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## Factors Affecting Students Walking to School: Case Study of Two Middle Schools in Lincoln, Nebraska

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**Factors Affecting Students Walking to School**  
**Case Study of Two Middle Schools in**  
**Lincoln, Nebraska**

**By**  
**Nivin S. Khalil**

**A Thesis**

**Presented to the faculty of**  
**The Graduate College at the University of Nebraska**  
**In Partial Fulfillment of Requirements**  
**For the Degree of Master of Community and Regional Planning**

**Major: Community and Regional Planning**

**Under the Supervision of Professor Yunwoo Nam**

**Lincoln, Nebraska**

**May 2013**

# Factors Affecting Students Walking to School

## Case Study of Two Middle Schools in

Lincoln, Nebraska

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University of Nebraska, 2013

Advisor: Yunwoo Nam

Physical activity, including walking, can be a very healthy and sustainable mode of transportation. Children walking to their schools can get a lot of benefits from acquiring good habits that can be carried through their adulthood. Also, walking to school can reverse the trend of increasing obesity rates among children in the United States. This study is trying to identify the effect of urban form, presented in the distances between residences and schools, on the children's behavior whether they walk to school or not depending on different urban forms around their schools. Two middle schools in Lincoln, Nebraska were selected as case studies using network analysis in Geographic Information System (GIS). These schools featured diverse socioeconomic status and urban form characteristics for their surrounded neighborhoods. A survey was conducted on a sample of one hundred and sixteen students from both schools. From our results, we found that 21.8% of the sample in Lefler School use active modes of transportation to their school located near the city center, where the school is built in a traditional neighborhood featuring grid street system and high connectivity. Only 6.7% of the sample in Scott

School bike to school, and nobody walks to it, since Scott School is located in a late-modern neighborhood on the city's fringes built in the 1990s, and features dead-end streets and low connectivity. We concluded that distances seem to increase in the latter neighborhood resulting in diminishing the number of students willing to walk or bike to their school. Other factors like parents' and children's perceptions about safety, traffic, convenience, and strangers might have an influence on determining the child's behavior whether to walk to school or not.

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## **Dedication**

This thesis is dedicated to my husband, Peter William, my kids, Ethan and Emma, and my parents for their support and love during my graduate studies in the program.

## **Acknowledgments**

I would like to express my deepest appreciation for my advisor, Professor Yunwoo Nam, for his help, guidance, and support during my thesis and throughout my graduate coursework.

Also, I would like to thank my master's committee members, Professor Gordon Scholz, and Professor Rodrigo Cantarero for their support, their valuable comments, and the time they spent reviewing my thesis.

I would like to recognize all the participants who facilitate the progress of my experimental study (survey). Special thanks to Rachel Wenzl from the Institutional Review Board at the University of Nebraska-Lincoln, and to Dave Knudsen and Kelly Schrad, the schools' principals.

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## **Chapter 1: Introduction**

Physical activity, including walking, was proved to have excellent benefits for the body and the mental health of human beings. It is a form of relaxation which helps the person to lower his tension and to get rid of stress and fatigue. Walking began to receive a great attention in the 1990s due to the new recommendations that encouraged moderate-intensity physical activity. Moreover, the increased rates of overweight children, adolescents and adults alarmed the public health officials to perform researches and carry out some programs to encourage students to improve their physical activity level, especially walking to school (McDonald 2007, 509).

Active transportation, through walking to school, is considered a form of reintroducing regular physical activity into the lives of today's children. Active children in their childhood are more likely to carry healthy behaviors and activity habits and routines into their adulthood. They may also encourage other members in their families to perform more physical activities in their day. Walking to school enables children to socialize with friends and develop independence and confidence.

The prevalence of children walking to school has declined in the last four decades. Data from the National Personal Transportation Survey conducted by the U.S. Department of Transportation showed that 40.7 percent of students used to walk or bike to school in 1969. However, this percentage dropped to 12.9 percent in 2001.

Distance to schools seems to have the greatest influence on the likelihood of walking and biking to school. It is affected by the urban form of the neighborhood,

whether it is a traditionally designed one (built early in the 1900s near the city center), early-modern (built soon after World War II near the city center), or late-modern neighborhood (built in the past two decades near the urban fringe) (McMillan 2005, 446). The fields of urban design and public health have been connected together in the past few years recognizing their common interest of having walkable communities that favor residents' health (Ewing and Handy 2009, 65).

Urban form also has a strong relation with the increase of distances between households and different community buildings and services. Distances to shopping areas impact the frequency of walking trips among residents of those neighborhoods. Mixed land use, site design (including pedestrian facilities, block size, and sidewalk length) and the route directness (representing accessibility) also affect walkability.

A new trend took place in the United States that has resulted in building new schools in the suburban areas on the fringes of the cities. These new suburban areas do not promote walkability due to their design that is formed of cul-de-sacs, curves, and dead ends, unlike the old grid street system that generated shorten distances between destinations and encourages walking behavior.

Research has been performed to find out how we can improve the paths and routes to schools in order to encourage children to walk to school. Federal and state governments are also adopting programs to boost children to walk to their schools by providing a safer, more convenient physical environment for them.

## **Research Question**

This thesis hypothesizes that a grid street system network around schools, increases the students' chances to have more active transportation to their schools. Other factors, like the socioeconomic status of households in the census tracts around the schools, are included in the study.

## **Research methodology**

This study aims to compare two middle schools in Lincoln, Nebraska as case studies. The two schools are located in different urban form areas, with relative differences in some demographic factors. Schools were selected based on Network analysis using the Geographic Information System (GIS).

A survey was conducted on a sample of students from these schools. The University of Nebraska Institutional Review Board (IRB) approved the instrument and protocol used for this study after submitting a copy of the survey, parental informed consent form, child assent form, and other information. A copy of these forms is included in Appendix A. Surveys were sent home with the students through the school system, along with parental informed consent form, child assent form, and a letter explaining the study. Eight hundred and forty students were invited to participate in the study from the 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> grade. Children had the chance to discuss with their parents whether to participate or not. One hundred and thirty-six surveys were returned. However, only 85 percent of these responses were usable and have the required signed consents and assents. The final response rate was 13.8 percent.

## **Chapter 2: Literature Review**

### **Walkability**

In the last 20 years, the United States faced a period of rapid suburbanization, economic growth, and an increase in vehicle ownership and use. Urban sprawl increased by having low-density neighborhoods, with separated uses, and low street connectivity.

Smart growth and New Urbanism emerged as a reaction to sprawl. Those trends aim to improve air quality, solve traffic congestion, and promote better overall quality of life. They are trying to reduce traffic by reducing car dependence and promoting walkability.

Land use regulations and zoning codes are being adjusted in order to increase the development's density, mix of land uses, and provide pedestrian facilities (Moudon, et al. 1997, 48) and to recreate the best of the United States pre-sprawl, small-town past. In the walkable community terms, neighborhood plans should provide local destinations within reasonable walkable distances for residents who want to walk.

Smart growth and New Urbanism support the idea of building schools within walking or biking distance of the majority of the population they are meant to serve. This concept will decrease the need for resources such as school buses or parent's time and private cars transporting children to and from school (McMillan 2005, 444).

Moreover, the increase in using private vehicles as a main option for transporting children to school contributes to traffic congestion, air pollution, and the risk of injury

and death to road users, especially around schools. Shifting this behavior to walking and biking poses little risk to others and provides great opportunities for physical activities.

In a study that included four case studies of neighborhoods in the San Francisco Bay Area, Handy (1996) found that the numbers of walking trips to different destinations increase as the distances are shorter. Also, the presence of street design elements such as narrow streets, shaded sidewalks, and front porches increased the perceived level of accessibility. The study also found that the percentage of people walking to commercial areas in a specific period of time was higher in the traditionally designed neighborhoods compared to the modern neighborhoods built soon after World War II (Handy 1996).

Pedestrian facilities in the form of sidewalks, paths, and crosswalks were normally constructed in any residential or commercial area, until World War II. Then, after the widespread use of private cars, these facilities were not built as before, which led the developers to diminish their efforts on providing a safe pedestrian environment in their new developments (Moudon et al. 1997, 48).

A published article by Saelens et al. (2003) focused on neighborhood environment characteristics that may have an influence on the choices of people whether to walk or not, such as connectivity and proximity. They define connectivity as the directness or ease of travel between two points. They also define proximity as the straight-line distance between different land uses such as residential, office, retail, and commercial activities (Saelens et al. 2003, 81). Based on this study, proximity can be determined by two land use variables, which are the density or compactness of land uses, and the land use mix shown in the level of integration within a given area of different types of uses. The

traditional old neighborhoods were characterized by having high mixed use within a small area, while in modern suburbs, different land uses are separated. Furthermore, old neighborhoods were characterized by having grid street system that is known for high connectivity and the presence of fewer barriers between origins and destinations, while modern suburbs have low connectivity with low density of intersections, long blocks, and barriers to direct travel (Saelens et al. 2003, 82). Saelens's study found that the frequency of walking trips per week is relatively low regardless of the neighborhood environment, compared to other travel modes. However, the number of walking trips per week for residents in higher connectivity neighborhoods is higher than those living in low connectivity neighborhoods (Saelens et al. 2003, 83).

In other research that was done by Moudon (1997) in Washington, the study indicated that the pedestrian low frequency walking trips, even in mixed-use, medium-density environments, is due to inadequate site design and low connectivity represented in lack of direct, continuous, and safe pedestrian systems holding all other factors constant (Moudon et al. 1997, 54).

### **Walking to school**

Walking to school is an environmentally clean mode of transportation that is affordable to everybody. Active children in their childhood are more likely to carry healthy behaviors and activity habits and routines into their adulthood. Exposing children at early ages to healthy modes of transportation, like walking and biking, may be a successful strategy to encourage them to increase physical activity among adults, and to



use these active modes later in their life. They may live longer, healthier lives than less active individuals (Schlossberg et al 2006, 338; Heelan et al. 2005, 341).

Walking to school simply increases the physical activity of the children and reduces the incidence of obesity rates and overweight children. Reduced physical activity among children can result in a number of diseases in their adulthood. These diseases can include, but are not limited to, major risk factor for cardiovascular disease, stroke, diabetes, hypertension, and obesity. In addition, depression and anxiety can be contributing factors that have an impact on the mental and emotional health of children (Ziviani et al. 2006, 27).

A number of studies and surveys were conducted by the Federal Highway Administration in order to understand residents' travel behavior. From the results, it was found that in 1969, about half of all students walked or bicycled to school (FHWA Safety Program n.d.). In the 1995 Nationwide Personal Transportation Survey (NPTS), which was also conducted by The Federal Highway Administration (FHWA), it was indicated that children aged 5 to 15 made most of their trips (69 percent) by a private car. Twenty-six percent of these trips were travelling to school. Only 10.5 percent of children aged 5 to 9 walked to school, 52.8 percent were driven, 30.2 percent rode a school bus, and 6.5 percent traveled to school with other modes (McMillan 2005, 441). The same study indicated that most of the trips transferring children to school, social events, or health care are done by women in the household (McMillan 2005, 451).

In the Greater Toronto Area, Canada's largest city-region, the percentages of students walking to school also decreased over decades. For children aged 11-13 years,

53 percent used to walk to their schools in 1986, compared to 42.5 percent in 2006. For children aged 14-15 years, 38.6 percent of children used to walk compared to 30.7 percent over the same period (Buliung et al. 2009, 509).

Wong et al. conducted a study in Ontario, Canada in 2009 addressing the mode shifting in school travel mode for children reported to be actively transported to school. The results indicated that for elementary school students 38 percent of the sample was active in the morning (going to school), while the percentage increased to 47 percent in the afternoon (returning home). For the high school students, only 23 percent were active in the mornings compared to 32 percent in the afternoons (Wong et al. 2011, 5). The authors pointed out that those percentages are higher than those reported in the United States, similar to percentages in Australia and New Zealand, but lower than European countries. The results were expected for the authors because of the wide existence of neighborhood schools within neighborhoods established in the 19<sup>th</sup> century, before the car invention and its widespread after that. These neighborhoods were characterized by their grid street system and high land use density that encouraged the active modes of transportation (Wong et al. 2011, 9).

