ABSTRACT

JONES, DWANE LAMAR. The Behavioral Impacts of Urban Street Modifications: A Case Study of East Blvd. in Charlotte, NC. (Under the direction of Professor Robin Moore.)

Increasing rates of obesity and related health consequences have characterized the U.S. population for the past 20 years. The lack of opportunities for daily active transportation and social interaction in places that are safe and convenient has been a major contributing factor to sedentary lifestyles for both adults and children. *Complete streets* interventions aim to provide safe and convenient opportunities for all users to engage in physical and social activities, thereby improving quality of life. Understanding the relationship between microscale physical characteristics of complete streets and user behavior relative to active transportation and social interaction is essential to evaluating the effectiveness of these interventions and their potential influence on quality of life.

Although significant studies have been conducted on the influences of streetscape elements on human behavior, no studies have attempted to determine the impacts of complete streets modifications on human behavior. East Blvd. (located in Charlotte, NC) was selected to determine the impacts of microscale physical complete streets modifications on human behavior relative to active transportation, social interaction, and quality of life. East Blvd., was recently modified to encompass elements and characteristics of a complete street. Modifications included installation of bicycle lanes, addition of pedestrian crosswalks and refuges, and reconfigured travel
lanes (road diet).

Changes in users' behavior in response to modifications were determined through semi-structured interviews of street users who experienced East Blvd. before and after modifications (n=66), site observations, traffic and collision analyses, and examination of archival documents. Interviews were conducted to determine if and how behavior changed and what characteristics of the street contributed to these changes. Site observations were used to examine the context in which changes occurred and the nature of and causes or conditions associated with the changes. Site observations were linked with data obtained from interviews. Traffic and collision analyses were conducted to link (1) perceived changes in the number of accidents and traffic volumes, with (2) changes in behavior. Finally, archival documents of East Blvd. were examined with the above data to determine which, why, and how specific microscale physical modifications contributed to changes in behavior.

Findings suggest the following:

1. Increasing the number of affordances provided by an urban streetscape can lead to increases in active transportation (walking, jogging, and cycling) and social interaction.

2. Installation of pedestrian crosswalks and refuges can result in a safer, more walkable environment that increases opportunities for active transportation and social interaction.

3. Installation of bicycle lanes can support a safer environment for cyclists by
creating a mutual “awareness of shared space” between cyclists and drivers.

4. Complete streets for all users may improve public health and quality of life by supporting pedestrian and cyclist activity and social interaction.
The Behavioral Impacts of Urban Street Modifications:  
A Case Study of East Blvd. in Charlotte, NC

by
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APPROVED BY:

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Professor Jay Tomlinson             Professor Art Rice
DEDICATION

This page is dedicated to anyone who has the time and patience to read this dissertation. Good luck!
BIOGRAPHY

Dwane Jones was born on July 20, 1978 in Manhattan, Kansas. He graduated from high school in Creswell, NC in 1996 and received his Bachelor of Science degree in Urban and Regional Planning from East Carolina University in 2000. Dwane continued his graduate studies at the same university and in 2002 received his Master of Science in Environmental Planning and Technology Systems. During his graduate career, Dwane developed a keen interest in urban design, specifically in architecture, landscape architecture, and urban planning. In 2009, Dwane started on a Ph.D. in Design (specializing in urban design) at North Carolina State University. Dwane is a member of the American Planning Association, American Institute of Architects, and Congress for New Urbanism. He intends to continue his research in urban design with special emphases on the built environment, water quality, and human behavior.
ACKNOWLEDGMENTS

I am very appreciative for the privilege and opportunity to embark upon and complete this journey. The end of this phase of my life only serves as the beginning of the next. Hopefully, I will never “arrive,” but instead always seek to gain further insights into the urban design profession and ideally, influence the world around me.

My deepest gratitude goes to my advisor, Professor Robin Moore, and my outstanding dissertation committee members: Professor Andrew Fox, Professor Art Rice, and Professor Jay Tomlinson. Although not an official member of the committee, Dr. Nilda Cosco was also tremendously helpful. All were very helpful, thorough, and approachable, which made a tremendous impact on the quality of this research and my person.

My sincere appreciation goes to staff at the City of Charlotte, especially Malisa McCreedy and Dan Gallagher, who promptly and enthusiastically responded to my many requests for data, information, and personal insights. Without their assistance, completion of this dissertation would have taken six and a half years rather than three and a half, and the long-lasting friendships I have developed with them would not have been possible. For this, I am most grateful.

I especially want to thank numerous others who provided information and insights, including Dr. Perver Baran, Dr. Jay Jayarante, Ann Hartel, The NC Rural Center, and all who endeavored to make this journey successful.
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CHAPTER 1: INTRODUCTION

1.1. Prologue

Nearly all human activities take place on a street. Humans have always lived on streets (Appleyard, 1982). Streets are places where children learn about the world, where social interactions occur, where motorized and nonmotorized activities (active transportation) take place, and where people perceive the city (Appleyard, 1982; Moore, 1991; Lynch, 1960). These street activities are necessary but have created an environment where conflicts take place. Pedestrian and cyclist activity dominated the street until the beginning of the 20th century, when household use of the automobile proliferated (Appleyard, 1982). Eventually, streets became known for traffic, noise, and pollution.

Several early attempts sought to reclaim pedestrian and cyclist use of the street and to reduce domination by automobile traffic. The Garden City movement sought to make streets safe by implementing cul-de-sacs, residential squares, and neighborhood units, with safe pedestrian pathways to school (Appleyard, 1982). In the early 1960s, Jane Jacobs in her classic, *Death and Life of Great American Cities*, called for return to and eyes on the street (Appleyard, 1982). She considered streets the primary place where short, undemanding social interactions occur. These occurrences create social capital, which knits together neighborhoods and people. Although her observations influenced movements toward multi-functional, pedestrian- and cycle-friendly streets, physical design of a street was not addressed until the Dutch introduced the *woonerf*
in 1976.

Woonerf is a street scheme that allows residential streets to be controlled by the people who live on them (Liebmann, 1996). *Woonerven* (the plural of woonerf) first appeared in the Netherlands in 1976. This innovation was based on the idea that in residential areas, traffic and people should be integrated, but with automobiles serving a secondary or tertiary role to pedestrian and cyclist activity (Liebmann, 1996). Some woonerven allowed elimination of curbs and allowed children to play freely. Traffic calming resulted from lower posted speed limits, implementation of infrastructure such as speed bumps, street narrowings, and numerous four-way stop signs. Liebmann (1996) suggested that social cohesiveness resulted from the process of planning and implementing woonerven.

