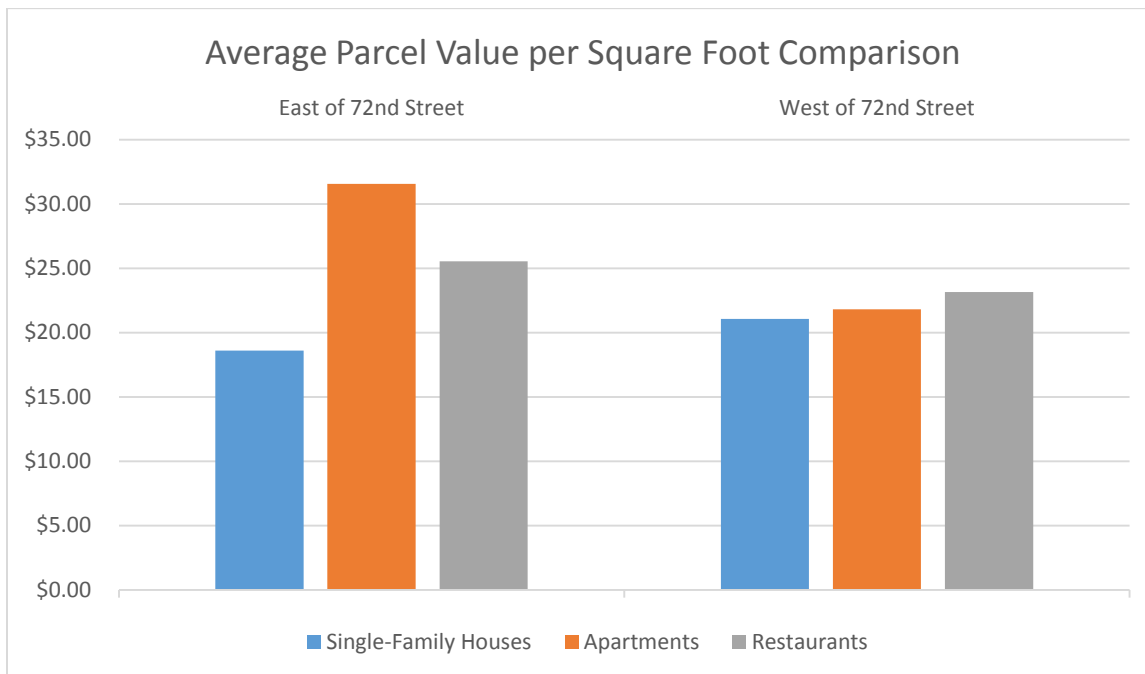


*Comparison of R values: parcel value per square foot vs. WalkScore*

Figure 4.15 below shows a comparison of the average parcel value per square foot among the three land uses in the study. Average values east of 72<sup>nd</sup> Street vary more by land use than the parcel values per square foot west of 72<sup>nd</sup> Street. The highest average value of all categories were apartments east of 72<sup>nd</sup> Street, at \$31.56 per square foot.

The average values of apartments and restaurants west of 72<sup>nd</sup> Street were lower while the average value per square foot of single-family houses was higher on the west side of the city. The average apartment value per square foot west of 72<sup>nd</sup> Street was \$21.81 which is \$9.75 less per square foot than apartments from the east side of town. Restaurants on the west side had an average value of \$23.15 per square foot which was \$2.38 less than restaurants on the east part of town. Average single-family house parcels on the west side were \$21.07 which was \$2.47 higher per square foot on average than single-family house parcels on the east side of town.