McDonald (2007) analyzed data from the 1969, 1977, 1983, 1990, 1995, and 2001 National Personal Transportation Surveys (NPTS) conducted by the U.S. Department of Transportation to document the active transportation changes and trends. The study indicated that in 1969, 66 percent of students lived less than 3 miles away from school, while in 2001 it is only 49.5 percent of students, which means that the distances between households and schools increased over the decades (McDonald 2007, 512). In the same study, McDonald stated that 85.9 percent of children living within one mile of

school used to walk or bike, compared to 49.9 percent in 2001 (McDonald 2007, 512). In Heelan's study, based on the 1995 NPTS, he stated that only 28 percent of children aged 5-15 years living within 1 mile of school used to walk in 1995. Furthermore, only 2.2 percent of children living within two miles of school biked to and from school (Heelan et al. 2005, 342). Thus, distances to schools appear to influence the likelihood of walking to and from the school.

Walking to school increases the physical activity done by children and helps reduce the childhood obesity that has more than tripled in the past 30 years. The Centers for Disease Control and Prevention (CDC) stated that the percentage of obese children aged 6-11 years in the United States increased from 7 percent in 1980 to nearly 20 percent in 2008. In the same manner, the percentage of obese adolescents aged 12-19 years increased from 5 percent to 18 percent over the same period (Centers for Disease Control and Prevention n.d.)

The practice of encouraging or even allowing children to walk to school has declined in some cities. This has been a result of considering walking to be a sign of low status, or an anti-cultural activity, despite of all the health benefits that walking provide to children and adults (Kearns, Collins and Neuwelt 2003, 286). Moreover, the increase in private car ownership has an effect on decreasing the children's freedom of movement and choosing the travel mode they prefer (Kearns, Collins and Neuwelt 2003, 286).

### **Schools locations**

A new trend in the United States and Canada took place following World War II which aimed at constructing spacious homes and buildings, separating work places from

homes, and extremely depending on cars even for local neighborhood trips. These postwar suburbs were known to be “designed for cars, not for people” (Randall and Baetz 2001, 1). During the same time, more than 50 years ago, the same trend encouraged building new larger schools in areas with low housing densities and low street network connectivity. This shifting happened due to the demand of having larger sport fields in the schools, which is difficult to have in older school’s neighborhoods (Schlossberg et al. 2006, 337). In addition, the only available large space is usually near the fringes of the cities. Most of the time, it is agricultural land being converted to residential purposes, with lower densities. These schools are built near high-capacity roads, which ease the car access to schools, as opposed to walking or biking access. However, many states have implemented new strict minimum acreage requirements for building new schools (Zhu and Lee 2009, S178).

Developers and planners tend to plan those new communities in favor of curvilinear patterns and cul-de-sacs that made these suburbs substantially distinct from older urban neighborhoods. They provided expansive residential lots, with obvious large houses, and boulevards (Randall and Baetz 2001, 2). As a result of this trend, distances to schools substantially increased, which resulted in a shift in the travel mode of children to schools.

### **Factors affecting children’s walking behavior**

The primary factor discussed in this study is the effect of the urban form of our communities on the children’s travel behavior. Urban form fundamentals include block

lengths, street widths, and presence of sidewalks may have a direct influence on walking and bicycling behavior in children. The increasing distances associated with different urban forms is also considered a main factor affecting the children's choices.

In a study that was done in Belgium by D'Haese et.al, a criterion distance was indicated for walking and biking to school for 11-12 year old children. The study included a sample of 696 parents from randomly selected 44 classes in elementary schools in Belgium. The results indicated that almost 60 percent of the total sample commuted actively to school, whether by walking or biking. The standard distance was set to be 1.5 kilometers (almost 1 mile) for walking, and 3 kilometers (almost 1.9 miles) for biking to school among the 11-12 years old Belgian children. The study also showed that in the range of 2 to 2.5 kilometers distance from school, the number of passive commuters (using inactive modes of transportation) exceeded the number of the active ones. D'Haese et al. suggested that improvements should be done in this criterion distances to promote more active commuting among the rest of the children living within this distance to school (D'Haese, et al. 2011, 4). The researchers also suggested that for children living more than 3 kilometers away from school, a possible way to promote active commuting is to drop off their kids at a reasonable distance (for example 1.5 kilometers) away from school, where they can meet other children, teachers, or volunteers and walk to school with them to ensure safety for children (D'Haese, et al. 2011, 7).

Parents' perceptions regarding safety are also very crucial in determining whether their children can walk to school or not. Traffic safety, accidents, and presence of strangers on the way to school were the main concerns addressed in most studies

(McDonald and Aalborg 2009, 336; Ziviani, Kopeshke and Wadley 2006, 31). Parents presume streets closest to schools to be the most dangerous locations for students walking or biking as a result of the school rush hour, and the traffic volumes at specific times (McMillan 2005, 441). Due to the same reason, children are having less independent play outside. However, the urban form may have an influence on some of the parents' decisions and perceptions about traffic safety, by constructing sidewalks or marking bicycle lanes.

Socioeconomic status seems to have an effect on parents' decision whether to allow their kids to walk to school or even have an outside activity or not. In a research article that used data collected by the Millennium Cohort Study (MCS)<sup>1</sup>, results found that as the socioeconomic status increased for the primary care provider for children, it was less likely that they walk to school. The socioeconomic status determined in this study was measured depending on the parental income and length of time in education. However, it was more likely that children will walk to school if the family does not have a private car, if one of the parents is not working, or if they live in an urban area. Yet, children are also more likely to walk to school if their families have high income but physically active and allow them to participate in organized sports. In general, depending on this study, income plays an important role in determining the children behavior at young age, where one of the parents usually walks with them, but it may not have the same effect on older children. However, the cohort study did not measure the distance to school, which may be an important determinant than income (Brophy, et al. 2011, 2).

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<sup>1</sup> The Millennium Cohort Study (MCS) is a study that follows the lives of a sample of 18,552 babies born between 1 September 2000 and 31 August 2001 in England and Wales, and between 22 November 2000 and 11 January 2002 in Scotland and Northern Ireland.

Ethnicity of families was also addressed in many studies. Although some of the studies indicated that low-income or minority children walk more often to school, other studies indicated that these factors are not significant. However, other factors like crime rate and neighborhood safety can be related to lower-income districts, and results in affecting the rates of children who can walk safely to their schools (Zhu and Lee 2008, 282). Zhu and Lee (2008) led a study trying to understand the relationship between ethnicity and children's behavior. Their analysis for their case studies suggested that Hispanic children tend to live closer to school; they have more sidewalks in their neighborhoods, and may tend to use active transportation as a mode to get to school, as they might not have other options, depending on their socioeconomic status. However, safety in those neighborhoods may alter the children's and their parents' decisions. Thus, ethnicity might not be one of the effecting factors on the choice of whether to walk to school or not (Zhu and Lee 2008, 289).

McDonald prepared a comparable study using data from the 2001 National Household Travel Survey<sup>2</sup>, to document rates of walking and biking to school among low-income and minority youth in the U.S. The results found that race and income have significant effect on rates of active transportation. For example, Hispanics were more likely to walk to and from school than others. Also, students from higher-income families (earning more than \$60,000) were less likely to actively commute to school compared to students from lower-income families (earning less than \$30,000). However, these results are affected with other explanatory factors, such as that whites are the least likely to live

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<sup>2</sup> The 2001 National Household Travel Survey is a population based survey conducted by the U.S. Department of Transportation that collects information on all trips undertaken by members of selected households on a randomly assigned survey day.

within a half-mile distance from school, they have higher incomes, high levels of vehicle access, and live in lower-density areas, which may explain the lowest rates of walking and biking to school between the Whites. Moreover, this study confirms that distance is greatly associated with choosing to actively commute to school or not. Students living within half-mile of school were more likely to walk or bike across all groups (McDonald 2008, 342, 343).

In another study that was done in Canada by Pabayo et al. (2011), the data used was from a study conducted by the Canadian National Longitudinal Study of Children and Youth (NLSCY)<sup>3</sup>. The study aimed the socio-demographic factors affecting the likelihood of active transportation to school across time. The results showed that children are more likely to walk at age 6, and peak at age 10 years, and then their active transportation decrease throughout the teenage years. It is believed that when children are more than 10 years old, they move to middle and high schools, which can be located further away from home, and so they need a different kind of transportation, which in turn show that distance to school is related to active transportation to school (Pabayo, Gauvin and Barnett 2011, e408, e409). Also, the study's results showed that income and marital status of the parents can have an influence on the children's behavior. Income inadequacy (depending on the income and number of people in the household) and single parenthood were significant determinants for increasing likelihood for children to walk to school. Those families may have limited transportation alternatives, which led to more

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<sup>3</sup> The Canadian National Longitudinal Study of Children and Youth (NLSCY) was conducted by statistics Canada in 1994 and 1995 among 22,831 children aged 0 to 11 years from the 10 provinces of Canada. The study followed the development and well-being of children every 2 years done on 4 cycles.



active behavior in their children. Also, having older siblings in the household increased the chances of walking to school (Pabayo, Gauvin and Barnett 2011, e408, e410).

Few studies aimed the active commuting for adolescents. Babey et al. led a study that addressed adolescents aged 12-17 years. The research used data from the 2005 California Health Interview Survey for 3,983 adolescents. The study found that males, adolescents from lower-income families, those who have no adult present at home most of the time, and those attending public school are more likely to actively commute to school. Also, those who live in urban areas were more likely to walk or bike to school than those living in rural or suburban areas (Babey, et al. 2009, S209).

### **Policies and programs adopted to promote children's safe and active travel**

Federal and state governments are adopting some policies and programs to alter the trend of having parents driving their kids to school. One of these programs is Safe Routes to School (SRTS). It is a Federal-Aid program of the U.S. Department of Transportation's Federal Highway Administration (FHWA) (FHWA Safety Program n.d.). SRTS is a national and international movement directly aiming the child's trip to school. The program is trying to create a safe, convenient, and fun opportunities for children to walk and bike to and from their schools, and reverse the decline in children walking and biking to schools, along with reversing the alarming nationwide trend toward childhood obesity and inactivity. Their goal is to make walking and biking to school a safe routine activity once again on an everyday basis. The funding for the program is used to build safer environment and safer street crossings to encourage children and parents to walk or bike safely to school (FHWA Safety Program n.d.).

Safe Routes to School programs comprise the five E's which are education (for the child and driver on road safety), encouragement, engineering and infrastructure, enforcement of traffic laws around schools, and evaluation, in order to have successful program (Safe Routes to School National Partnership n.d.).

SRTS vision focuses on having a safer way to get to school. This concept can be performed by:

- Building sidewalks, bicycle paths and pedestrian-friendly infrastructure
- Reducing speeds in school zones & neighborhoods
- Addressing distracted driving among drivers of all ages
- Educating generations on pedestrian & bicycle safety

Also, they focus on having a healthier way for children to start their day. They emphasize the healthy benefits gained from walking, rolling and biking to school like increasing the daily physical activity, and arriving at school energized and ready to learn. SRTS highlights one more benefit from walking to school which is building relationships and the sense of neighborhood (National Center for Safe Routes to School n.d.).

The International Walk to School Day is also a good presentation of how important it is for children to walk to their schools. It first began in the United States in 1997 as a one-day event aimed at building awareness for the need of having walkable communities. The United Kingdom and Canada joined the move in 2000. Nowadays thousands of schools across the United States participate in this day along with more than 40 countries worldwide (Walk Bike to School n.d.).

Walking school bus (WSB) is another implemented program addressing children and encouraging them to walk to school. The idea is very simple. Walking school bus is a group of children walking to school with one or more adults. It can be a small bus of two families taking turns, or a structured big one with meeting points and picking up additional children along the way. It is considered an attempt to reduce the risks of children walking to and from schools. The idea of WSB started in 1998 in a school in England. It reduced the car travel to this school by 30 percent in one year. Then the idea was transferred to the rest of the countries (Kearns, Collins and Neuwelt 2003, 286).