The popularity of *woonerven* has led to several related, but unique, street modification initiatives aimed at increasing pedestrian and cyclist use of the street. Home zones, which originated in the United Kingdom (UK) in the early 1990s, are residential streets in which road space is shared between motorists and other road users to improve quality of life by making streets places for people and not just traffic (Gill, 2005). The one significant difference between woonerven and home zones is that the latter have no legal design requirements (Gill, 2005).

Similar street use modification efforts were spurred in the U.S. when Donald Appleyard (1982) published his seminal work, *Livable Streets*, which further illuminated the negative role of traffic, noise, and pollution on pedestrian and social
activity. Appleyard’s work addressed residential streets near shopping and community facilities, but it did not examine how physical elements of a modified (complete) street might influence active transportation (nonmotorized transportation) and/or social interaction of pedestrians and cyclists. Yet, Appleyard’s research helped inspire the most recent national effort aimed at influencing physical and social activity by means of street modification, known as the “Complete Streets” movement.

“Complete streets are designed and operated to enable safe access for all users” (National Complete Streets Coalition, 2011). Pedestrians, bicyclists, motorists, and public transportation users of all ages and abilities should be able to safely move along and across a complete street. Physical characteristics of complete streets are presumed to make it easy to cross the street, walk to shops, and bicycle to work (National Complete Streets Coalition, 2011). Complete streets allow buses to run on time and make it safe for people to walk to and from train stations (National Complete Streets Coalition, 2011). Although each complete street is unique to its context (urban, suburban, or rural), influences of complete streets on behavior are thought to be the same—safety and convenience for all users and improved quality of life (National Complete Streets Coalition, 2011). Complete streets policies aim to create streets that foster active transportation and social capital. However, empirical evidence of actual or perceptual outcomes on behavior in context of active transportation or social interaction of an urban street that has been converted into a complete street is scarce.

Streets can be used to influence active transportation and community social
capital by providing affordances that facilitate active transportation and by placing more “eyes on the street” (Jacobs, 1961; Liebmann, 1996). The obesity pandemic necessitates maximizing use of common, public spaces (such as streets) by providing safe and regular access to these spaces to promote active transportation (U.S. Department of Health and Human Services [USDHHS], 1996). Complete street designs aim to influence active transportation and social interaction by providing affordances that are not present in incomplete streets (National Complete Streets Coalition, 2011).

The goal of this study was to investigate street how users’ active transportation, social interaction, and quality of life changed when an incomplete, automobile-oriented street has undergone microscale physical modifications (installation of bicycle lane, pedestrian crossings and refuges, and implementation of road diet) and converted into a complete street. Affordances, or what the environment offers, provides, or furnishes, were increased as a result of street modifications to create a complete street.

The results are intended to inform designers and policy-makers with empirical evidence about how behavior may change when a street is modified. Conclusions may add to the growing body of knowledge on how streetscape modifications influence active transportation and social interaction for pedestrians and cyclists. The overall methodology employed is within the environment-behavior and ecological psychology traditions. A pilot study was employed to test various strategies and methods. The specific methods used are semi-structured interviews, traffic and collision analyses, site
observations, and examination of archival documents.

1.2. Definition of the Problem of Physical Inactivity and Quality of Life

During the past 20 years, there has been a dramatic increase in obesity in the United States, and rates remain high (Centers for Disease Control and Prevention [CDC], 2010). Adults are defined as being obese if they have a body mass index (BMI) of 30 or greater, and as being overweight if they have a BMI of at least 25 but less than 30 (CDC, 2010). Children and adolescents are defined as overweight if they have a BMI above the 95th percentile for their age and sex (CDC, 2010).

The National Health and Nutrition Examination 2009–2010 Survey reported that more than one-third of U.S. adults (35.7% or 78 million) are obese and approximately 17% (or 12.5 million) children and adolescents aged 2–19 are obese (CDC, 2010). Obesity-related conditions include heart disease, stroke, type 2 diabetes, and certain types of cancer, which are among the leading causes of death (USDHHS, 1996). Obesity has also been linked to social isolation and discrimination (National Institutes of Health [NIH], 1998).

Obese individuals are also subject to higher health costs. In 2008, medical costs associated with obesity were estimated at $147 billion; the medical costs paid by third-party payers for the average obese person were $1,429 higher than for the average normal-weight person (CDC, 2010). There is strong evidence that reducing obesity reduces risk factors associated with high-blood pressure and cholesterol, reduces prevalence of type 2 diabetes, and may reduce health-care-associated costs (NIH,
Lack of adequate opportunities in the built environment to engage in active transportation and poor dietary habits are the two major causes of the obesity epidemic (USDHHS, 1996). Active transportation includes walking and cycling, and variants such as small-wheeled transport (skates, skateboards, push scooters, and hand carts) and wheelchair travel (Victoria Transport Policy Institute, 2012). These modes provide both recreation and transportation, although users may consider a particular trip to serve both objectives (Victoria Transport Policy Institute, 2012).

In 2000, Healthy People, a collaborative effort comprised of governmental entities, nonprofits, and institutions, issued Healthy People 2010 to set national disease prevention and health promotion objectives to be achieved by 2010. The effort had two overarching goals: to increase the quality and length of healthy life and to eliminate health disparities (Healthy People, 2012).

Healthy People 2010 featured 467 science-based objectives, of which 10 were chosen as Leading Health Indicators for tracking progress toward Healthy People 2010 goals. The Leading Health Indicators represent the important determinants of health for the full range of issues in 28 focus areas and included active transportation and overweight and obesity among other important measures. The report aimed to reduce obesity prevalence by 15% and for at least 50% of Americans to engage in regular active transportation ranging from 60 minutes a day for children to 2 hours and 30 minutes per week for adults (Healthy People, 2012).

No state met the Healthy People 2010 goal to lower obesity prevalence to 15%
by the end of 2010. The number of states with an obesity prevalence of 30% actually increased from none in 2000 to nine in 2009 (CDC, 2010). Physical activity levels for adolescents and adults essentially remained unchanged (CDC, 2010). Increasing active transportation is one successful approach to reducing obesity (USDHHS, 1996). In this respect, additional emphases placed on opportunities to increase active transportation through incremental changes in daily life, especially through use of the built environment, may help reduce obesity (USDHHS, 1996).