**Figure 4.15 Average Parcel Value per Square Foot Comparison**

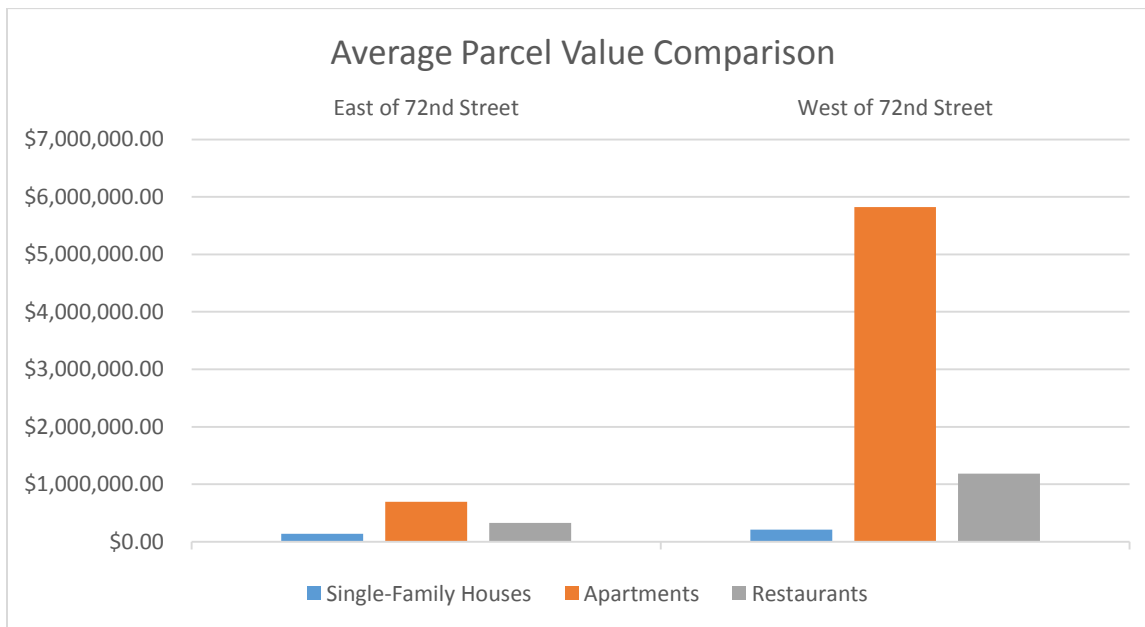


*Comparison of average parcel value per square foot*

Figure 4.16 shows the average parcel values of different land uses in the study divided between east and west Omaha. Across all land uses, the total parcel values were higher on the west side of town than on the east side. The average parcel value of apartment parcels on the west side were \$5.8 million while on the east side the average apartment parcel was less than \$700k. This could be explained by fewer buildings per parcel on the east vs. west. In west Omaha the average number of buildings per parcel was 6.3 while in the east the average number of buildings per parcel was 1.7.

The parcel value of restaurants on the west side of town had a higher average value than those on the east side. The average restaurant parcel from the sample was valued at over \$1.1 million on the west side while restaurant samples on the east side were valued at an average of \$327k. This difference may be explained in part by the size of the restaurants, the average restaurant size in the east group was 4,646 square feet while the average size in the west was 6,016 square feet. Single-family parcels were also more valuable on the west side of town vs. the east side. The average value of the west sample group was \$209,965. The average value in the east was \$136,477. Both groups of single-family houses had an average size of close to 1,700 square feet.

**Figure 4.16 Average Parcel Value Comparison**

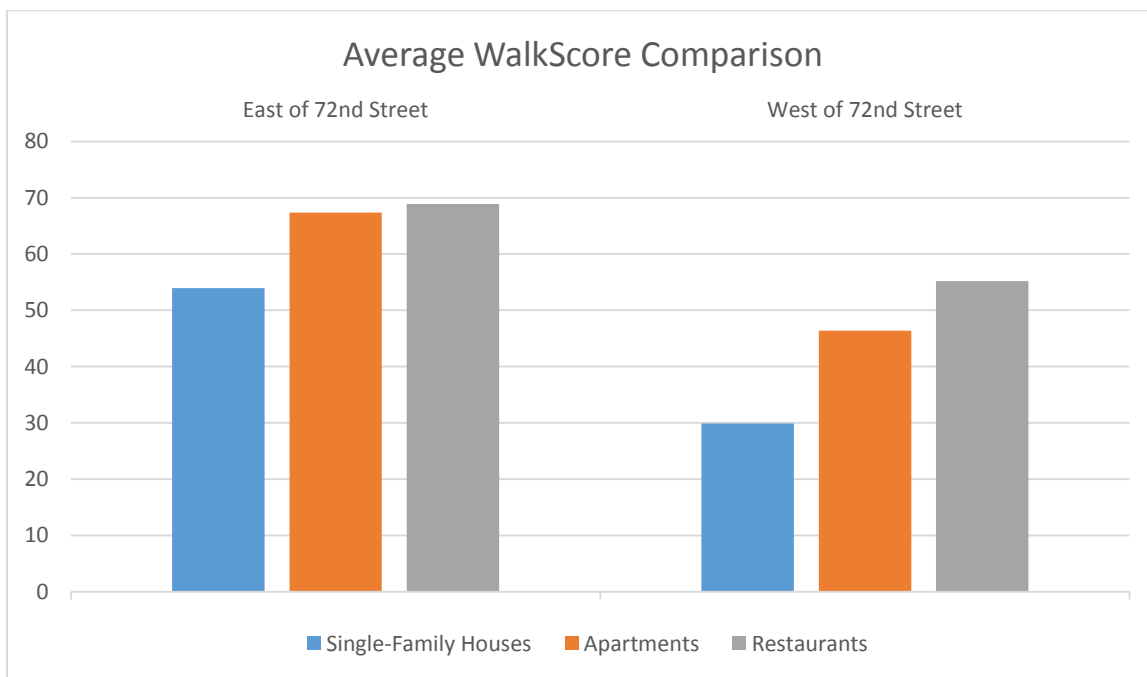


*Comparison of average parcel values*

Figure 4.17 below provides a comparison of the average WalkScore for each land use in the study and divides the WalkScores between east of 72<sup>nd</sup> Street and west of 72<sup>nd</sup> Street. As shown in the figure, each land use had a higher WalkScore east of 72<sup>nd</sup> Street vs. west of 72<sup>nd</sup> Street.

The highest average WalkScore were restaurants on the east side of town which scored 69 on average while restaurants on the west side had an average WalkScore of 55. There was a bigger difference with the apartments, scores in the east were an average of 67 and in the west 46. There was a similarly large drop off in WalkScore for the single-family house parcels with an average score of 54 in the east and 30 in the west.