Children usually like the idea of the walking school bus. Children being independent promotes both personal and environmental health. Besides, it is a practical education on how to cross the road safely (Kearns, Collins and Neuwelt 2003, 287). WSB allows children to engage in exercise, helps them explore their surrounding environment, and promotes social interaction. However, many American school districts refuse to sponsor the Walking School Bus due to liability. It is a main concern for schools to be liable for any injuries that may occur during the walk to school (McDonald and Aalborg 2009, 338).

## **Chapter 3: Analysis and Results**

### **Case study selection**

Geographic Information System (GIS) is now widely used in many applications. This research utilized Network analysis as one of the tools used to select two middle schools in Lincoln, Nebraska as case studies so that they are located in different urban neighborhoods. We selected to perform the analysis on the middle school children for the following reasons: the students are big enough to walk themselves to school, parents have more confidence regarding the safety of their older children walking to school, and the children are mature enough to answer the survey questions themselves.

By using Network analysis, four polygons were created around Lincoln's middle schools. These polygons define four walking/driving distances around those schools. This analysis used the network data set of streets. Figure 3.1 is a map that shows the polygons around Lincoln middle schools.

The polygons represent the distances of a quarter mile, a half mile, three quarters of a mile, and a one mile driving distances around middle schools. By assuming that all streets have sidewalks (on either side or both) that students can use to walk to their schools, we accept those polygons to present the walking distance as well.

From Figure 3.1, we can realize that there are some clear differences between the shapes and areas of those polygons. The schools that are constructed in a grid system neighborhood type have regular shaped polygons that look more like rhombus, where their two diagonals are perpendicular. While polygons around schools constructed in Lincoln's suburbs, near its city limits, may look different.

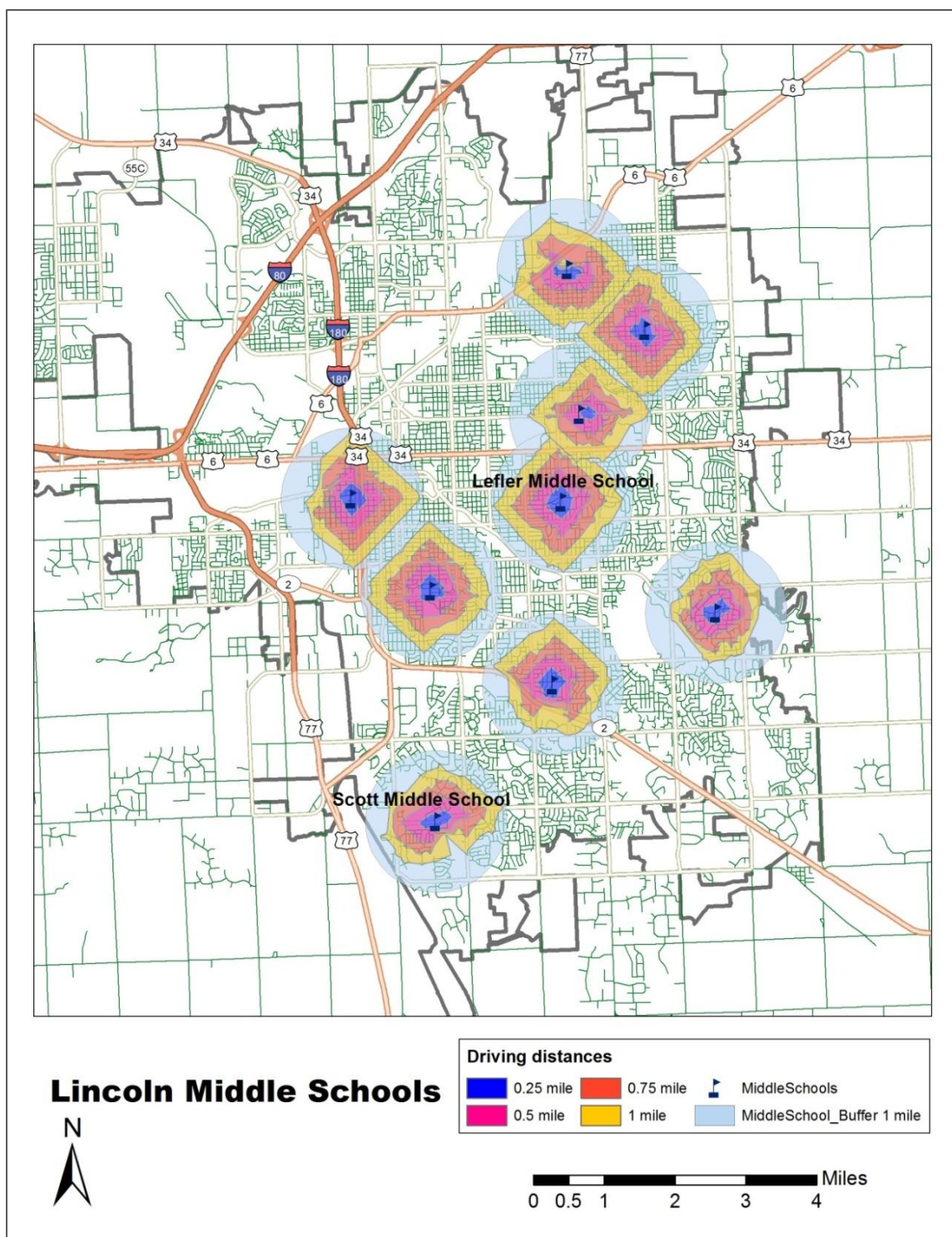


Figure 3.1 A map showing the polygons around Lincoln middle schools.

Two middle schools were selected, based on this approach, with different polygons shapes. The first is Lefler Middle School; it is located at Randolph and 48<sup>th</sup> Streets, near the city center. The second is Scott Middle School; it is located at Pine Lake and 22<sup>nd</sup> Streets close to Lincoln's city limits. Figure 3.2 and Figure 3.3 show a closer look at those two schools.

A buffer zone of one mile was also created around each of those schools. With a quick comparison between the two schools, it was found that the polygons around Scott middle school (Figure 3.3) seem to be irregular compared to those around Lefler middle school (Figure 3.2).

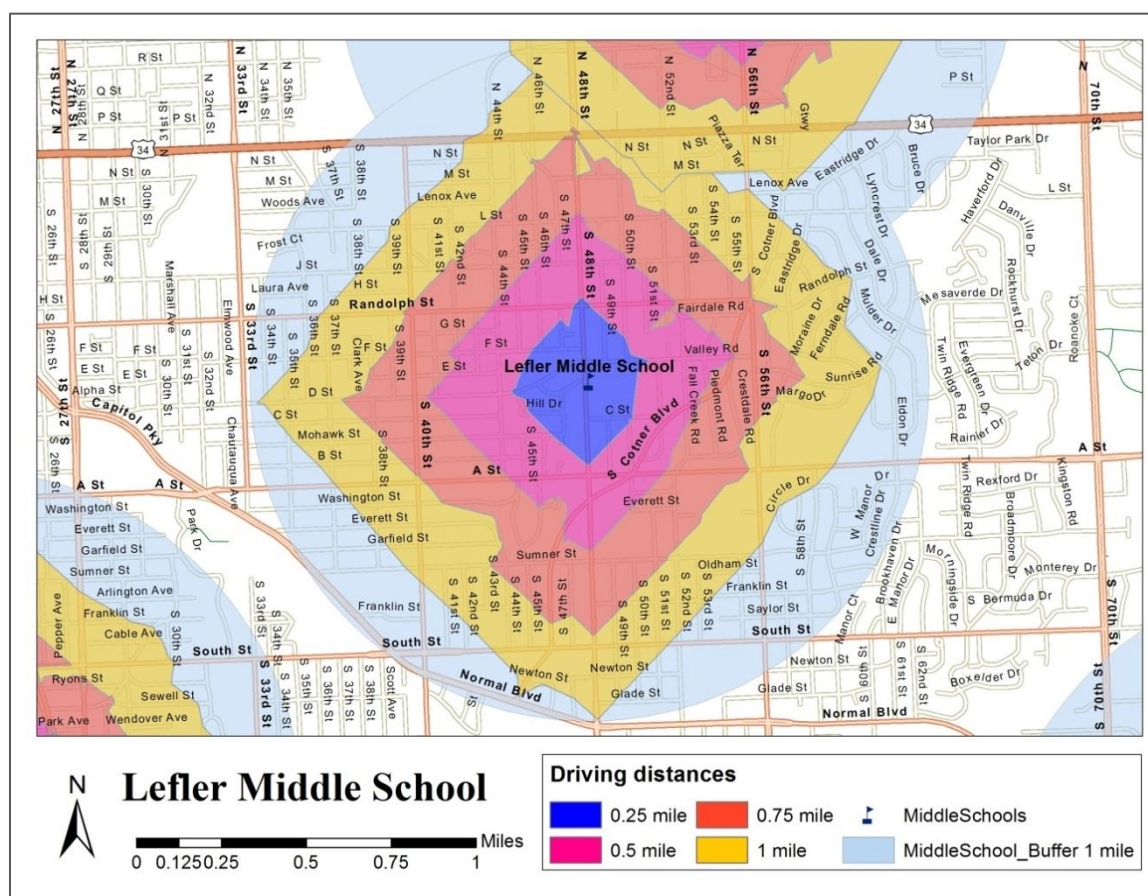


Figure 3.2 A map for driving distances to Lefler Middle School



Lefler Middle School is located in the center of Lincoln, Nebraska with a grid street system around it, and high level of connectivity. This grid system justifies the regularity in the polygons, and indicates that the distances to the school can be shorter and more direct.

Scott Middle School is located near the city limits, with fewer numbers of streets from the west and south sides. Streets located on the north and east sides of the school contain numbers of cul-de-sacs and dead-end streets that lack connectivity. Those kinds of streets seem to increase the walking/driving distance for those residents, either to reach the nearest school or the nearest community facility.