Many factors influence adopting and maintaining a physically active lifestyle, such as socioeconomic status, cultural influences, age, and health status (USDHHS, 1996). The built environment significantly influences active transportation and as a result affects rates of obesity (Transportation Research Board, 2005; Miles, 2007; Healthy People, 2012).

Some of the most successful approaches to increasing active transportation occur in environments where individuals (i) feel safe executing the activity, (ii) can easily access the activity regularly, (iii) can fit the activity into their regular schedule, and (iv) feel that the activity does not generate financial or social costs unable to be supported (Miles, 2007). Walking and cycling are feasible methods for integrating regular active transportation into sedentary lifestyles by means of the built environment (i.e., streetscape) (Miles, 2007). Walking is the most commonly reported active transportation, followed by bicycling, jogging, and running (USDHHS, 1996).
Levels of active transportation is determined by accessibility and availability of adequate affordances of the built environment such as parks, sport facilities, bicycle lanes, and sidewalks (USDHHS, 1996; Kahn et al., 2002; Transportation Research Board, 2005; Librett, Yore, & Schmid, 2006). Integrating elements such as bicycle lanes or crosswalks can increase street function, thereby increasing the number of potential street users.

When more people use the street, whether through active transportation such as exercise, or leisure activity such as shopping or dining, it creates more “eyes on the street,” community cohesion, and a perception of safety (Jacobs, 1961; Appleyard, 1982; Mehta, 2010). Considering this, understanding the role that elements of complete streets play in influencing active transportation and social interaction is key to affecting obesity and quality of life (CDC, 2010). In this respect, this research aims to influence designers and policy-makers on how behavior changes in response to complete streets can influence active transportation, affect social interaction, help reduce obesity, and improve quality of life.

The following table (Table 1-1) provides supporting research and rationale for this study.
Table 1-1: Study Framework and Rationale Summary

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<td>Nearly all human activities take place on a street; however, the prevalence of pedestrian and cyclist activity is determined by traffic, noise, and pollution (Appleyard, 1982).</td>
<td>A street is a relevant research site to improve quality of life, especially with regard to pedestrian and cyclist activity.</td>
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<td>Since the beginning of the 20th century, streets have become conduits for traffic rather than multi-functional public spaces (Appleyard, 1982; Jacobs, 1961).</td>
<td>This research adds to the growing body of knowledge on human use of streets for purposes other than conduits for automobile traffic.</td>
</tr>
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<td>Several studies and programs show how physical rearrangement and elements of a street can influence behavior by making streets multi-functional (Liebmann, 1996; Gill, 2005; Mehta, 2010).</td>
<td>Research may indicate and confirm that adding specific physical microscale modifications to an urban streetscape can increase the number of users and uses of the street, thereby making the street multi-functional and user-friendly.</td>
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<td>Multi-use streets increase the number of eyes on the street, resulting in perception of safety, increased social capital, and liveliness of the street—in essence, improved quality of life (Jacobs, 1961; Appleyard, 1981; Lynch, 1960; Mehta, 2007, 2010).</td>
<td>Most streets today are single-use and lack physical elements that encourage pedestrian or cyclist use of the streets. Complete streets provide affordances not present on an incomplete, single-use street.</td>
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<td>Incomplete streets with high traffic volumes and speeds and that lack elements that encourage non-motorized activities are unsafe for pedestrians and cyclists and worsen quality of life (Appleyard, 1982; Moore, 1991; Liebmann, 1996; CDC, 2010; National Complete Streets Coalition, 2011).</td>
<td>Determining if modifications of bicycle lanes, crosswalks, pedestrian refuges, and road diet calms traffic and makes a street safer for pedestrians and cyclists is key to improving quality of life by increasing the number of individuals who can safely use the street for non-motorized purposes.</td>
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<td>Over the past 20 years, approaches to addressing obesity have not changed obesity rates. Active transportation in places that are easily accessible, safe, and inexpensive is needed (CDC, 2010; Healthy People, 2012). Walking and cycling are feasible methods for integrating active transportation into daily lifestyles (Miles, 2007).</td>
<td>Alternative, commonplace approaches are needed to curb obesity rates. A street can provide a safe, easily accessible space to add regular active transportation in daily life. Research may show that certain affordances provided by a street help increase active transportation and social interaction, which is the intent behind complete streets.</td>
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This research is based on studies that support the idea of a street as a common place for human activity. Streets were once the hubs for nonmotorized human activities, especially walking and cycling; however, due to proliferation of the automobile, beginning at the 20th century, street use gradually became traffic facilitation rather than a multi-functional public space. Calming traffic and increasing the number of affordances provided by streets is key to increasing opportunities for uses other than automobile traffic facilitators. Complete streets aim to increase nonmotorized use of streets by calming traffic, increasing affordances, and providing safe and convenient street access for all users. In response, streets can once again be used to encourage active transportation and provide a space for creating social capital. Increasing active transportation and social capital helps reduce obesity and improve quality of life.
2.1 Environment-Behavior Research

The built environment has long been a mechanism through which behaviors are influenced (Hawley, 1950). Design of the built environment can provide opportunities that contribute to, discourage, or inhibit certain types of behaviors and should not be separated from its relationship with human activities (Jacobs, 1961). Recent studies show that certain physical elements of a streetscape influence behavior (Appleyard, 1982; Mehta, 2007, 2010; Foster et al., 2011). In recent years, there has been an increasing interest in promoting active transportation and social interaction through design of the streetscape (Badland & Schofield, 2005; Heath et al. 2006; Badland, Opit, Witten, Kearns, & Mavoa, 2010; Carlson et al., 2011).

Modifications to the physical environment should be considered as an effective intervention to increase active transportation, especially when the pre-modified environment (a) has a neighborhood design that is not conducive to active transportation; and (b) lacks facilities such as pavements and recreational areas that are maintained and safe (Appleyard, 1982; Miles, 2007). Interventions that specifically include urban design features such as density, land use mix, street connectivity, street scale, and aesthetic qualities are especially critical to influencing use of active transportation (Saelens, Sallis, Black, & Chen, 2003). Likewise, other measures such as seeing others exercising, enjoyable scenery, traffic, and shade are found to promote physical and social activity, especially in regard to walking in neighborhood
commercial areas (Handy, Clifton, & Fisher, 1998).