**Figure 4.17 Average WalkScore**



*Comparison of average WalkScores by land use and geography*



## Qualitative Comparison

Looking at statistics can help shed light on the relationship between variables and whether a change in one is related to a change in another. This study looked at WalkScores vs. property values to see if there is a correlation between the two. The primary means of analysis was the Pearson R test which was used to determine the strength and direction of correlation. Another way to understand what is going on with walkability and property values is to look at qualitative data. Walkability is a phenomenon of the built environment, it takes into account multiple variables as does property value. A place may be highly walkable for one reason like population density but could score low on destinations, for example no school or retail close by. It may be highly walkable per the WalkScore algorithm but may not be as walkable in reality because of micro-scale phenomena that WalkScore does not include like aesthetics. Additionally, WalkScore does not take into account barriers to pedestrian movement like high-speed roads or bridges that would prevent people walking from one place to another.

The property value statistics used in the study may not be perfect either, as property values can change from one year to another and if a parcel has not sold for a number of years, its value may not be fully reflected the Assessor's record. Property value, like walkability, can be thought of as a bundle of characteristics. A single-family house may be valuable because of its school district, the number of bedrooms, or the number of garage stalls it has. An apartment may be valuable because of amenities like a pool or weight room. It is possible that the age of a property could play a role in its value. Would a restaurant built in 1960 be as valuable as one built recently? The older restaurant may be showing its age or not fit with current preferences of style and layout.

In order to shed some additional light on the correlation between walkability and property values, a few of the parcels from the sample groups were looked at in greater detail. The property 4606 Capitol Avenue was the single-family house parcel with the highest WalkScore of both groups, east and west of 72<sup>nd</sup> Street. This modest house valued at \$75,900 had a WalkScore of 87. Below is a map providing some context on where this property is and why it may have received such a high WalkScore.

There are a number of destinations within one-half of a mile from this parcel: a Walmart Neighborhood Market, several restaurants, a drug store, and a hardware store. It is close to Dodge Street which is Omaha's major east-west arterial so the parcel is close to major employment centers like the University of Nebraska Medical Center less than one-half of a mile away and other major employers downtown about two miles to the east. For all the advantages this parcel has, combined with a high WalkScore, it seems to refute the idea that WalkScore is linked to an increase in parcel value for single-family houses. The subject property had a value of \$60,577 below the average parcel value for properties in its group and nearly \$98,156 below the average value of all east and west single-family parcels. It does not appear in this case that a high WalkScore has imparted a higher value for this parcel. Figure 4.18 shows a map of 4606 Capitol Avenue and the walking route one would take to nearby retail.

**Figure 4.18 Highest Single-Family House WalkScore**



*4606 Capitol Avenue. Single-Family house with the highest WalkScore (Google, 2018)*

**Figure 4.19 Walking path along Dodge Street**



*Path to retail destinations from 4606 Capitol Avenue (Google, 2018)*

This example shows one of the limitations of WalkScore as a walkability metric. Although 4606 Capitol Avenue has a number of retail destinations close to it, the path one would take to these destinations is not especially comfortable for the person walking. Figure 4.19 above shows part of the path. There is a sidewalk, but it is at the back of the curb leaving no protection between pedestrians and West Dodge Road, a five-lane major arterial. This could make pedestrians feel uncomfortable. The sidewalk along Saddle Creek Road further along the path has a similar layout with the sidewalk at the back of curb. It is not until one gets to the Neighborhood Walmart, a newer store, that the sidewalk is set back several feet from the curb, and there are trees between the sidewalk and Saddle Creek Road which make the path more comfortable for a person walking.

Figure 4.20 shows the parcel with the highest WalkScore of the sample of single-family houses west of 72<sup>nd</sup> Street. The house is 3106 South 116<sup>th</sup> Street. This parcel had a WalkScore of 73, and a total value of \$187,100. The parcel is valued at \$15 per square foot when factoring in the value of the building and land, divided by the size of the property. These are relatively low values.

This parcel has a high WalkScore because it is adjacent to a park with a swimming pool. There is an elementary school two blocks away and a major shopping center less than one half of a mile away. Although the shopping center is 0.6 miles away using the available walking network, one would have to cross a four-lane street to get there. This would not be a comfortable or safe crossing for a pedestrian visiting the shopping center.