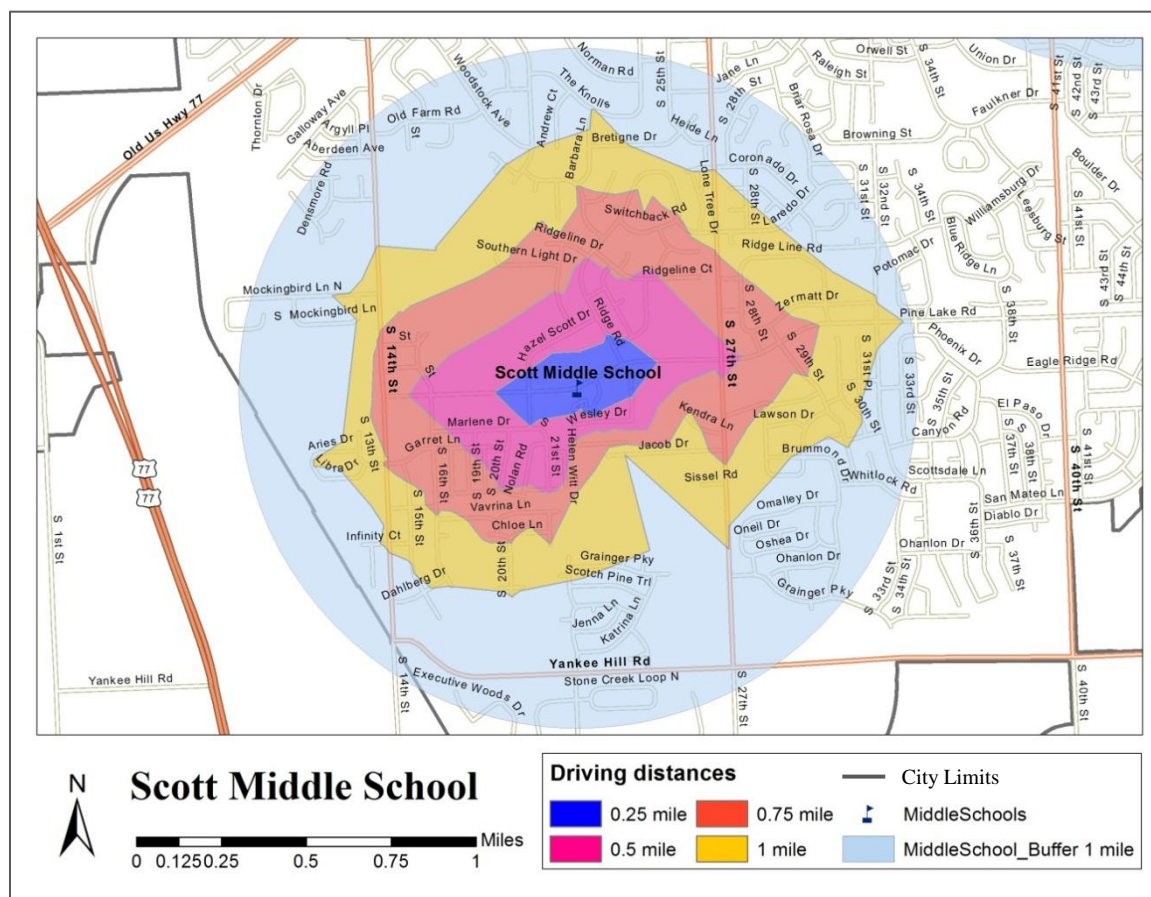
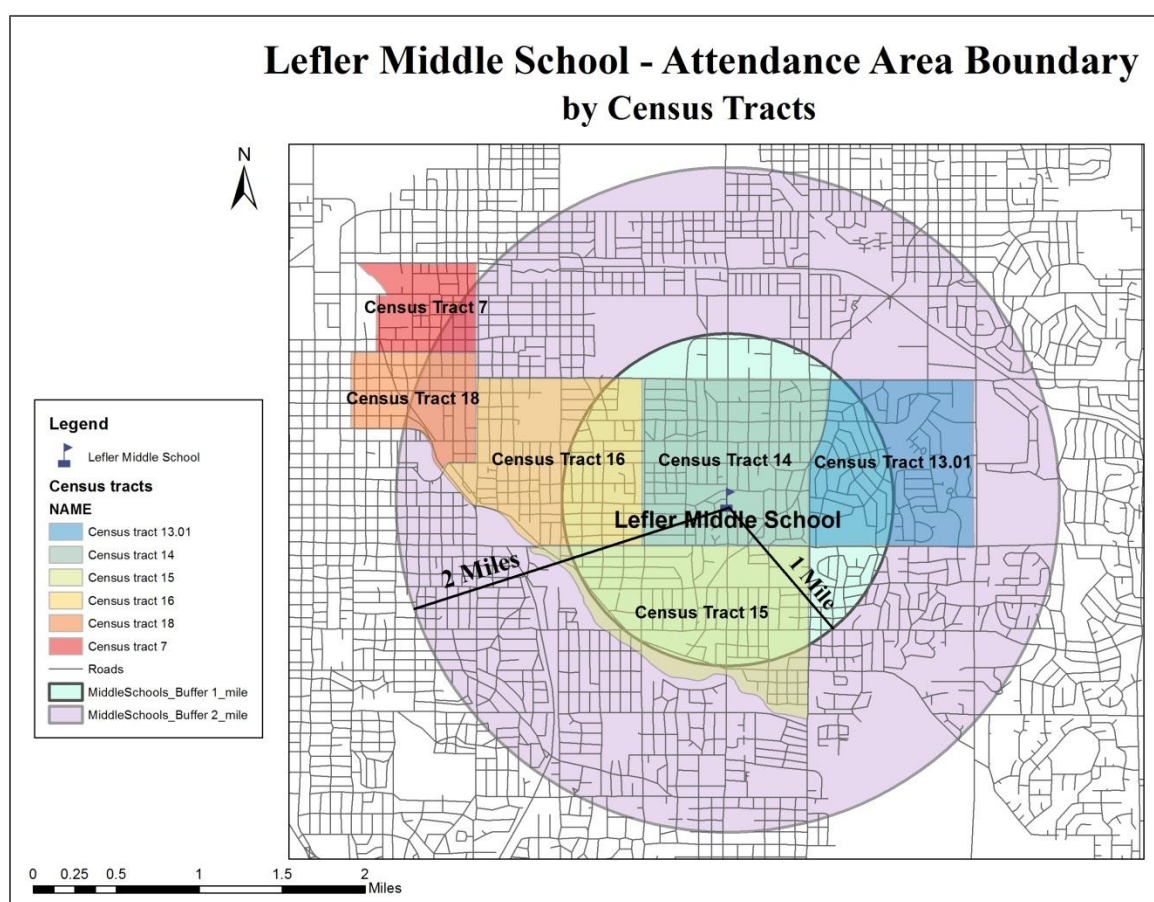


Figure 3.3 A map for driving distances to Scott Middle School

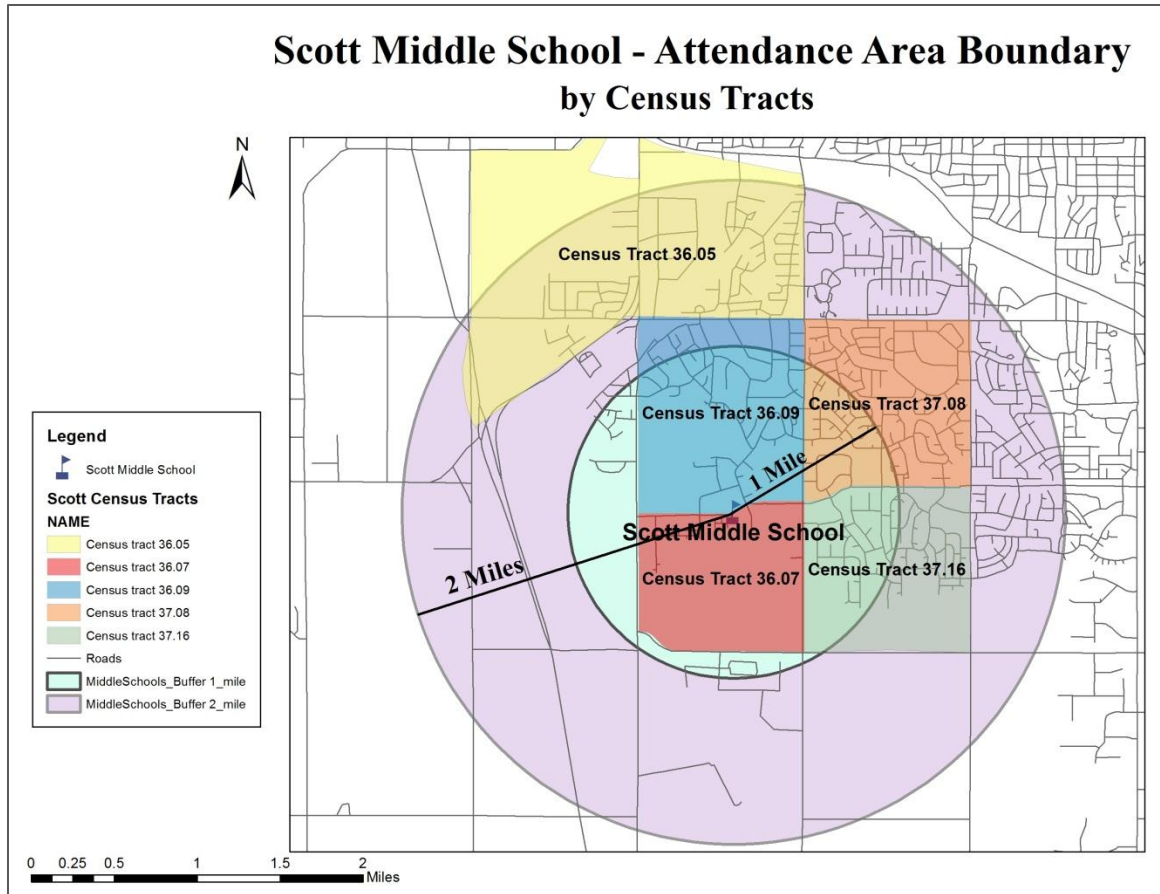
## Differences between the two neighborhoods

By looking at the 2011 – 2012 middle school attendance areas map provided by Lincoln Public Schools, it was found that there are six census tracts surrounding Lefler Middle School, and there are five census tracts surrounding Scott Middle School. Those census tracts are considered the attendance areas for our selected schools. Figure 3.4 and Figure 3.5 show these census tracts and one mile buffer zone around those two schools.



**Figure 3.4 Lefler Middle School – Attendance area boundary by Census Tracts**





**Figure 3.5 Scott Middle School – Attendance area boundary by Census Tracts**

From the literature review, we found that income and education attainment could be good measures of socioeconomic status. We examined those factors for the census tracts available around those schools. From Census 2010, it was found that the average median household income for census tracts 7, 13.01, 14, 15, 16, and 18, where Lefler middle school is located, is \$40,036. While for census tracts 36.05, 36.07, 36.09, 37.08, and 37.16, where Scott middle school is located, the average median household income is \$81,193 based on the data collected by the American Community Survey for 5-year estimates (American Fact Finder n.d.).

Also, educational attainment data were gathered from Census 2010 for those census tracts. It was found that the percentage of population 25 years and over that holds a bachelor's degree or higher differs from one neighborhood to another. For the census tracts located at the attendance area of Lefler School, the average percentage was 34.5 percent for the whole population 25 years and over. However, it was 58.4 percent for the census tracts located around Scott School, based on the data collected by the American Community Survey for 5-year estimates (American Fact Finder n.d.).

By looking at the 2010 census summary file 1 of the general housing characteristics data available from the U.S. Census Bureau, it was found that the average percentage for owner occupied housing units is 46 percent from the total housing units for census tracts surrounding Lefler School, compared to 73.8 percent for census tracts surrounding Scott School (American Fact Finder n.d.).

In addition, from Census 2010, it was found that the median year that structures were built in these census tracts are different. The average median year for structures built in attendance area around Lefler School is 1958; while the average median year for available data for structures built around Scott School is 1990. These data illustrate the huge difference between the ages of the buildings in those two areas based on the data collected by the American Community Survey for 5-year estimates (American Fact Finder n.d.).

All the data gathered for the surrounding neighborhoods and census tracts give us an idea that the two neighborhoods are different in many ways. The socioeconomic status seems to be higher for Scott Middle School boundaries, depending on the data for median

household income and the level of education achieved. Moreover, from the general housing characteristics data, we found that the percentage of owners occupying housing units is higher for Scott School boundaries than Lefler School boundaries. Even the structures built around Scott School are newer than those around Lefler School. A detailed table for these data is presented at Appendix B.

### **Differences between the two schools**

More data was gathered about those two schools from the facilities section of the annual statistical handbook prepared by Lincoln Public Schools. It was found that the original building of Lefler Middle School was built at 1955. Its area was 83,498 square feet on two floors. Three additions were added later to reach a total of 130,580 square feet. The site area is 12.28 acres. The number of students in Lefler Middle School is 591 students. The area for each student is 221 square feet per student from the total building area, and about 905 square feet per student (0.02 acre per student) from the total site area (Annual Statistical Handbook 2011-2012).

The original building of Scott Middle School was built at 1996. Its area was 154,404 square feet on one level. The first addition was added in 2008 to reach a total of 159,255 square feet. The site area is 20.47 acres. The number of students in Scott Middle School is 924 students. The area for each student is 172 square feet per student from the total building area, and about 965 square feet per student (0.022 acre per student) from the total site area (Annual Statistical Handbook 2011-2012). Table 3.1 summarizes these differences.

**Table 3.1 Differences between the two schools**

	<b>Year built</b>	<b>Acres</b>	<b>Square footage</b>	<b>Student capacity</b>
<b>Lefler Middle School</b>	1955	12.28 acres	130,580 square feet	591 students
<b>Scott Middle School</b>	1996	20.47 acres	159,255 square feet	924 students

From the literature review, we found that newer schools tend to be bigger in area, and require more space for each student. In our case study, the site area of Scott School is larger than that of Lefler School, due to its location near Lincoln suburbs and the city limits. However, the number of students in the first is bigger than the latter, which justifies the insignificant differences between the actual areas per student in both schools. However, on the contrary, the student area in the building itself is more in Lefler Middle School.