2.2 Theoretical Framework

Built environment theory asserts that the form and content of the built environment significantly affects human behavior (Barker, 1968). The effects on behavior provided by the built environment are looked at as affordances of its environmental attributes (Barker, 1968).

A review of existing literature on street design and behavior indicated that streetscape characteristics can influence behavior by affecting opportunities for active transportation, social interaction, and quality of life (Jacobs, 1961; Appleyard, 1982; Mehta, 2007, 2010). The influences of two theories constitute the main focus of this study: (1) Behavior setting theory (Barker, 1968), which addresses standing patterns of behaviors in physical settings, and (2) Concept of Affordance developed by Gibson (1979), which explains how humans (agents) respond to opportunities afforded by the physical environment.

The aim of this study is to investigate how behavior changed in the behavior setting of an urban street in response to modifications to the street environment, which improved walkability and bikability and reduced negative driving behaviors. Modifications included bicycle lane, pedestrian crosswalks and refuges, and road diet. This study addresses the question, “How does street user behavior change relative to active transportation and social interaction (both of which are components of quality of life) in response to opportunities provided by specific microscale physical
modifications to make a complete street?”

Figure 1 depicts the conceptual framework of the study. An incomplete street was converted into a complete street by addition of bicycle lanes, crosswalks, and refuges and implementation of road diet. This study aims to determine behavior influences of modifications on pedestrians, cyclists, and drivers (perception and use). Improved affordances for pedestrians and cyclists and reduced affordances for drivers help create a more walkable and bikable streetscape. Streetscape modification variables and street users are defined as the independent variables. Active transportation, social interaction, public health, and quality of life variables are defined as the dependent variables (outcomes).

Bicycle lanes, pedestrian crosswalks, pedestrian refuges, and road diet were added to East Blvd. Street users participated in semi-structured interviews to convey how their behavior or perception of East Blvd. changed in response to modifications, specifically in context of active transportation, social interaction and public health.

![Figure 1. Conceptual Framework of the Study](image)
2.2.1 Behavior Setting

Barker (1968) introduced the theory of behavior settings, which states that the observable environment exists independent of the psychological processes of any particular individual. Barker defined a behavior setting as “a standing pattern of behavior synomorphic and circumjacent to the milieu.” A behavior setting consists of a standing pattern of behavior that is tied to a particular place and occurs at regular intervals (Bechtel, 1987). These behaviors are easily seen and recognized as the ordinary events of life (Bechtel, 1987).

A behavior setting is separate from its surrounding context and behavior (Bechtel, 1987). People are replaceable and interchangeable components of settings; it’s relatively unimportant who fills a position, as long as each essential place within the setting is covered (Bechtel, 1987). Examples include how people act in a worship service in a church or children in a school. These patterns occur because of the environment in which the individual is situated. In these examples, the church building is an objective, observable environment, independent of psychological significance for any particular parishioner (Bechtel, 1987). The same is true for the school building. The building is a school facility, which is objective and independent of any particular student’s perception (Bechtel, 1987). Parishioners and students respond to the objective components of these two environments, respectively. Although each individual does not act exactly the same way in a given setting, there are behavioral responses to the environment that are common among a population
(Schoggen, 1989). This synomorphic relationship says that the actions and objects fit compatibly together (Schoggen, 1989).

As a theory in the field of ecological psychology, behavior settings helps explain many aspects of the physical and geographical environment in relation to behavior (Schoggen, 1989). Behavior settings make use of “focal points,” which are physical areas most accessible to the largest numbers of various kinds of people in a given geographical area (Bechtel, 1987). “A behavioral focal point helps any geographical entity become a community by providing an essential condition: to become a community, people must have a place where they can meet each other on a regular face-to-face basis” (Bechtel, 1987). Focal points tend to be centrally located and provide high visual access (Bechtel, 1987).

Behavior settings are the immediate environments of human behavior; they are environments that provide moment-to-moment inputs to people (Wicker, 1979). Behavior settings are self-regulating, active systems (Wicker, 1979). They impose their program of activities on the persons and objects within them. Behavior settings may also be temporary in some respects (Wicker, 1979). For example, over time, some buildings become obsolete. Some functions of spaces become obsolete (Wicker, 1979). Nevertheless, the physical environment significantly influences human behavior in context.

Streets can be behavior settings. For example, Mehta (2009) used three neighborhood commercial streets as behavior settings to determine what urban design
characteristics of these streets support stationary, sustained, and lingering activities that are social in nature. Mehta found that physical characteristics such as benches, trees for shading, and a variety of land uses most support social activities and that streets can be ideal locations for encouraging community social capital.

The aim of this study is to investigate how street user behavior changes in response to physical streetscape modifications. Specifically, the objective of this study is to determine how addition of bicycle lane, pedestrian crosswalks and refuges, and road diet influenced changes in behavior of street users, especially changes related to active transportation and social interaction in the context of quality of life.

2.2.2 Concept of Affordance

The theoretical concept of affordance relates to behavior settings. Affordance explains how humans (agents) perceive their environment (Gibson, 1979). Gibson defined affordances of the environment as what it offers, provides, or furnishes to the agent (Gibson, 1979). Affordances may be negative (threats) or positive (promises), which collectively characterize items in the environment relative to organisms (Scarantino, 2002). The term implies the complementarity of the agent and the environment (Scarantino, 2002).

Affordances are unaffected by whether they are perceivable or whether they are directly or indirectly perceived (Scarantino, 2002). The affordance of something does not change as the need of the observer changes (Gibson, 1979). Instead, the object offers what it does because it is what it is (Gibson, 1979). Humans can alter the
affordances of the environment, but is still the creature of his or her situation—inseparable from the environmental properties of the context (Gibson, 1979).