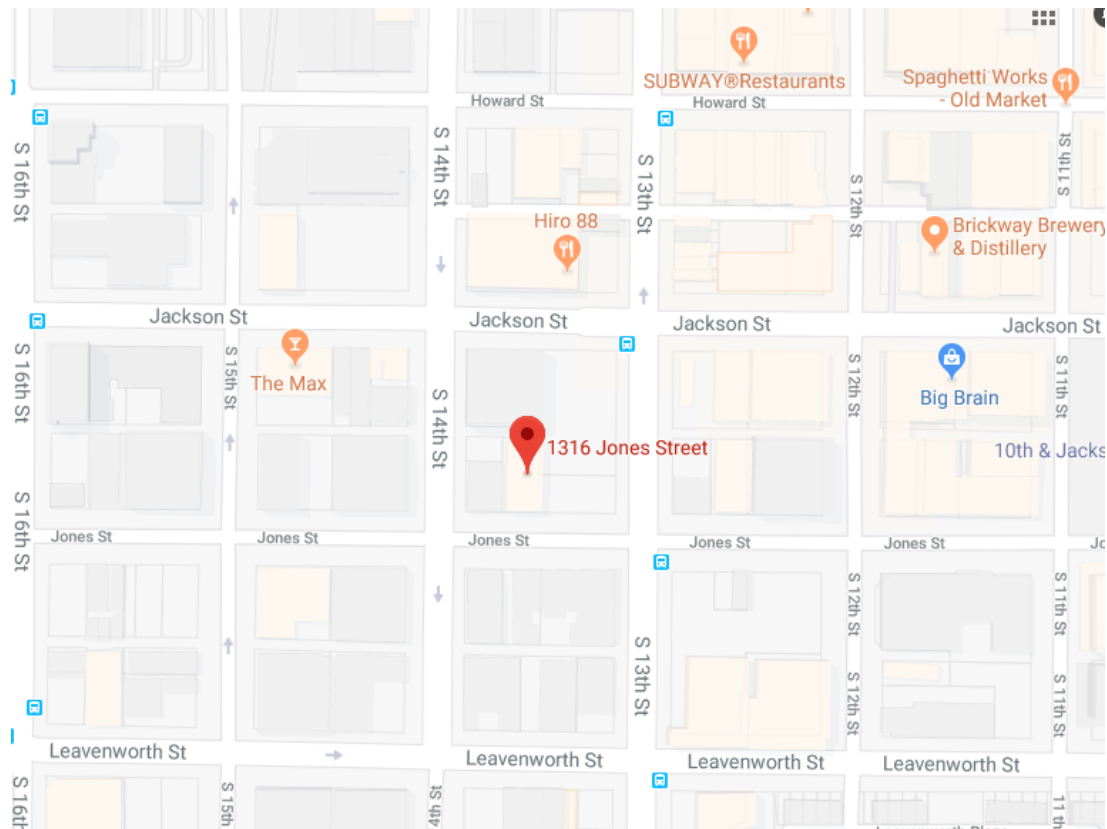
**Figure 4.20 Highest WalkScore Single-Family Parcel West of 72nd Street**



*3106 S. 116<sup>th</sup> Street (Douglas County Assessor, 2017)*

There were four apartment parcels that scored 92, these were the highest WalkScores for apartments in the study. All four were in the highly walkable downtown area with parcel values per square foot above average (\$31.56), one parcel stood out with an average parcel value of \$208.49 per square foot. This parcel has a three-story brick apartment that is built to the property line. It does have a surface parking lot, but the parking lot is on an adjacent parcel. This probably contributes to its high value per land area because the lower value parking lot is not included in the subject parcel. Figure 4.21 below shows the surrounding context of 1316 Jones Street. It is in the Old Market entertainment district less than a quarter of a mile to a dance club, a sushi restaurant, a brewery, and several restaurants.

**Figure 4.21 Highest WalkScore Apartment**



*1316 Jones Street location in the Old Market (Google, 2018)*



Figure 4.22 below shows a Google Street view of 1316 Jones Street. The apartment was built in 1889. It is called Nuts and Bolts lofts because the building used to be a hardware store. The property underwent a major renovation in 2012 and today has twelve units. A one-bedroom apartment at Nuts and Bolts rents for \$1,034 per month, this is above average for Omaha, NE where the average one-bedroom apartment rents for \$753 (Rent cafe, 2018). This property has walkable features which may also contribute to its value. There is a sidewalk in front of the property which is protected from the street in front of it by parked cars. The building is aesthetically interesting and there is a street tree to provide shade and human scale. This is typical of the Old Market where one will find an interesting urban environment filled with people and walkable destinations. It is not surprising that this property has a high value and received a high WalkScore.

**Figure 4.22 Street view of 1316 Jones Street**



*1316 Jones Street (Google, 2018)*

Figure 4.23 shows the highest value apartment complex west of 72<sup>nd</sup> Street, the Whispering Ridge Apartments at 17551 Pinkney Plaza. The WalkScore of this apartment complex was low at 34, while its total value was high at \$26,480,900. There is a shopping center anchored by a Target store one half a mile away from this parcel, which would be a walkable destination, but there was not a complete sidewalk at the time. When the parcel gets developed between the apartments and Target there would be a complete walking path to Target, four fast food restaurants, a bank, a hair salon, an auto parts store and a pet store. While these destinations would be technically accessible by foot, they are clearly designed around the auto because of the large building setbacks and plentiful off-street parking that promote an auto vs. human scale.

**Figure 4.23 Highest Apartment Value West of 72nd Street**



*Whispering Ridge Apartments (Douglas County Assessor, 2017)*

Two restaurants tied for the highest WalkScore and both are located in the Old Market, within ½ a mile of the highest WalkScore apartment parcel. Figure 4.24 below shows one of the restaurants, Saigon Surface, a Vietnamese restaurant located at 324 South 14<sup>th</sup> Street. Saigon Surface received a WalkScore of 93. The parcel is within walking distance of major employers and is close to several restaurants, a theatre, and the Gene Leahy pedestrian mall.

**Figure 4.24 Highest Restaurant WalkScore**



*324 South 14<sup>th</sup> Street Map (Google, 2018)*



Figure 4.25 below shows a street view of 324 South 14<sup>th</sup> Street where Saigon Surface restaurant is located. The restaurant is on the lower level of the building. There is a bank above and a parking garage in back of the property. This parcel has some walkable features; the wide sidewalk with street trees and a bump out at South 14<sup>th</sup> Street which makes the pedestrian crossing shorter. There are also parked cars and a bike lane that separates pedestrians from traffic along Harney Street. One downside is that the street in front of Saigon Surface, Harney Street is a one-way road with three lanes of traffic moving in the same direction. One-way streets are designed to move traffic faster than two-way streets and this aspect is a negative for pedestrians because they could suffer injury from fast moving traffic or at a minimum feel less comfortable.