From the student section of the annual statistical handbook prepared by Lincoln Public Schools, we found that 53.5 percent of the students at Lefler Middle School are participating in the free or reduced price lunch program during the 2011-2012 school year, compared to only 13 percent at Scott Middle School (Annual Statistical Handbook 2011-2012). This information settles the idea that Scott School has a higher socioeconomic status than Lefler School.

## **Survey**

Another aspect of this research was conducting a survey for the students from both schools. As it was indicated before that we selected middle school children (aged 11 to 14 years old) to perform this analysis as they are big enough to walk to school and understand the safe issues that may impede their way.

All the surveys' packages were sent to the principals of the schools in February 2012. The principals were responsible for distributing the surveys among their students in different grades. The researcher had no control after handing the surveys to the principals. The principals received all the completed surveys and sent them to the researcher in May 2012. The survey conducted took approximately 15 minutes to be completed. It included 17 questions which required either a multiple choice response or a judgment using a rating scale.

The first section in the survey asked basic demographic questions, including the student's grade, gender, and race. The second section is the research data needed. It contains questions about distances between schools and residences (from the child perspective). A map was provided with the survey for both schools, showing different buffer distances around schools to help students answer this question as accurate as they can to their best knowledge. The maps used are in Appendix C. Questions also were asked on how they usually get to school and the child's preferred choice whether to walk, bike, use a bus, or any other form of transportation on a good weather day. More questions in this section were about the availability of a private car, school bus, or a bicycle.

The third section in the survey is about the child's perceptions about walking to school. The children were asked how do they feel about walking to school, whether it is fun, boring, safe, unsafe, healthy, not healthy, and whether it saves time or not. Also, there were questions asking about the availability of continuous sidewalks all the way to school and rating those sidewalks around the school, along with describing the surrounding environment. Appendix C includes the survey questions that were used.

## Analysis of the Results

One hundred and thirty-six surveys were returned from eight hundred and forty sent to students. Only one hundred and sixteen of these responses were usable and have the required signed consents and assents. The sample size from Lefler Middle School is 56, while the sample size from Scott Middle School is 60.

Descriptive statistics were calculated using SPSS. Frequency distributions summarized the majority of the data. Chi-squared tests were also performed to test the relationship between the distances from home to school and type of transportation that student usually choose to get to school.

Table 3.2 summarizes the demographic division of the sample we have got from both schools. From Table 3.2, we can tell that 50% of the responses came from grade 8; however we are not sure that the surveys were evenly distributed between the 3 grades in the schools. From our sample size, 47.4 % were males and 51.7 % were females. Students who responded to the survey reflect percentages from all races joining the two schools. As would be expected from a Lincoln-based sample, 81.9 % from our sample are White/ Caucasian, 4.3 % are Asian, 2.6 % are Black/ African American, and other races also responded to our survey.

Table 3.3 shows the frequency distributions of how far our sample lives away from school, and how they usually get to school. We can see that 28.3% of our sample in Scott Middle School live more than 2 miles away from school compared to only 10.7 % at Lefler Middle School. Also, from Table 3.3, we found that the largest portion of students (75.9%) is usually driven to school by either their parents, or someone else. 69.6

% of students are driven to Lefler Middle School, while 81.7 % are driven to Scott Middle School. 12.5% of the sample at Lefler School walk to their schools, while nobody walks to Scott Middle School. These findings matched those from the literature review found in McDonald's, Heelan's and McMillan's studies (McDonald 2007; Heelan, et al. 2005; McMillan 2005).

**Table 3.2 Frequency distributions of demographic data**

	<b>Total</b>		<b>Lefler Middle School</b>		<b>Scott Middle School</b>	
	n= 116	%	n=56	%	n=60	%
<b>Grade</b>						
6	47	40.5 %	29	51.8 %	18	30 %
7	11	9.5 %	11	19.6 %	0	0 %
8	58	50 %	16	28.6 %	42	70 %
<b>Gender</b>						
Male	55	47.4 %	29	51.8 %	26	43.3 %
Female	60	51.7 %	26	46.4 %	34	56.7 %
Unanswered	1	0.9 %	1	1.8 %	0	0 %
<b>Race</b>						
White/Caucasian	95	81.9 %	41	73.2 %	54	90 %
Black/African American	3	2.6 %	2	3.6 %	1	1.7 %
American Indian/Alaska Native	1	0.9 %	0	0%	1	1.7 %
Asian	5	4.3 %	3	5.4 %	2	3.3 %
Other	10	8.6 %	8	14.3 %	2	3.3 %
Prefer not to answer	2	1.7 %	2	3.6 %	0	0 %

A detailed cross tabulation for Lefler and Scott Middle Schools for how the students usually get to their schools in relationship with how far away they live from school is shown in detailed tables in Appendix D. It is noticeable that no matter what the distance was between homes and school, students are used to be driven.

**Table 3.3 Frequency distributions of how far children live away from school and how they usually get to school**

	<b>Total</b>		<b>Lefler Middle School</b>		<b>Scott Middle School</b>	
	n=116	%	n=56	%	n=60	%
<b>Distance from School</b>						
Less than 1/4 mile	6	5.2 %	3	5.4 %	3	5.0 %
1/4 mile to 1/2 mile	7	6 %	4	7.1 %	3	5.0 %
1/2 mile to 1 mile	24	20.7 %	14	25.0 %	10	16.7 %
1 mile to 2 miles	55	47.4 %	28	50.0 %	27	45.0 %
More than 2 miles	23	19.8 %	6	10.7 %	17	28.3 %
Left unanswered	1	0.9 %	1	1.8 %	0	0%
<b>Usually get to school</b>						
Walk	7	6 %	7	12.5 %	0	0 %
Bike	8	6.9 %	4	7.1 %	4	6.7 %
School Bus	5	4.3 %	0	0 %	5	8.3 %
Parents Drive	72	62.1 %	34	60.7 %	38	63.3 %
Older brother/sister drive	4	3.4 %	0	0 %	4	6.7 %
Someone else drives	12	10.4 %	5	8.9 %	7	11.7 %
Ride city bus	7	6 %	5	8.9 %	2	3.3 %
Skate board	1	0.9 %	1	1.8 %	0	0 %

To simplify the data we have, the categories were combined together so that the active types of transportations like walking, biking, and skate boarding are regrouped. Also, other types of driving, like parents driving, or someone else driving, were combined in one category. Table 3.4 and Table 3.5 illustrate the results we got.



**Table 3.4 Cross tabulation for how students usually get to school related to the distance to Lefler Middle School**

<b>Lefler School</b>		<b>How do students usually get to school</b>			<b>Total</b>
		Active	Driving	Ride city bus	
<b>Distance from School</b>	Less than ¼ mile	1	2	0	3 (5.5%)
	¼ mile to ½ mile	2	2	0	4 (7.3%)
	½ mile to 1 mile	3	11	0	14 (25.5%)
	1 mile to 2 miles	6	19	3	28 (50.9%)
	More than 2 miles	0	5	1	6 (10.9%)
<b>Total</b>		12 (21.8%)	39 (70.9%)	4 (7.3%)	55 (100%)

**Table 3.5 Cross tabulation for how students usually get to school relate to the distance to Scott Middle School**

<b>Scott School</b>		<b>How do students usually get to school</b>				<b>Total</b>
		Active	Driving	School Bus	Ride city bus	
<b>Distance from School</b>	Less than ¼ mile	1	2	0	0	3 (5%)
	¼ mile to ½ mile	1	2	0	0	3 (5%)
	½ mile to 1 mile	0	10	0	0	10 (16.7%)
	1 mile to 2 miles	1	24	0	2	27 (45%)
	More than 2 miles	1	11	5	0	17 (28.3%)
<b>Total</b>		4 (6.7%)	49 (81.7%)	5 (8.3%)	2 (3.3%)	60 (100%)

From Table 3.4 and Table 3.5, we found that 21.8% of students are usually active going to Lefler School, while only 6.7% of the Scott Middle School sample is active. However, the largest share is for driving to both schools.

By performing Chi-Square analysis on the data obtained from Scott Middle School, the observed value of Pearson Chi-Square  $X^2$  is 23.878, the asymptotic  $p$ -value is 0.021, and the exact  $p$ -value is 0.041. Therefore, there is a statistically significant

relationship between the distances from home to Scott Middle School and type of transportation that student usually choose. While for Lefler Middle School the relationship was not statistically significant with asymptotic  $p$ -value 0.625, exact  $p$ -value is 0.646, and Pearson Chi-Square  $X^2$  is 6.199.

A cross tabulation between the students' grades and the kind of transportation they use to get to school revealed new thoughts. From Table 3.6, we realized that when children in Lefler Middle School are older, the probability that they use active transportation increases, and the percentages of being driven to school decreases. While for Scott Middle School, shown in Table 3.7 when the children gets older the percentages of children being active decreased, and the percentages of being driven to school increased.

**Table 3.6 Cross tabulation with percentages for the students' grades and the means of transportation used to get to Lefler School**

Lefler Middle School		Grade			Total
		6	7	8	
Active	Count	3	4	5	12
	% within means of transportation	25.0%	33.3%	41.7%	100.0%
	% within Grade	10.3%	36.4%	31.3%	21.4%
	% of Total	5.4%	7.1%	8.9%	21.4%
Drive	Count	23	7	9	39
	% within means of transportation	59.0%	17.9%	23.1%	100.0%
	% within Grade	79.3%	63.6%	56.3%	69.6%
	% of Total	41.1%	12.5%	16.1%	69.6%
Ride city bus	Count	3	0	2	5
	% within means of transportation	60.0%	0%	40.0%	100.0%
	% within Grade	10.3%	0%	12.5%	8.9%
	% of Total	5.4%	0%	3.6%	8.9%
Total	Count	29	11	16	56
	% within means of transportation	51.8%	19.6%	28.6%	100.0%
	% within Grade	100.0%	100.0%	100.0%	100.0%
	% of Total	51.8%	19.6%	28.6%	100.0%

**Table 3.7 Cross tabulation with percentages for the students' grades and the means of transportation used to get to Scott School**

Scott Middle School		Grade		Total
		6	8	
Active	Count	2	2	4
	% within means of transportation	50.0%	50.0%	100.0%
	% within Grade	11.1%	4.8%	6.7%
	% of Total	3.3%	3.3%	6.7%
Drive	Count	13	36	49
	% within means of transportation	26.5%	73.5%	100.0%
	% within Grade	72.2%	85.7%	81.7%
	% of Total	21.7%	60.0%	81.7%
School bus	Count	2	3	5
	% within means of transportation	40.0%	60.0%	100.0%
	% within Grade	11.1%	7.1%	8.3%
	% of Total	3.3%	5.0%	8.3%
Ride city bus	Count	1	1	2
	% within means of transportation	50.0%	50.0%	100.0%
	% within Grade	5.6%	2.4%	3.3%
	% of Total	1.7%	1.7%	3.3%
<b>Total</b>	Count	18	42	60
	% within means of transportation	30.0%	70.0%	100.0%
	% within Grade	100.0%	100.0%	100.0%
	% of Total	30.0%	70.0%	100.0%

When asking about the students' choice on how to get to school on a good weather day, they were allowed to select all that they like. The answers varied a lot. For Lefler Middle School, only 28.6 % selected walking as their primary choice, while 48.2% selected biking as their first or second choice on how to get to school. While considering skate boarding, and roller blading active types of transportation, 9% selected those types as their first choice. However, 35.7 % selected driving as their first and second choices to get to school.

For Scott Middle School, the results came to be very close to Lefler's. Only 28.3% selected walking as their primary choice, which is exactly the same percentage as Lefler's. 35% selected biking as their first or second choice, while 45% selected driving as their primary choice to get to school.

The responses of this question gave us an idea that a good percentage of students may prefer to walk or bike to school, while there may be other barriers preventing them. We can also realize that a bigger percentage in Scott Middle School decided to be driven anyway. That may be due to the longer distances to school.