2.2.2.1 Human Activities and Affordances

The concept of affordance is useful for explaining what is an available choice to an agent; the way that a situation lends itself to being used (Gibson, 1979). As such, affordances are preconditions to human activity. However, the presence of an affordance for some activity does not imply that the activity will occur; it merely contributes to the possibility of that activity (Greeno, 1994). The presence or absence of an arrangement of particular affordances may encourage or inhibit certain human activities (Greeno, 1994). For example, the lack of sidewalks or bicycle lanes along a busy street with high traffic speeds may reduce an agent’s perceived set of options for active transportation. On the other hand, the presence of sidewalks or bicycle lanes may encourage (or afford) walking or cycling. Some affordances highlight obvious things to do, such as walking along the sidewalk versus walking along the paved section of a busy thoroughfare, whereas other affordances highlight opportunistic things to do, such as choosing to walk versus drive on a busy thoroughfare because presence of a sidewalk makes it safe (Kirsh, 1995).

In order for street users to safely engage in physical and social activities by means of the streetscape, the streetscape should afford opportunities that are not available on an incomplete street (Moore, 1991; Liebmann, 1996; Mehta, 2007). Complete streets often consist of bicycle lanes, pedestrian crosswalks, pedestrian
refuges, and traffic calming via rearrangement of the physical street travelway dimensions (National Complete Streets Coalition, 2011). These physical features provide opportunities, but this does not necessarily imply that the opportunities are being used for the activities for which they were designed—primarily encouraging a pedestrian- and cyclist-friendly environment.

2.2.3 Independent Variables

The independent variables used here to determine the behavioral impacts of urban street modifications are (1) addition of bicycle lanes; (2) addition of pedestrian crosswalks and refuges; and (3) road re-striping (road diet). These variables were expected to influence pedestrian, cyclist, and driver behavior by helping to increase active transportation for pedestrians and cyclists and heighten their sense of safety and social interaction. For drivers, these variables were expected to calm or slow traffic and heighten the perception that the urban street has speed tables significantly slower than a typical boulevard.

2.2.4 Dependent Variables

The dependent variables are active transportation and social interaction as components of quality of life. Human behavior can be intricately linked to elements of the built environment: bicycle lanes, pedestrian crossings and refuges, and road diet. Bicycle lanes, pedestrian crossings, and pedestrian refuges create opportunities for safer walking and cycling, whereas road diets calm traffic and help bring about the perception of a safe environment. Incorporating these physical changes to streets
undergoing modification can in turn encourage active transportation, whether walking, cycling, jogging, or strolling, which also encourages social interaction. The result is improved quality of life for all street users.

2.2.5 Definition of Terms

Built environment: Land use patterns, transportation systems, and design features that together provide opportunities for travel and active transportation. Land use patterns refer to the spatial distribution of human activities. The transportation system refers to the physical infrastructure and services that provide the spatial links or connectivity among activities. Design refers to the aesthetic, physical, and functional qualities of the built environment, such as the design of buildings, and streetscapes, and relates to both land use patterns and transportation system.

Streetscape: The combination of the physical elements installed within and along the street right-of-way that affect its usability, functionality, appearance, and identity. Multi-functional streetscapes enhance the community environment by providing access to land uses, locations for social interaction, and sites for locating and maintaining infrastructure and amenities.

Crosswalk: The most direct pedestrian pathway across a given leg of an intersection, whether marked or unmarked. It is the designated portion of the street that is specifically designated for pedestrian crossing, whether at an intersection or a mid-block. Crosswalks clearly define pedestrian space, enhancing safety and comfort for all users.
Refuge: A protected area between traffic lanes that separate a pedestrian crossing into segments and allows pedestrians to wait safely for gaps in traffic. Pedestrian refuges reduce pedestrian/vehicular conflicts and shorten the distance a pedestrian must cross at one time. Pedestrian refuges are generally a component of a crosswalk.

Bicycle lane: The portion of the street specifically designated for the use of bicyclists by pavement markings or other means of delineation on the street. Bicycle lanes help reduce conflicts between motor vehicles and bicycles and provide an additional buffer between pedestrians and motor vehicles.

Road diet: A physical conversion of the street, wherein one or more travel lanes is converted to another use, often to support the use of other modes. It is also a narrowing of the motor vehicle travelway. Road diet converts excess vehicle capacity on a street into useable space for other modes and helps calm traffic.

Active transportation: Travel by foot, bicycle, or other non-motorized means.

Nonmotorized travel: Travel by nonmotorized means, including walking, cycling, or wheelchair. This study focuses only on walking and cycling.

Social interaction: The social networks and interactions that inspire trust and reciprocity among citizens.

2.3 AASHTO’s Functional Classification for Urban Areas

Highway designers and engineers strive to provide for the needs of highway and street users by providing sound guidance through a text entitled, A Policy on
Geometric Design of Highways and Streets. This guidance manual, produced by the American Association of State and Highway Transportation Officials (AASHTO), is the primary technical document used by designers and engineers when planning, designing, and constructing highways and streets. Some municipalities plan, design, construct, and maintain their own streets (especially within corporate jurisdictional boundaries) and may or may not observe guidance provided by AASHTO.

2.4 Complete Streets

The US has over 4 million miles of public streets (Research and Innovative Technology Administration, 2011). Today, most streets are designed solely as conduits for traffic, while ignoring other dimensions of human behavior (National Complete Streets Coalition, 2011). The lack of adequate opportunities to support activities of all users has spawned a growing movement across the US to reclaim, redesign, and expand the functionality of the street (Smith, Reed, & Baker, 2011). This movement is most commonly referred to as the “complete streets” movement (Smith, Reed, & Baker, 2011).

According to the National Complete Streets Coalition (2011), a complete street typically includes sidewalks, bicycle lanes, shared use path, designated bus lanes, safe and accessible transit stops, and frequent and safe crossings for pedestrians, including median islands, accessible pedestrian signals, and curb extensions. A complete street in a rural setting may look quite different from one in an urban or suburban setting. For example, the former may involve providing wide shoulders or a separate multiuse path.
The guiding principle for complete streets is to create roadways and related infrastructure that provide safe travel for all users. Each complete street has to be customized to the characteristics of the street area it serves (National Complete Streets Coalition, 2011). A complete street is designed to accommodate the needs and expectations of the travelers who want to access or pass through the surrounding neighborhood community or region (Smith, Reed, & Baker, 2011).

Agencies such as the Federal Highway Administration (FHWA), the Interagency Partnership for Sustainable Communities, the U.S. Department of Transportation (USDOT), the U.S. Department of Housing and Urban Development (HUD), and the U.S. Environmental Protection Agency (EPA) indirectly support the complete streets movement with joint interest in providing more transportation choices. These agencies support existing communities through transit-oriented, mixed-use development and land recycling and value communities by investing in healthy, safe, and walkable neighborhoods (Smith, Reed, & Baker, 2011).