**Figure 4.25 Street view of 324 South 14th Street**



*324 South 14<sup>th</sup> Street Image (Google, 2018)*

Figure 4.26 below is the restaurant with the highest WalkScore west of 72<sup>nd</sup> Street. This International House of Pancakes at 12423 West Center Road had a WalkScore of 80 and was valued at \$842,100 which includes the building and land. The high WalkScore at this location could be explained by the proximity of retail adjacent to the restaurant. The parcel is an outlot of Westwood Plaza, a neighborhood retail development with an office supply store, specialty shops, and other restaurants nearby. The high number of destinations close to it increases its WalkScore, but one would not consider the area surrounding this parcel favorable for walking. There are sidewalks, and even a bench, but the building has a weak relationship to the connecting sidewalks and the area has low population density which would not support many customers within walking distance.

**Figure 4.26 Restaurant Parcel with Highest WalkScore West of 72nd Street**



*12423 West Center Road (Douglas County Assessor, 2017)*

## Conclusion

The research question asks if walkability has an impact on property values in Omaha, NE across different land uses and if so, is the correlation positive or negative? The hypothesis of the study is that walkability would have a positive correlation to economic values but that the correlation would be lower in the more auto-centric parts of the city. The answer to the research question is that it is not straight forward and depends on a number of factors.

There was a positive correlation between WalkScore and property values east of 72<sup>nd</sup> street. The correlation was the highest with the apartment land use, second highest with restaurants, and the single-family land use was third. These same land uses all had a negative correlation between parcel value and WalkScore west of 72<sup>nd</sup> Street.

There was also the distinction between how parcel value was measured. Correlations were stronger and more significant when measured as value per square foot and lower or non-existent when the value of the building and land were added together, but the lot size was not considered.

The qualitative part of the study found examples of high WalkScore parcels that upon closer inspection, have some major drawbacks to walkability. West of 72<sup>nd</sup> street, a parcel may be close to retail establishments and have a sidewalk but the pedestrian walking from their house to neighborhood retail might have to cross a five-lane major arterial to get there. The west Omaha properties with high WalkScores seemed to be high by coincidence of their location and walking was not really a viable form of transit. East of 72<sup>nd</sup> street was a different story, especially in the Old Market where walking from one's apartment to a nearby restaurant would be more realistic. The walking paths were protected from traffic by parked cars or trees, and block lengths were shorter leading to more direct routes of travel.

## Chapter 5 - DISCUSSION

The correlation between WalkScore and property value was different depending on geography, how property value was measured, and the type of land use. The following is a discussion of these points and possible explanations.

### **Geography**

The strongest correlation between property value and WalkScore was east of 72<sup>nd</sup> Street. In the parcel value per square foot Pearson's correlation coefficient test, the R values were positive across all three land uses east of 72<sup>nd</sup> Street and negative across all three land uses west of 72<sup>nd</sup> Street. With random sampling, why would the correlation between WalkScore and property value be so different east of 72<sup>nd</sup> street vs. west of 72<sup>nd</sup> street? WalkScore is a metric that measures walkability by an algorithm that takes into account population density, block length, intersection density, and distance to retail and other destinations like schools and parks.

The development pattern of Omaha is different east of 72<sup>nd</sup> Street vs. west of 72<sup>nd</sup> Street, which may account for the difference in WalkScores from east to west. East of 72<sup>nd</sup> Street there is a higher population density, shorter blocks, and more intersections per square mile than west of 72<sup>nd</sup> Street. These variables are all associated with higher WalkScores, but it could also be that in the pre-World War II era when the eastern part of the city was built, people relied on a more diverse transportation system, one that involved walking and streetcars in addition to the personal auto. While west Omaha was designed around the auto, east Omaha was not. Newer properties in west Omaha would not value walkability because they do not need to. In the eastern parts of the city, there may be more value associated with walkability because walking was more popular when that part of the city was built and it is reflected today with a higher level of walkability.

### **Property value measurement**

The correlation between WalkScore and property value was strongest when the property value was measured in value per square foot vs. total value. For example, single-family house parcels east of 72<sup>nd</sup> Street had an R value of 0.357 indicating a positive correlation between WalkScore and property value when measured per square foot. When the same set of parcels

were evaluated as total value, the R value was lower at 0.1040 and suspect to chance because of the test's high p-value.