One of the questions that were asked in the survey is about the direction of the driver after dropping off the students in school. In Table 3.8, we found that for Lefler School, 53.6 % of the drivers, either parents or someone else, were going somewhere else after that, while only 35.7% were going back home. For Scott School, the percentage for drivers going somewhere else was higher (71.7 %). The missing data from both schools were for students walking, riding a city bus, or riding the school bus in the case of Scott School. For both schools, these high percentages indicate the convenience of the drivers just to drop off the students on their way to work or any other place.

**Table 3.8 The destination of the driver after dropping off the children**

	<b>Lefler Middle School</b>		<b>Scott Middle School</b>	
	n=56	%	n=60	%
Going somewhere else	30	53.6 %	43	71.7%
Going home	20	35.7 %	11	18.3 %
Left unanswered	6	10.7 %	6	10 %
<b>Total</b>	<b>56</b>	<b>100 %</b>	<b>60</b>	<b>100 %</b>

The data collected from the two schools also contained the availability of owning a bicycle, parents owning private cars, and school bus availability. The data presented in Table 3.9 shows that more than 75% of the students own bicycles, although, from table 3.3, only less than 8% use them to bike to school. More than 94% of the parents own a private car. By checking the transportation services on the Lincoln Public schools website, it was found that there is no regular school bus for Lefler Middle School, while there is a regular one for Scott Middle School, which agrees with the results we got from our survey.

**Table 3.9 Frequency distributions of school bus, bicycle and car availability**

		<b>Lefler Middle School</b>		<b>Scott Middle School</b>	
		n=56	%	n=60	%
<b>School bus availability</b>	Yes	4	7.1 %	23	38.3 %
	No	50	89.3 %	36	60 %
	Unanswered	2	3.6 %	1	1.7 %
<b>Bicycle owned</b>	Yes	43	76.8 %	53	88.3 %
	No	12	21.4 %	6	10 %
	Unanswered	1	1.8 %	1	1.7 %
<b>Car availability</b>	Yes	53	94.6 %	59	98.3 %
	No	2	3.6 %	0	0 %
	Unanswered	1	1.8 %	1	1.7 %

Table 3.10 shows how students feel about walking to school. More students in Lefler School feel that walking to school is fun. Although more students in Scott School feel that walking to school is safe, their percentage of being active going to school is lower than that of Lefler School.

**Table 3.10 How students feel about walking to school.**

How do you feel about walking	Lefler Middle School		Scott Middle School	
	n=56	%	n=60	%
So Fun	11	19.6 %	8	13.3 %
Fun	22	39.3 %	16	26.7 %
Neutral	12	21.4 %	25	41.7 %
Boring	11	19.6 %	8	13.3 %
So Boring	0	0 %	3	5.0 %
Very Safe	9	16.15 %	21	35.0 %
Safe	25	44.6 %	20	33.3 %
Neutral	19	33.9 %	13	21.7 %
Unsafe	2	3.6 %	4	6.7 %
Very unsafe	1	1.8 %	2	3.3 %
Very Healthy	39	69.6 %	49	81.7 %
Healthy	11	19.6 %	7	11.7 %
Neutral	3	5.4 %	1	1.7 %
Unhealthy	2	3.6 %	2	3.3 %
Very unhealthy	1	1.8 %	0	0 %
Left unanswered			1	1.7 %
So Cool	9	16.1 %	8	13.3 %
Cool	18	32.1 %	23	38.3 %
Neutral	23	41.1 %	24	40.0 %
Uncool	5	8.9 %	1	1.7 %
So uncool	1	1.8 %	3	5.0 %
Left unanswered			1	1.7 %
Very Time saving	1	1.8 %	2	3.3 %
Time saving	4	7.1 %	8	13.3 %
Neutral	21	37.5 %	9	15.0 %
Not time saving	13	23.2 %	13	21.7 %
Does not save time at all	17	30.4 %	28	46.7 %

More than 90% of the students in both schools agreed that walking to school is healthy. However, 4.3 % of students in both schools indicated that walking is unhealthy. The latter percentage indicated that there should be more educational programs in schools explaining the benefits of walking in general, and its importance for kids and adults of all ages. A high percentage of students agreed that walking to school is not time saving. It is believed that their answers depend on how far they live from school.

Table 3.11 displays the students' answers about having continuous sidewalks all their way to school, and their rating to those sidewalks. The results came to be good where more than 65% indicated that there are continuous sidewalks to both schools, with average good rating. The strange results were that 65% of our sample from Scott Middle School indicated that the sidewalks are good, while only 6.7% shows active going to school. Also, 46.6% from Lefler School indicated that the sidewalks are good. It is believed that for Scott Middle School having been located in a newer developed area, compared to the area surrounding Lefler Middle School, is why the sidewalks are good.

**Table 3.11 Frequency distributions for the presence of continuous sidewalks and their ratings.**

		<b>Lefler Middle School</b>		<b>Scott Middle School</b>	
		n=56	%	n=60	%
<b>Continuous Sidewalks</b>	Yes	37	66.1 %	44	73.3 %
	No	18	32.1 %	15	25 %
	Unanswered	1	1.8 %	1	1.7 %
<b>Rating Sidewalks</b>	Very bad	2	3.6 %	2	3.3 %
	Bad	8	14.3 %	2	3.3 %
	Not bad or good	18	32.1 %	14	23.3 %
	Good	20	35.7 %	23	38.3 %
	Very good	6	10.7 %	16	26.7 %
	Unanswered	2	3.6 %	3	5 %

A cross tabulation between the means of transportation of children and their rating for the sidewalks led to a new assumption. We noticed from Table 3.12 and Table 3.13 that a big number of students who are driven to both schools confirmed that the sidewalks' conditions are either good or very good.

**Table 3.12 Cross tabulation for means of transportation and rating the sidewalks for Lefler School**

<b>Lefler Middle School</b>		Means of transportation			Total
		Active	Drive	Ride city bus	
Rate sidewalks	Very bad	1	1	0	2
	Bad	4	3	1	8
	Not bad or good	4	10	4	18
	good	2	18	0	20
	very good	1	5	0	6
Total		12	37	5	54

**Table 3.13 Cross tabulation for means of transportation and rating the sidewalks for Scott School**

<b>Scott Middle School</b>		Means of transportation				Total
		Active	Drive	School bus	Ride city bus	
Rate sidewalks	Very bad	1	0	1	0	2
	Bad	0	2	0	0	2
	Not bad or good	2	10	1	1	14
	good	1	22	0	0	23
	very good	0	14	1	1	16
Total		4	48	3	2	57

Students were asked what they see on their way to school. They had the opportunity to select all that apply. More than 75% answered that they see trees, occupied buildings, neighbors and strangers on their way to Lefler School. However, more than 50% answered that they see parks, dogs, gas stations, parking areas, and trash. For Scott School, more than 75% answered that they see trees, occupied buildings, dogs, neighbors,



strangers, along with parking areas. However, more than 50 % added that they see apartment buildings, stores, gas stations, and construction areas. Fewer parks are seen on the students' way to Scott School, along with more empty lots than Lefler School. Around 30% of students see vacant buildings during their trip to both schools. Only 3% indicated that they see crimes on their way to both schools. That is why crime data was not included in this study. It seems not to be a problem or an obstacle that prevents children from walking to their schools. The collected data is included in Appendix E.

Similarly, students were asked what would make walking or biking to school more achievable. More than 70% from our sample in both schools answered that walking or biking with friends would increase the fun of walking to school. More than 30% in both schools selected that less cars on the roads near the school along with sidewalks clear of snow will also help. Some students indicated that having safe places to cross the road is also important. However, a larger percent from Scott School pointed out that nothing will improve their experience to walk or bike to school, since they live too far to walk. The collected data is included in Appendix F.

The last question in the survey was asking the students about how likely they would walk or bike to school if the route to school was improved so they felt safer. Table 3.14 displays the frequency distribution for the answers of students of both schools. The chances that students will walk or bike is higher (60.7 %) in Lefler Middle School, while in Scott Middle School, the chances were only 46.6 %. The students who answered that they are definitely not going to walk or bike to Scott School were 30% of our sample, while it was only 10.8 % for Lefler School. It is believed that this is due to the longer

distance between homes and Scott School. Some of the students stated that no matter what improvements were done, they live so far away to walk or bike.

**Table 3.14** Frequency distribution for students' chances whether to walk or bike to school if the route to school was improved to be safer.

Walk or Bike if it is safer	Lefler Middle School		Scott Middle School	
	n=56	%	n=60	%
Definitely will not walk	3	5.4 %	9	15 %
Will not walk	3	5.4 %	9	15 %
May be	15	26.8 %	13	21.7 %
Will walk	19	33.9 %	14	23.3 %
Definitely will walk	15	26.8 %	14	23.3 %
Left unanswered	1	1.8 %	1	1.7 %

## **Chapter 4: Discussion and Conclusion**

### **Discussion of results**

The primary focus of this study was to determine if children going to a school built in a traditionally old neighborhood will be more likely to walk or bike to school than those attending a school in a new development in suburbs. By comparing the two case studies we selected in Lincoln, Nebraska, we found that more students (21.8 %) use active transportation modes to go to Lefler Middle School, located near the center of Lincoln, whereas, less than 7 % were actively going to Scott Middle School, located near the city limits. It is a low incidence in all the active modes of transportation, from walking, biking, and skating for both schools.

As with other studies discussed in the literature review, the car was the most common mode of transport used in travelling to school. More than 70 % of students were driven by either their parents or someone else, regardless of the distances from residences to schools.

In D'Haese's study in Belgium, they set a criterion distance for walking that was 1 mile, and almost 2 miles for biking to school among the 11-12 years old Belgian children (D'Haese, et al. 2011). According to our case study, nearly half students (47.5%) live within 1 to 2 miles away from school. For Lefler School, 21% of those living within 1 to 2 miles are being active, while it is only 3% in the sample of those living within the same distance from Scott School. If more analysis were done, we will find that other factors are also behind this big difference between those percentages.

More students (28.3 %) in Scott School live more than 2 miles away than students attending Lefler School (10.7 %), which may be a result of the urban form for the two neighborhoods where the schools are located, which in turn increases the distances to schools. However, our sample is not large enough to use this finding as a conclusion. One more explanation can be that Scott School is located south of Lincoln, near the city limits, to serve a bigger widespread area, not like Lefler School which is serving a limited area around it. Again, it is one of the consequences for cities sprawl.

Race and ethnicity were changeable factors in the literature review. Some studies indicated that low-income and minority children walk more to school, while others indicated that they are not significant. In our case study, race was found not to be statistically significant with the mode of children's transportation.

The analysis for the neighborhoods surrounding the schools has revealed that they are different in many ways. The socioeconomic status for the attendance area of schools, measured by the income and education attainment, was higher for Scott Middle School. The average median household income for census tracts surrounding Scott School is twice that for Lefler School census tracts. Even the educational attainment measure shows that more people from Scott School neighborhood hold a bachelor's degree or higher from the population 25 years and over.

From the findings, as an another measure for socioeconomic status of schools, the percentage of students who are participating in the free or reduced price lunch program were higher (53.5 %) at Lefler School compared to Scott School (13%). These percentages confirmed that Scott School has higher socioeconomic status overall.

The average median years that the structures were built are also dissimilar. The median years structures were built within one mile of Lefler School were 1944 and 1956, which means right before and after the trend that took place in the United States after World War II that targeted constructing spacious homes and buildings. Thus, we can consider this area as an early-modern that is built near the city center. By looking at the street system in this area, we can see that it is more like a grid street system, with high connectivity, yet with longer block length in some of the newer parts.

The available data for census tracts around Scott School indicate that most structures were built in the 1990s or after, which means they are characterized by features of the late-modern era. By looking at the maps of these areas, we can realize that the streets are formed of cul-de-sacs, dead-ends, and that they lack connectivity.

Similar to previous studies, Scott School square footage area and site acreage are larger than that of Lefler School, since it is newer and built in a new development. However, the increasing number of students in the first corresponds and equates to these bigger areas.

Nearly 28% from students of both samples selected walking to be their mode of transportation to school on a good weather day. However, the actual percentage walking to both schools is far less than that, which might indicate that more barriers are facing those students. By analyzing more survey answers, we found that those barriers can be parents' convenience to drop off their children at the morning on their way to somewhere else. Also, many students indicate that walking to school does not save time. Parents are the main decision makers regarding whether their children can walk to school or not.