Policies and mandates that support complete streets stem from United States Code, Title 23, chapter 2, section 217 (23 USC 217), which mandates that “bicycle transportation facilities and pedestrian walkways shall be considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities, except where bicycle and pedestrian use are not permitted.”
The federal government has also promoted the Context Sensitive Solutions (CSS) program, which is a collaborative and interdisciplinary approach that involves all stakeholders in attempt to provide information for communities that preserves and enhances scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure (Smith, Reed, & Baker, 2011; McCann, 2005).

An example of a program that supports complete streets is the Safe Routes to School program. This program brings together individual schools and students to develop programs to encourage students in kindergarten through eighth grade to walk or bike to and from their schools. This program promotes exercise in students’ daily lives and reduces the need for parents to drive the children, thereby helping to reduce traffic congestion (Smith, Reed, & Baker, 2011).

When taken together, these agencies, policies, and frameworks provide alternatives to the automobile and promote more multimodal, pedestrian-friendly street networks. Pedestrian-friendly networks increase opportunities for active transportation and social interaction. By providing these opportunities, streets can be used to help curb the obesity epidemic as well as reduce cardiovascular disease, diabetes, and certain cancers and improve psychological well being (CDC, 2010; National Complete Streets Coalition, 2011; Smith, Reed, & Baker, 2011). By doing so, quality of life can be improved for all street users.
2.5 Emerging Trends on Complete Streets

Complete-streets policies are rapidly increasing across the US. Complete-streets policies have been adopted by Florida, Rhode Island, Oregon, California, Illinois, North Carolina, Minnesota, and Connecticut. In 2011 alone, over 140 jurisdictions adopted a complete-streets policy, up from 80 in 2010. In total, 352 regional and local jurisdictions, 26 states, the Commonwealth of Puerto Rico, and the District of Columbia have adopted policies or have made written commitment to do so (National Complete Streets Coalition, 2011). The increasing number of states and jurisdictions adopting complete-streets policies adds to the growing need for empirical research on the behavioral influences of complete-streets features on behavior.

2.6 Charlotte’s Urban Street Classification System

Charlotte’s Urban Street Classification System aims to provide the best possible streets to accommodate growth, provide transportation choices, and help keep Charlotte livable. It requires a different approach to and philosophy of planning and designing streets from that of AASHTO, in that it provides design flexibility and is directly linked with land use. Cities across the country are seeing the need to plan for and design “complete” streets—streets that better serve all users, rather than focusing only on one set of users. The Urban Street Design Guidelines (USDG) are essentially Charlotte’s complete street guidelines and are based on the following principles:

- Streets are a critical component of public space.
- Streets play a major role in establishing the image of a community. Therefore, they
affect the health, vitality, quality of life, and economic welfare of a city.

- Streets provide the critical framework for current and future development. The locations and types of streets will affect the land development pattern, as well as how much development can be supported by the street network.
- The design of a street is only one aspect of its effectiveness. How the street fits within the surrounding transportation network and supports adjacent land uses will also be important to its effectiveness.
- Charlotte’s streets will be designed to provide mobility and support livability and economic development goals.
- The safety, convenience, and comfort of motorists, cyclists, pedestrians, transit users, and members of the surrounding community will be considered when planning and designing Charlotte’s streets.
- Streets should be designed to encourage Charlotte residents and visitors to make trips by means other than cars, thereby improving congestion, air quality, and the health of our citizens.
- Planning and designing streets must be a collaborative process, because decisions about the street should be made with a variety of interests and perspectives represented.

To meet the goals described above, Charlotte’s streets are classified according to the following five types:

- Main streets
• Avenues
• Boulevards
• Parkways
• Local streets

These street types fall along a continuum, with the main street's being the most pedestrian-oriented and the parkway's being the most auto-oriented. “Pedestrian- and auto-oriented” refer both to the design of the street itself and to the characteristics of the land uses located along the street. Even though each street type emphasizes different mixes of modes, all of these streets are designed with all potential travelers and stakeholders in mind. By creating a variety of street types, the street network can better provide appropriate choices for those travelers and stakeholders, including Charlotte’s current and future residents, commuters, and visitors. Once a street (or portion of a street) is classified as a certain street type, the street design should reflect that classification, and as should future land use decisions along the street. The following are brief descriptions of each street type:

*Main streets* are “destination streets.” They provide access to and function as centers of civic, social, and commercial activity. Main streets are designed to provide the highest level of comfort, security, and access for pedestrians. Development along Main streets is dense and focused toward pedestrians. Land uses on main streets are typically mixed and are generators and attractors of pedestrian activity. Because of their specialized function and context, Main streets represent a relatively small portion
of Charlotte’s overall street network.

*Avenues* can serve a diverse set of functions in a wide variety of land use contexts. Therefore, they are the most common (non-local) street type in the city. They provide access from neighborhoods to commercial areas, between major inter-city destinations, and, in some cases, through neighborhoods. Avenues are designed to provide a balance of service for all modes of transport. They provide for high-quality pedestrian access, high transit accessibility, bicycle accommodations such as bike lanes, and in some instances, significant automobile traffic. Most thoroughfares in Charlotte’s street network would be classified as avenues. The collector/connector function can also be served by some avenue cross sections.

*Boulevards* are designed to move large numbers of vehicles (as through-traffic) from one part of the city to another and to other lower-level streets in the network. Therefore, maintaining vehicular movement is a higher priority than with an avenue, but pedestrians and cyclists are still provided for in the design. In fact, the higher speeds and traffic volumes increase the need for safe pedestrian and bicycle treatments, such as providing adequate buffers from the traffic. Land uses along boulevards can vary, but development will usually be set back further from the street than on avenues.

*Parkways* are the most auto-oriented of the street types. A parkway’s primary function is to move motor vehicle traffic efficiently from one part of a metropolitan area to another and provide access to major destinations. Therefore, design decisions
for this type typically favor the automobile mode over other modes. As with the main street, relatively few streets in Charlotte are classified as parkways.

Local streets provide access to residential, industrial, or commercial districts, as well as to mixed-use areas. They represent the majority of the lane miles of Charlotte’s street network. Speeds and motor vehicle traffic volumes are low, providing a safe and comfortable environment for pedestrians and bicyclists. Since local streets are built through the land development process, specific cross-sections for a variety of local street types are available. For residential streets, the three alternative cross-sections are narrow, medium, and wide, based on the expected need for on-street parking. The general intent of these streets is to keep pavement as narrow as possible.