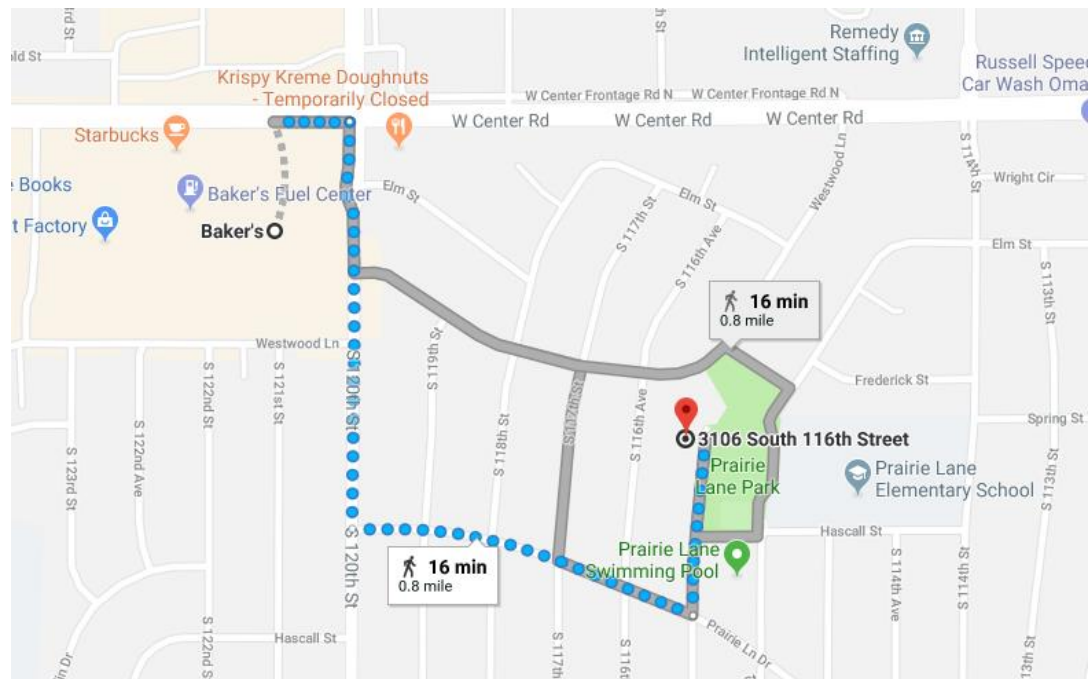
The difference between the two measures of value is that the value per square foot takes into account the parcel size and divides it by the building and land value. A parcel with a high value per square foot is likely to have more square feet of building on less land. To put it another way, development density is rewarded when parcel value is measured per square foot. An apartment, house, or restaurant without a parking lot would be worth more per square foot of its parcel than a similar use with a large parking lot or landscaping because parking lots and landscaping are not as valuable as the building.

### **Type of land use**

Single-family house parcels with high WalkScores were not particularly valuable. The highest WalkScore single-family house east of 72<sup>nd</sup> Street was \$98,156 below the average single-family parcel value in the study, this was 4606 Capitol Avenue which is close to nearby retail, but the retail destinations were not particularly easy to access and the high WalkScore did not impart a higher value on the property.

The single-family house with the highest WalkScore on the west side of Omaha was similar. Its address is 3106 South 116<sup>th</sup> Street. It is a modest house with a value of \$187,100 which is higher than average for all single-family samples (\$174,056), but lower than the west Omaha group whose average value was \$209,965. The house is located across the street from an elementary school and a public pool. It is also a 16-minute walk to the neighborhood grocery store. But it is doubtful a person would actually take this walk unless they had no driver's license or car. A car ride to the same store would take three minutes and one could carry all of the groceries home vs. managing them without a vehicle for a 16-minute walk. Figure 5.1 illustrates the route one would take from 3106 South 116<sup>th</sup> Street to the nearest grocery store. The efficiency of driving to the store vs. walking illustrates why there may not be a correlation between WalkScore and property value in the single-family house land use. Granted, WalkScore takes into account proximity to other destinations besides retail like schools and parks. This property is close to a school and park, yet it still had an average value which indicates weak correlation between its WalkScore and property value.

**Figure 5.1 Grocery Store walk from 3106 South 116th Street**



*3106 South 116<sup>th</sup> Street to Grocery Store Walk (Google, 2018)*

There was more correlation between property value and WalkScore with apartments than with single-family houses, although this correlation was only positive in the eastern part of the city. The apartments with the highest WalkScores were concentrated east of 72<sup>nd</sup> Street in the Midtown and downtown areas, although not all apartments in this group had high WalkScores. The apartments with the combination of highest WalkScore and value per square foot were located in Dundee, the Old Market, Midtown Crossing / Blackstone, and Aksarben Village neighborhoods. The things these neighborhoods have in common is that they are mixed-use, they are organized around a commercial district, and they do not have large off-street parking lots. Each neighborhood was developed before World War II with the exception of Aksarben Village which was developed recently.

Restaurants followed a similar correlation as apartments. There were more restaurants with a high WalkScores in older parts of the city east of 72<sup>nd</sup> Street. The properties that were more valuable than average and had high WalkScores were located in the Old Market, Dundee, and West Dodge Road between 72<sup>nd</sup> and 84<sup>th</sup> Streets. There were a few restaurants in South Omaha that had both high WalkScores and high values. Other properties either had high WalkScores or high values but not both. The restaurants along Dodge Street did not seem

particularly walkable on closer inspection. Restaurants along this corridor like Applebee's and Village Inn have large off-street parking lots and are located next to a busy road. It is doubtful that people walk to these restaurants. Their high WalkScore is probably due to the algorithm taking into account proximity to other retail and a higher population density.