Thus, parents' perceptions and beliefs about distance to school and time saving may become the main obstacle in front of children who needs to walk.

Other perceptions can be related to safety and traffic around schools. Number of students indicated that they would walk to school if there are fewer cars on the roads near the schools. These findings are consistent with literature review. When more students are driven to school with private cars, more transportation problems are created around those schools, which increase the risk affecting pedestrians and bicyclists around schools.

Furthermore, 70% of students in both schools proclaimed that they might walk or bike to school if friends are available to walk or bike with them. As expected, walking to school increase socialization between children and build independence and self-confidence.

## **Conclusion**

From the literature review, it is assumed that the grid street system decreases the distances and encourages more walking and that the urban form plays an important role determining children's decisions whether to walk to school or not depending on the distance to school. From our findings, household distance from school came to be the most important predictor for shaping the travel mode to school. Usually distance causes effects on other factors like time saving, convenience, and having fun if the distance is not too big. Walking in straight connected streets appears to be more exciting than going in curved closed ended streets, without any shortcuts, in order to reach to the main artery. Although not all the findings regarding the relationship between distance and modes of

transportation were statistically significant, the percentage of children using more active types of transportation was higher in Lefler Middle School.

The children's travel needs should be considered in the development of new land uses related to children's services. More children are travelling with cars, which creates transportation problems around schools, air pollution, and may increase pedestrian and bicyclist collisions around schools. Interventions and improvements should be focusing on children living within 2 miles from school since they are more likely to walk or bike to school. Programs and policies should address changing the behavior of those who live close enough to walk, but are currently driven. Programs like Walking School Bus can be implemented easily in Lincoln elementary and middle schools since it does not need any funding.

Lincoln, Nebraska is blessed by having a very good trail system. South Pointe trail is adjacent to Scott Middle School, and is connected to other trails in the neighborhoods around Scott School, which should in turn increase all the active transportation modes from walking, biking, skating, and others.

### **Further research**

Future research should separate analysis of modes of transportation for children going to school from their modes coming back home. Literature reviews indicated that there might be mode shifting depending on some factors, such as whether the parents are working full-time or whether an adult is available to pick up children after school or not.

**Limitations of the study:**

The low response rate we received from the survey, resulted in a small sample size, was a main limitation in our study. Another limitation was that we did not have access to exact home addresses. Students self-reported the distance between their homes and school, depending on a map that was provided with the survey. The distance may not be very accurate, but it is believed they answered to their best knowledge. If we have got the exact addresses, we could have geocoded them, using GIS, and determined the exact distances and had more analysis done using GIS.

Since we questioned the students, we did not have a chance to ask about the socioeconomic status for parents in their households.



## **Chapter 5: Implications for planners and policymakers**

The study is providing some suggestions for planners and policymakers in order to provide a better environment for children to encourage them to walk to school. First, based on literature reviews, they need to pay attention to the new schools' site locations. Locating a new school on the city's fringe may have a diverse effect on the development around it. A new school attracts people to buy houses around it, even if they are too far from all other services. This act increases the sprawl of the city and may later lead to leap-frog urban sprawl.

Another suggestion is to pay attention to planning of new developments and to make sure the new streets inside the developments will have good level of connectivity, and that the urban design applied promotes walkability. Urban form may increase the distances, which may result in decreasing the number of people walking to any place in their neighborhood.

Having continuous sidewalks with good quality, and crossing signals on most of the paths from homes to schools should in turn increase the possibility of having more children to actively commute to their schools. Parents will be more assured that their kids are walking or biking in a safe route, instead of going in streets with high or even medium traffic that may endanger their lives. But these improvements should work along with ensuring an appropriate school location and a walkable distance. "Walking School Bus" should also gain more attention and support, providing that they overcome some of the parental and children's safety concerns.

Public health organizations need to organize educational classes or workshops for children at schools to educate them about the benefits of walking, biking and having a regular routine of physical activity in their lives. They should also be educated on the risks of being inactive, and what diseases can result from that including being overweight and its problems and dangers. Walking to school can be very useful for everybody's health with just a simple routine every day.

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## **Appendix A.1: The cover letter attached with the survey**

Nivin Khalil  
 nivinkhalil@hotmail.com  
 402-xxx-xxxx  
 February 13<sup>th</sup>, 2012

Dear Parents,

You are invited to permit your child to participate in a research study. The following information is provided in order to help you make an informed decision whether or not to allow your child to participate.

In this study, a survey is going to be conducted on children of two different middle schools. The purpose of this study is to investigate how urban designs and distances between residences and schools affect the choices and behavior of children whether to walk or bike to their schools, along with trying to understand their perceptions about walking to schools. This study will take approximately 15 minutes of your child's time.

Please find enclosed the parental informed consent forms, the child assent forms, the survey questions, and an envelope. If you allow your child to participate in this study, you will need to enclose in the provided envelope one signed copy of the parental consent form, and one signed copy of the child assent, along with the survey answers, seal it, and return it back to the school to be collected by the class teacher.

One participant from each school will be randomly selected to receive a 20 dollar gift card from Wal-Mart. The winner will be mailed the gift card if an address is provided in the returned package.

Please feel free to contact me with any questions. Your contribution is appreciated and is very valuable for the study required for my Master's thesis.

Sincerely,

Nivin Khalil

Graduate Student  
 Community and Regional Planning Program  
 School of Architecture  
 University of Nebraska-Lincoln  
 nivinkhalil@hotmail.com

## **Appendix A.2: Parental informed consent form that was sent in the package**

### **PARENTAL INFORMED CONSENT FORM IRB # 12109**

#### **THE URBAN FORM AFFECTING CHILDREN'S BEHAVIOR WHETHER TO WALK TO SCHOOL OR NOT**

You are invited to permit your child to participate in this research study. The following information is provided in order to help you to make an informed decision whether or not to allow your child to participate. If you have any questions please do not hesitate to ask.

In this study, a survey is going to be conducted on children of two different middle schools. Your child is eligible to participate in this study. Your child will also be asked if he/she is willing to participate.

The purpose of this study is to investigate how urban designs and distances between residences and schools affect the choices and behavior of children whether to walk or bike to their schools, along with trying to understand their perceptions about walking to schools.

This study will take approximately 15 minutes of your child's time. The survey is attached if you would allow your child to participate. There are no known risks associated with this research. The information obtained from this study may help us to better understand the impact of urban designs' forms on limiting children's behaviors for commuting to their schools.

Any information obtained during this study will not be shared with others, and will be only used for research purposes. The information may be published in a Master's thesis. No names or contact information for participants will be obtained. The data obtained will be kept for 3 years at University of Nebraska-Lincoln.

One participant from each school will be randomly selected to receive a 20 dollar gift card from Wal-Mart. The winner will be mailed the gift card if an address is provided. Your child will have a one in 100 chance to win the gift card.

Your child's rights as a research participant have been explained to you. You may ask any questions concerning this research and have those questions answered before agreeing to participate in the study. Or you may call the investigator at any time, (402) xxx-xxxx.

Please contact the investigator:

- If you want to voice concerns or complaints about the research

Please contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965 for the following reasons

- You wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- To voice concerns or complaints about the research
- To provide input concerning the research process
- In the event the study staff could not be reached

Participation in this study is voluntary. You are free to decide not to enroll your child in this study.

#### **DOCUMENTATION OF INFORMED CONSENT**

**YOU ARE VOLUNTARILY MAKING A DECISION WHETHER OR NOT TO ALLOW YOUR CHILD TO PARTICIPATE IN THE RESEARCH STUDY. YOUR SIGNATURE CERTIFIES THAT YOU HAVE DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE HAVING READ AND UNDERSTOOD THE INFORMATION PRESENTED. YOU MAY KEEP ONE OF THE COPIES OF THIS CONSENT FORM FOR YOUR RECORDS.**

\_\_\_\_\_  
Child's Name

\_\_\_\_\_  
Signature of Parent

\_\_\_\_\_  
Date

#### **IDENTIFICATION OF INVESTIGATORS**

**PRIMARY INVESTIGATOR:** Nivin S. Khalil, Graduate Student: 402-xxx-xxxx, nivinkhalil@hotmail.com

**ADVISOR:** Yunwoo Nam, Assistant Professor: 402-472-9279, ynam2@unl.edu





### **Appendix A.3: The child assent form sent in the package**

#### **CHILD ASSENT FORM**

IRB # 12109

#### **THE URBAN FORM AFFECTING CHILDREN'S BEHAVIOR WHETHER TO WALK TO SCHOOL OR NOT**

We would like to invite you to take part in this study.

In this study, a survey is going to be conducted on students of two different middle schools. The purpose of this study is to investigate how urban designs and distances between residences and schools affect the choices and behavior of students whether to walk or bike to their schools, along with trying to understand their perceptions about walking to schools.

Your parents will also be asked to give their permission for you to take part in this study. Please talk this over with your parents before you decide whether or not to participate.

You do not have to be in this study if you do not want to. If you decide to participate in the study, you can just answer the questions in this survey. This study will take approximately 15 minutes of your time.

One participant from each school will be randomly selected to receive a 20 dollar gift card from Wal-Mart. The winner will be contacted by mail if you provide an address. You have a one in 100 chance to win the gift card.

If you have any questions at any time, please contact the researcher.

**IF YOU SIGN THIS FORM IT MEANS THAT YOU HAVE DECIDED TO PARTICIPATE AND HAVE READ EVERYTHING THAT IS ON THIS FORM. YOU MAY KEEP ONE OF THE COPIES OF THIS FORM FOR YOUR RECORDS.**

---

Signature of Student

---

Date

**IDENTIFICATION OF INVESTIGATORS****PRIMARY INVESTIGATOR**

Nivin S. Khalil, Graduate Student: 402-xxx-xxxx, nivinkhalil@hotmail.com

**ADVISOR:**

Yunwoo Nam, Assistant Professor: 402-472-9279, ynam2@unl.edu



## Appendix B: Demographic differences between the two neighborhoods

	Lefler School Boundaries						
Census Tracts	7	13.01	14	15	16	18	Average
Median Household income	25,182	53,333	41,473	47,952	49,220	23,056	\$40,036
Education Attainment	47.4 %	45.9 %	30.8 %	29.7 %	41.7 %	11.5 %	34.5 %
Owner Occupied Housing units	15.6 %	60.4 %	63.3 %	64.9 %	60.8 %	11.1 %	46 %
Median Year Built	1977	1974	1956	1956	1944	1939	1958

	Scott School Boundaries					
Census Tracts	36.05	36.07	36.09	37.08	37.16	Average
Median Household income	56,476	70,667	116,708	72,979	89,135	\$81,193
Education Attainment	36.9 %	55 %	60.7 %	68.1 %	71.3 %	58.4 %
Owner Occupied Housing units	77.9 %	66.8 %	84.5 %	65.7 %	74.2 %	73.82 %
Median Year Built	1975	-	1994	-	2000	1990

Source: American Community Survey for 5-year estimates – Census 2010

## Appendix C: Survey used for Lefler and Scott Middle Schools

### THE URBAN FORM AFFECTING CHILDREN'S BEHAVIOR WHETHER TO WALK TO SCHOOL OR NOT

#### Demographic data:

1. What grade are you in?
  - a. 6
  - b. 7
  - c. 8
2. Are you:
  - a. Male
  - b. Female
3. What is your race?
  - a. White/Caucasian
  - b. Black/African American
  - c. American Indian/Alaska Native
  - d. Asian
  - e. Other
  - f. Prefer not to answer

#### Research data:

4. How far do you live from school? (Select one after referring to the map on page 4)
  - a. Less than  $\frac{1}{4}$  mile
  - b.  $\frac{1}{4}$  mile to  $\frac{1}{2}$  mile
  - c.  $\frac{1}{2}$  mile to 1 mile
  - d. 1 mile to 2 miles
  - e. More than 2 miles
5. How do you usually get to school? (Select one)
  - a. Walk
  - b. Bike
  - c. School bus
  - d. Parents drive
  - e. Older brother/sister drive
  - f. Someone else drives
  - g. Ride city bus
  - h. Roller blade
  - i. Skate board
6. If you had a choice, on a good weather day, how would you most like to get to school? (Select all that you like)
  - a. Walk
  - b. Bike
  - c. School bus
  - d. Parents drive
  - e. Older brother/sister drive
  - f. Someone else drives
  - g. Ride city bus
  - h. Roller blade
  - i. Skate board