2.7 Street-Scale Urban Design Modifications

Modifications to a street have been shown to influence active transportation, walkability, bikability, and social interaction. The following empirical studies address street-scale urban design studies that investigate the influence of street characteristics on pedestrian and cyclist behavior.

Appleyard (1982) studied three residential streets in San Francisco to explore the influence of traffic, noise, and air pollution on social, environmental, and psychological factors of human behavior. Observations and interviews focused on five sets of issues: (i) traffic hazards, (ii) stress, including noise and air pollution, (iii) neighboring and visiting, (iv) privacy and sense of territory, and (v) environmental awareness. This study found that traffic volumes and speeds polarized neighborhoods,
reduced social interaction among neighbors, and made streets less functional for nonmotorized activities. This study suggested that street design should be studied at multiple dimensions and that traffic-calming mechanisms have potential to increase street use by pedestrians and cyclists and improve quality of life for residents. Quality of life includes social capital. Higher traffic volumes worsen quality of life, whereas lower traffic volumes improve quality of life.

Painter (1996) conducted a pre-post study in Metropolitan London of street lighting improvements in three locations and a pedestrian footpath over a six-week period to determine their effect on the number of people using these areas at night. This was assessed using attitudinal and behavioral measures obtained through before-and-after surveys of pedestrians. On-street surveys were taken six weeks before and six weeks after improvements. The short time period of six weeks was to minimize the influence of environmental variables (i.e., climate) on behavior. A multi-agency team selected areas for lighting improvement that had been deemed crime- and fear-prone, with a goal of increasing the number of pedestrians who walk at night. Due to the lighting's effect in reducing crime, incivilities, and fear at night, the numbers of pedestrians increased for all areas, with an average gain of well over 50%.

Painter concluded that street lighting improvements can increase the number of pedestrians who use the street at night. Physical interventions added to or upgraded on a street (street lighting improvements) appeared to improve affordances for pedestrians, who in response increased their use of the street. This finding can be linked to efforts
to promote active transportation and social interaction at night using street-scale improvements. However, the post-survey was conducted six weeks after improvements, which may indicate that activity had not normalized. Additionally, the individuals interviewed before and after improvements were different and might therefore have been responding based on different criteria.

The present study (2012) utilized a similar approach to determining how physical modifications to a streetscape influence behavior, with several key differences: (1) Painter’s study occurred at night and utilized different respondents via survey technique; the present study occurred during the day and interviewed the same set of respondents before and after modifications. (2) The interview technique used in the present study provides a more in-depth approach to determining the nature and scope of behavior changes and linking those changes to physical implementation practices. Jones’ study would benefit from a pre-post approach, but this opportunity was not available due to the timing at which physical improvements and data collection transpired.

Physical elements of a streetscape also influence social behavior and quality of life. Mehta (2009) studied three neighborhood commercial streets in Cambridge, Massachusetts, using behavior mapping, observations, and street user perception through interviews, to determine how physical elements of the streetscapes influenced social interaction. In this regard, seating, sidewalks, building facades, tree cover, and permeability of buildings (i.e., windows) were found significant. People tend to use
streetscape settings where there is a degree of “liveliness” or people activity. Liveliness of a street is an indicator of quality of life (Appleyard, 1982; Mehta, 2010). The term “quality of life” has different meanings for each individual as well as each community (Lund, 2002). However, the term “quality of life” clearly includes social interaction and the social environment, especially with regard to streetscapes (Mehta, 2010).

Mehta’s above findings suggest that physical elements of a streetscape can create a comfortable and meaningful environment for people on neighborhood commercial streets. Microscale characteristics of a street can function together to create patterns of human activity. These patterns lead to “liveliness” of the street, which encourages more use of the street by pedestrians. Although Mehta included microscale physical characteristics of streetscapes, that study did not include physical elements of a complete street—bicycle lanes, pedestrian crosswalks and refuges, and road diet.

Ball, Bauman, Leslie, and Owen (2001) investigated how environmental aesthetics and convenience were related to physical and mental health. This cross-sectional/correlational study was based on self-report data from a random telephone survey of 3,392 Australians. It included measures such as, “A park or beach is within walking distance” or “A cycle path is accessible.” Those who reported low environmental aesthetics or low environmental convenience were about 40% less likely to walk for exercise than those giving high ratings for both variables. Having access to convenient places for exercise and recreation was rated high for active
transportation and for creating a positive social environment that fosters social interaction. Booth, Owen, Bauman, Clavisi, and Leslie (2000) confirmed these findings for Australians over age 60. The study found that neighborhood safety and access to local facilities were important predictors for being active. These findings were also confirmed by Weinstein, Feigley, Pullen, Mann, and Redman (1999), Hovell, Hofstetter, Sallis, Raul, and Barrington (1992); and Hunt and Abraham (2007).

Taken together, these street-scale urban design modifications provide a basis for further research on specific microscale physical characteristics of a street that influence behavior. In light of these findings, this study investigates the influence of pedestrian crosswalks, pedestrian refuges, bicycle lanes, and road diet in the context of a complete street on active transportation and social interaction. The following sections establish an empirical basis on how these microscale physical streetscape modifications influenced active transportation and social interaction as components of quality of life and within the context of public safety.

2.7.1 Mid-Block Pedestrian Crosswalks and Refuges and Public Safety (Pedestrians)

Public safety is the basic goal and the major factor deciding the success of urban design (Cai & Wang, 2009). Pedestrian safety is one of the most important safety concerns facing traffic engineers, planners, urban designers, and government officials. Many communities across the US are seeking to increase pedestrian activity and discourage automobile dependency, especially for short trips in residential settings (Sisiopiku & Akin, 2003). Crosswalks and refuges are physical street-scale interventions
designed to increase pedestrian safety when crossing a street.

The crosswalk refers to the most direct pedestrian pathway across a given leg of an intersection or street segment, whether marked or unmarked (City of Charlotte Department of Transportation [CDOT], 2007). The marked portion of the street is specifically designated for pedestrian crossing, whether at an intersection or a mid-block crossing (CDOT, 2007). Crosswalks clearly define pedestrian space, enhancing safety and comfort for all users (CDOT, 2007).