Restaurants in the Old Market, Dundee and South Omaha with high WalkScores and high property values are located in a more walkable setting where the pedestrian would feel more comfortable. These properties also lack off street parking which contributes to their higher value per square foot because parking lots are not as valuable as buildings. One such South Omaha restaurant is pictured in Figure 5.2 below. Restaurant San Luis received a WalkScore of 86 and it's total value per square foot was \$71.31 more than twice the average value for its group.

**Figure 5.2 Restaurant San Luis**



*4806 South 24<sup>th</sup> Street (Google, 2018)*

## Tie back to literature

The literature identified multiple variables that factor into both walkability and property value. The following is an attempt to corroborate previous studies with findings from this study.

**Literature:** People are interested in walkability but land development laws are not favorable for building walkable urban areas (Hack, 2013). In a national survey, 66% of respondents expressed preference for “living within walking distance of stores, restaurants, and other places in a community” (Spivak, 2011).

**Study:** Mixed results. West Omaha was built with land development laws that favor auto circulation, its properties have low WalkScores but are still of high value which shows an interest in auto-oriented development. But there are also walkable areas of the city that have high values like the Old Market, Dundee, and Midtown Crossing. Half of building permits in Omaha last year were infill, meaning that properties are being redeveloped in the city vs. built new on the edge of the city (Beals and Magid, 2018). There are several high-profile developments that feature walkability as a key element: Aksarben Village, La Vista Town Center, West Farm, and Prairie Queen. It is true that Omaha’s land development laws create suburban sprawl by default, but the new walkable developments listed above are usually built as a planned unit development or with special zoning overlays. These planning tools allow the types of setbacks and parking these areas require and the city has been accommodating when projects like these are proposed. Older parts of the city were built before zoning became so auto-centric, so they were more walkable from the start.

**Literature:** Walkable shopping areas perform better financially (Hack, 2013).

**Study:** The study did not specifically look at the performance of walkable shopping areas but there is evidence that Omaha’s restaurants in walkable areas have high property values. Some of the highest restaurant values per square foot were located in the Old Market and Dundee. J’s on Jackson at 11<sup>th</sup> & Jackson Street in the Old Market is worth \$57 per square foot which is twice the average value for the group of restaurants east of 72<sup>nd</sup> Street. The Upstream restaurant across the street from J’s was the highest at \$190.04 per square foot. There were also valuable properties with low WalkScores like Charleston’s restaurant in West Omaha which is valued at over \$3 million total and \$47.58 per square foot.



**Literature:** WalkScore has been validated as a tool to measure walkability, particularly at the one-mile range but its algorithm can miss environmental variables at the micro scale, like high speed roads that make walking uncomfortable or the quality of the built environment (Duncan et al., 2011 & Bereitschaft, 2017).

**Study:** Environmental barriers to walking were evident from looking at qualitative samples using Google Street View and Google Maps. Properties with high WalkScores were sometimes not pedestrian friendly because of the proximity of walking paths next to high speed roadways. Properties may have had retail destinations within ¼ of a mile but if the destinations are across a five-lane major arterial they would not be considered as walkable. Overall, the areas of the city with high WalkScores in downtown and midtown are places one would consider to be walkable and their high WalkScores would be justified.

**Literature:** Gridded, short blocks have a positive relationship to walkability while curvilinear, long blocks have a negative relationship to walkability (Southworth, 2005).

**Study:** WalkScore uses average block length as one of its variables to rate how walkable a place is, the lower the average block length the higher the score. This was demonstrated in the study. The average WalkScore for each land use was higher east of 72<sup>nd</sup> street where blocks are shorter and gridded vs. west of 72<sup>nd</sup> Street where blocks are longer and more curvilinear. This makes sense because longer blocks make it more difficult to get to one's destination. If a person lives on a block that is 1000 feet long they could potentially have to walk 1000 feet out of their way to get to where they want to go.

**Literature:** Low population density predicts driving (Holtzclaw, 1991). Walking trips begin to increase at a population density of 14 units per acre (Rand 2007).

**Study:** Population density was not the primary focus of the study, but it was available through a table that was joined to the census block groups. Population density of the block group for each parcel was determined by dividing the population of the block group by its size in acres. The result is the number of people per acre for each parcel. Population densities on average were found to be nearly twice as high east of 72<sup>nd</sup> Street than west of 72<sup>nd</sup> Street as shown in table 5.1.

**Table 5.1 Population Density & WalkScore of Sample Groups**

Sample Group	Population Density (People per Acre)	Average WalkScore
Single-Family East	9.99	54
Single-Family West	5.70	30
Apartments East	13.40	67
Apartments West	7.15	46
Restaurants East	8.97	69
Restaurants West	4.07	55

*Population Density (US Census, 2015 & WalkScore, 2017)*

**Literature:** There are higher residential rent and home values per square foot in walkable urban areas (Leinberger & Alfonzo, 2012).

**Study:** There was not a strong correlation between home value and walkability in the sample of single-family house parcels in Omaha. There was a positive correlation between WalkScore and parcel value, but only in the eastern part of the city.

**Literature:** There was a positive correlation between WalkScore and housing prices in 13 of 15 markets studied. There were two cities where there was no correlation; Las Vegas, NV (negative) and Bakersfield, CA (not significant). Overall, the study found that one WalkScore point was associated with between a \$700 and \$3,000 increase in home value. Further, the premium for walkability was higher in more populous urban areas (Cortright, 2009).