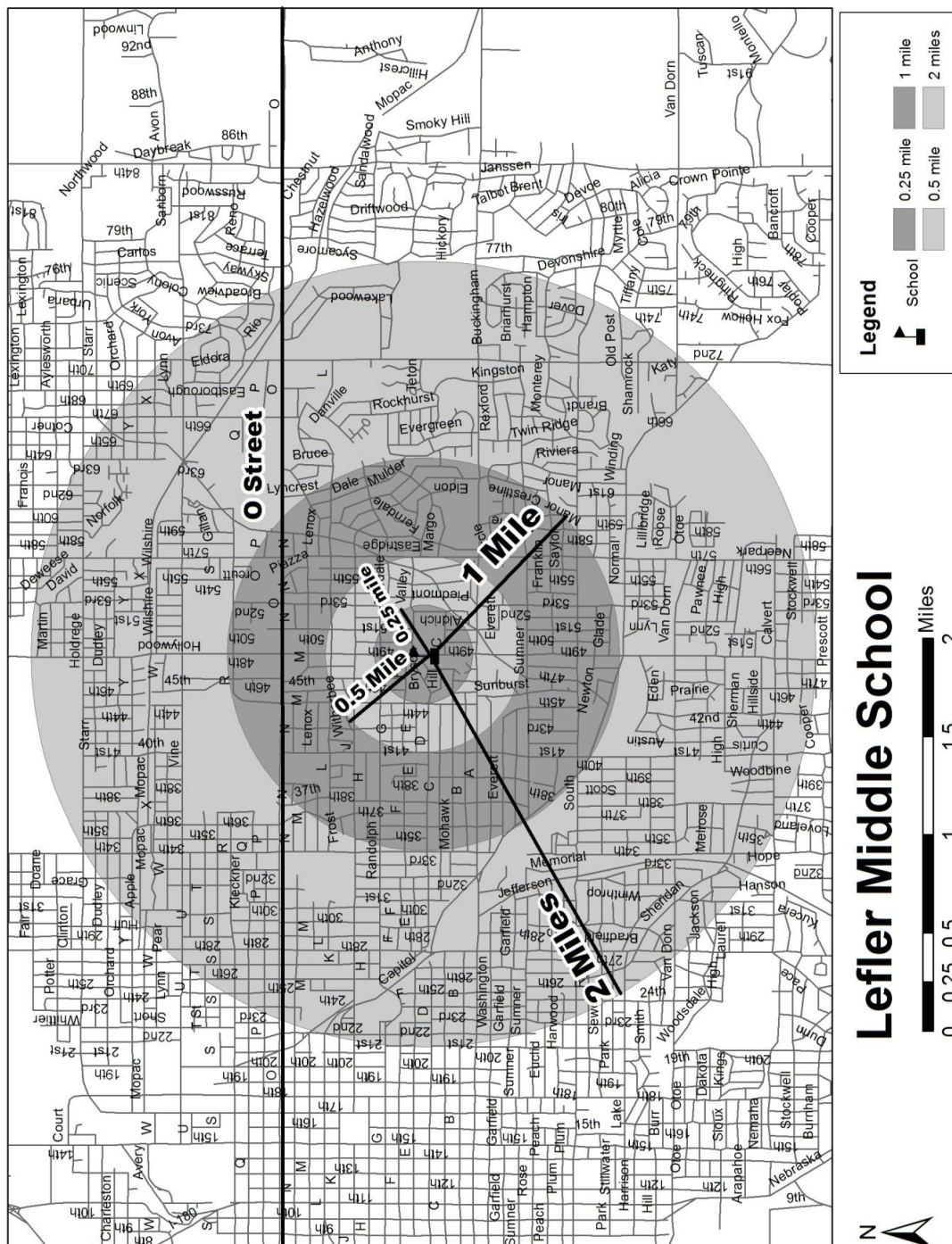
7. If you travel by car to school, is the driver usually: (Select one)
- Going somewhere else after they drop you off
  - Taking you to school and then going back home
8. Who usually accompany you to school? (Select all that apply)
- By myself
  - With friends or neighbors
  - With a parent or adult
  - With brother or sister
9. Is there a school bus that can pick you up and take you to school? (Select one)
- Yes
  - No
10. Do you have a bicycle that you can ride to school? (Select one)
- Yes
  - No
11. Do your parents/guardians have a car they can use? (Select one)
- Yes
  - No

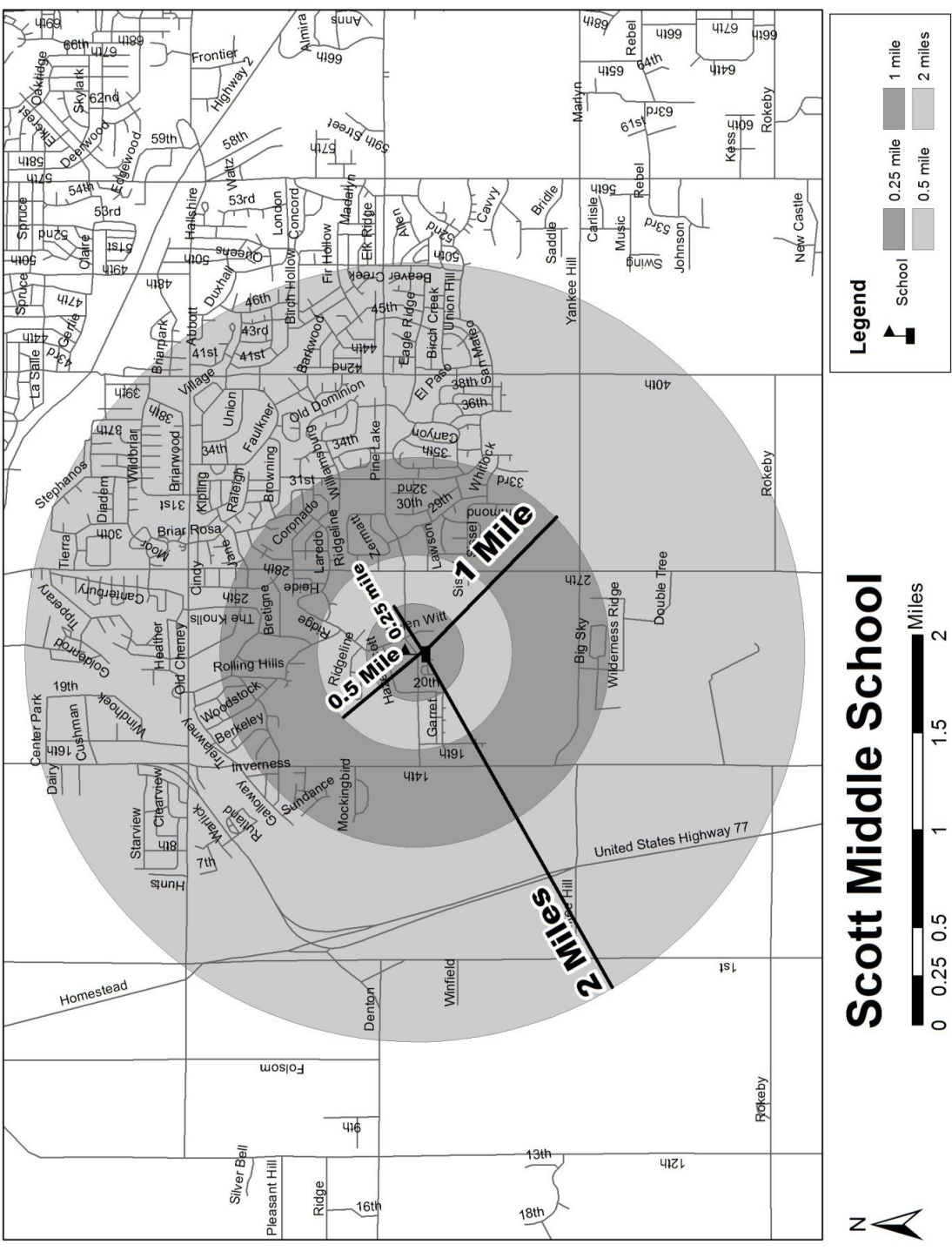
### Perceptions:

12. Please rate how do you feel about walking.

1	2	3	4	5
Fun				Boring
1	2	3	4	5
Safe				Not safe
1	2	3	4	5
Healthy				Not healthy
1	2	3	4	5
Cool				Not cool
1	2	3	4	5
Time saving				Does not save time









## Appendix D.1: A detailed cross tabulation for Lefler Middle School

A cross tabulation for how students usually get to school related to the distance to school, for Lefler Middle School.

<b>Lefler School</b>	<b>How do students usually get to school</b>								<b>Total</b>
	Walk	Bike	School Bus	Parents drive	Older brother /sister drive	Some-one else drives	Ride city bus	Skate board	
<b>Distance from School</b>									
Less than ¼ mile	1	0	0	2	0	0	0	0	3
¼ mile to ½ mile	2	0	0	2	0	0	0	0	4
½ mile to 1 mile	1	1	0	9	0	2	0	1	14
1 mile to 2 miles	3	3	0	16	0	3	3	0	28
More than 2 miles	0	0	0	5	0	0	1	0	6
<b>Total</b>	7	4	0	34	0	5	4	1	55

## Appendix D.2: A detailed cross tabulation for Scott Middle School

A cross tabulation for how students usually get to school related to the distance to school, for Scott Middle School.

Scott School	How do students usually get to school								Total
	Walk	Bike	School Bus	Parents drive	Older brother /sister drive	Someone else drives	Ride city bus	Skate board	
Distance from School									
Less than ¼ mile	0	1	0	2	0	0	0	0	3
¼ mile to ½ mile	0	1	0	2	0	0	0	0	3
½ mile to 1 mile	0	0	0	7	1	2	0	0	10
1 mile to 2 miles	0	1	0	20	1	3	2	0	27
More than 2 miles	0	1	5	7	2	2	0	0	17
<b>Total</b>	0	4	5	38	4	7	2	0	60

**Appendix E: A table to summarize what children see on their way to school**

<b>What you see on your way to school</b>	<b>Lefler Middle School</b>		<b>Scoot Middle School</b>	
Parks	32	57%	18	30%
Trees	55	98%	56	93%
Dogs	37	66%	48	80%
Houses where people live	55	98%	58	97%
Houses or buildings that are empty	18	32%	21	35%
Apartment buildings	17	30%	36	60%
Neighbors/ people that you know	45	80%	50	83%
Strangers/ people that you do not know	49	88%	49	82%
Crime	2	4%	2	3%
Stores	20	36%	43	72%
Gas stations	31	55%	37	62%
Factories	1	2%	1	2%
Parking areas	38	68%	48	80%
Empty lots	13	23%	24	40%
Trash	39	70%	21	35%
Construction areas	14	25%	35	58%
Farmland	0	0%	13	22%

**Appendix F: A table to summarize what makes walking or biking to school better**

<b>What makes walking or biking to school better</b>	<b>Lefler Middle School</b>		<b>Scoot Middle School</b>	
Adults to walk or bike with	1	2%	5	8%
Friends to walk or bike with	39	70%	45	75%
Less cars on the roads near the school	19	34%	23	38%
Less cars in the school parking lot	5	9%	3	5%
Sidewalks all the way to school	11	20%	11	18%
Bike racks/ a safe place to leave my bike	12	21%	7	12%
No strangers along the way to school	12	21%	14	23%
Nothing – my parents will not let me walk	5	9%	1	2%
More crossing guards	2	4%	10	17%
Sidewalks clear of snow	21	38%	21	35%
Safe places to cross the road	14	25%	13	22%
No bullies along the way to school	9	16%	8	13%
No crime along the way to school	7	13%	8	13%
Nothing – I live too far to walk	5	9%	16	27%