**Study:** A negative correlation was found in the low-population density West Omaha. This sounds similar to the finding for Las Vegas which is also low-density and auto oriented. A positive correlation was found in the eastern part of Omaha which has a higher population density.

## Community development implications

The theoretical framework underpinning the study is that walkable places can have a triple bottom line effect on a community. The literature indicates that walkable places have social benefits for the people who live there, they are profitable for developers, and are a long-term value for cities. A community of place is developed one parcel at a time. These developments add up and taken together characterize a community. Private land developers in general are motivated by profit, they need to make money with a development otherwise they will no longer be in business. The types of projects they deliver affect people who live in the community because their projects end up being where we live, shop, and work. These places also need public infrastructure to support them which needs to be maintained along the entire lifecycle of the development. If there is a link between walkability and property values in Omaha, it could imply that walkable places can serve a triple bottom line framework that benefits society, land developers, and city governments.

The study has indicated that there is a correlation between property values and walkability, but it is not consistent across geography or land use. There was a negative correlation between property value and walkability on the west side of Omaha and a positive correlation between property value and walkability on the east side of Omaha. Even on the east side, not all parcels had a high correlation. The land use with the highest correlation were apartments, followed by restaurants with a positive but lower correlation, and single-family houses with the lowest correlation of the three land uses. Parcels with the highest correlation were clustered in older mixed-use neighborhoods like Dundee, Blackstone, and the Old Market. A more recent development, Aksarben Village also scored high in both WalkScore and property values.

Currently there are many single-family house, low-WalkScore developments being built in Omaha. In 2017 Omaha was the only one of fifty metros whose cumulative WalkScore actually decreased (Whitley, 2017). Low density, car-dependent development continues unabated on the city's west side. This is not surprising from the study. West Omaha house prices had a higher value than houses on the east side of Omaha. The average WalkScore for single-family houses west of 72<sup>nd</sup> Street was 29.92 with an average value of \$209,965. On the east side of the city, the average WalkScore was 53.93 with an average value of \$136,477. There does not appear to be a link between WalkScore and property value in this land use. A land developer can

profit by developing relatively inexpensive land on the edge of town and building low-WalkScore housing.

However, recent developments in the Omaha metropolitan area have shown interest in mixed-use, walkable developments, especially with apartments and commercial land uses. Examples include: Aksarben Village, West Farm, La Vista Town Center, and Prairie Queen. The fact that places like these are being built indicates there are financial incentives for building walkable places, especially for apartment and restaurant land uses, as was born out in the study. Based on the new mixed-use projects that are being built in Omaha, one could add office to a land use that adds value to a walkable development.

Actions to make cities more walkable might include mimicking features of Omaha's most walkable areas. Designing shorter blocks, encouraging higher population density, and not requiring as much off-street parking. The proposed Prairie Queen missing middle housing development in Papillion, NE just south of Omaha is to be designed with walkability in mind. The land developer convinced the city of Papillion to let on-street parking be included in the amount of parking required so that the development would not have any big off-street parking lots which reduce walkability. This also allowed the developer to put more money into the buildings and less into land for parking lots (Beals & Magid, 2018).

Considering the value of walkable developments, Omaha should continue to accommodate development proposals that include walkable features. There seems to be a correlation between walkability and property value, especially with the apartment land use. There are many apartments in Omaha that get built every year but do not have good connections to nearby retail, parks, and schools. Perhaps better street and sidewalk layouts with shorter blocks would help make these developments more walkable, increasing their value for the developer, the city and the community at large.

## Limitations & Future Research

Looking back at the research question and methods of this study, there are some limitations. The choice was made to study land uses throughout all of Omaha by taking representative samples of three different land uses. The result, it was thought would be that a generalization could be made about these land uses and their relationship to WalkScore in the Omaha metropolitan area. The tradeoff for looking at the whole city is that the city's development pattern varies widely and it is difficult to make generalizations. The division between east and west was a crude but effective way to describe some of the differences in land value and walkability between the generally older and generally newer part of the city, but it might make sense for a future study to look at the WalkScore and property value relationship in a smaller area.

The decision was made to measure property value two different ways, parcel value per square foot and total value of the parcel without considering parcel size. Parcel value per square foot in retrospect, was a better measure because it was more of an analogous comparison. Total parcel value may not have been a fair measurement because west Omaha properties have more parking lots and landscaping where east Omaha properties do not. The parcel value per square foot measure is better for measuring the highest and best use of urban land vs. total value because it considers how much land is being used, and the opportunity cost of not building to the highest and best use.

An alternative to parcel value per square foot of land and total value of the building and land from Assessor records would be to use a more market-based value. Access to a database of recently sold properties could be used to compare against WalkScore and look for a correlation. Since apartments had the highest correlation among land uses, it might be interesting to use the rent for a one-bedroom apartment and compare the WalkScores from a representative sample of apartments in different neighborhoods. This would help determine the walkability premium for apartments. Comparisons could be made between different neighborhoods to measure the strength and direction of correlation WalkScore has on apartment value.

Finally, since there was a correlation between property value and WalkScore in certain land uses and areas, what are the design implications for a city? It may be a good idea for the city to change its zoning code and ordinances so that walkable properties are easier to build.

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