Pedestrian refuge refers to a protected area between traffic lanes that separates a pedestrian crossing into segments and allows pedestrians to wait safely for gaps in traffic (CDOT, 2007). Pedestrian refuges reduce pedestrian/vehicular conflicts and shorten the distance a pedestrian must cross at one time (CDOT, 2007). Pedestrian refuges are generally a component of a crosswalk and are essential to public safety.

Sisiopiku and Akin (2003) observed pedestrian behaviors at urban crosswalks and surveyed pedestrians using a divided urban boulevard in East Lansing, Michigan. Facilities they studied included signalized and unsignalized intersection crosswalks, unsignalized marked and non-striped mid-block crosswalks, physical barriers such as vegetation, and other streetscape elements. The study found that unsignalized mid-block crosswalks were the treatment of preference for pedestrians desiring to cross (83%). The location of these mid-block crosswalks relative to the origin and destination was the most influential decision factor for pedestrians deciding to cross at a designated location.
The findings also revealed that traffic control (i.e., traffic calming) strongly influenced whether and where pedestrians cross a street (74%). Observational data showed more pedestrians crossing the street, particularly at mid-block crossings. This study demonstrates the benefit of adding mid-block crosswalks to streets to encourage pedestrian activity and ease navigation. It confirms that pedestrian safety is critical to increasing pedestrian activity. Previous research shows that when facilities are convenient to pedestrians, they are more likely to utilize such facilities. In essence, the facilities afford behavior, which was otherwise deemed unsafe (Ball, 2001; Weinstein et al., 1999; Hovell et al., 1992; Hunt & Abraham, 2007).

Factors that influence pedestrian safety at mid-block crossings include presence of bus stops, road width, number of traffic lanes, and volume of pedestrians and vehicles (Diogenes & Lindau, 2010). Li, Yang, and Yin (2010) investigated the safety implications of the installation of pedestrian refuges at 45 signalized intersections in Beijing. They employed field observations and a questionnaire survey of 280 respondents (street users).

Eighty-nine percent of pedestrians supported installation of refuges to safely complete a two-step crossing (crossing across two-way traffic). Seventy-five percent of drivers supported installation of refuges because they felt that pedestrians were less likely to unsafely dash into oncoming traffic. Although no time period was given as to when pedestrian crossings were added and data were taken, the study revealed that the number of severe conflicts between pedestrians and vehicles dropped by 31% after
refuge installation. This study suggests that adding pedestrian refuges along busy signalized streetscapes with two-way traffic can result in the perception that the street is safer to cross. It also may reduce severe collisions between pedestrians and vehicles. Drivers also benefit from installation of refuges because pedestrians are less likely to unsafely cross into oncoming traffic.

2.7.1.1 Z-Style Mid-Block Pedestrian Crosswalks and Refuges

Z-style crosswalks are designed to minimize collisions by positioning a pedestrian refuge in a zig-zag pattern to encourage pedestrians to face oncoming traffic. They are implemented to enhance the road-crossing experience of pedestrians (Havard & Willis, 2012).

Havard and Willis (2012) investigated pedestrian-crossing behavior and perceptions of the walking environment in Edinburgh, UK, both before and after installation of a marked crosswalk one mile south of the city center. Vehicle volumes varied from 248 to 1100 vehicles per hour. The first video-filming was conducted 14 months before the z-style crossing had been installed. The second video-filming was conducted six weeks after installation. Also, 573 pedestrians were surveyed: 363 in the "before" phase and 210 in the "after" phase.

The study revealed that with the installation of the z-style crosswalk, people were more likely to cross the road at the study location, spent significantly less time waiting to cross, were less likely to have to wait in the center of the road, and crossed the road more slowly. People rated the crossing as safer, easier, and more convenient.
Survey data were consistent with observational data. This confirms previous studies showing that improved affordances can increase pedestrian activity in crossing the street and heighten perception of safety.

2.7.2 Bicycle Lanes and Public Safety (Cyclists)

A bicycle lane is the portion of the street specifically designated for the use of bicyclists by pavement markings or other means of delineation on the street (CDOT, 2007). Bicycle lanes help reduce conflicts between motor vehicles and bicycles and provide an additional buffer between pedestrians and motor vehicles (CDOT, 2007). This section addresses empirical studies where bicycle lanes were added to a street to influence cyclist safety and use.

In urbanized areas, most cycling opportunities occur on streets within residential neighborhoods or thoroughfares (City of Orlando, 2012). Many of these thoroughfares are equipped with bicycle lanes. Bicycle lanes provide the safest form of travel for cyclists in urban areas because they allow separation from traffic lanes and place cyclists in clear view of traffic (City of Orlando, 2012). When cyclists ride on sidewalks, many conflict points interrupt their travel. Bicycle lanes have been shown to provide significant benefits, including the following:

- Increased border widths to fixed objects
- Increased turning radius for vehicles in and out of driveways
- Buffer to sidewalks and pedestrians
- Traffic calming
• Accommodation of driver error

• Reduction of passing conflicts among motor vehicles, bicyclists, and pedestrians

Urban areas often have limited space to add bicycle lanes (City of Orlando, 2012). Bicycle lanes are often accommodated by tradeoffs such as eliminating a travel lane or on-street parking on at least one side of the street. In urban areas with lower speeds, bicyclists often “take the lane” and flow with traffic (City of Orlando, 2012).

Cycling provides substantial active transportation and health benefits. Despite this, few empirical studies have been conducted to determine what measures encourage cyclists to cycle more, especially with regard to cycling to work. One of them was Tin Tin et al. (2009), which conducted a cross-sectional study of 2,469 leisure cyclists to determine what measures would encourage them to cycle more, especially with respect to cycling to work. The provision of bicycle lanes was the measure most cited (by 88% of respondents), followed by bicycle paths (76%) and reduced motor vehicle speed (55%). These results suggest that provisions for bicycle lanes and paths can give cyclists a greater sense of safety and in response, encourage more cycling, particularly in regard to trips to work. It also suggests that traffic calming is needed to heighten sense of safety for cyclists.
In Toronto, Canada, a seminal study on installation of bicycle lanes on an existing thoroughfare by means of road diet minimized the potential for aggressive drivers to pass or travel well above posted speed limit (Macbeth, 1999). As a result of this measure, cyclists felt safer and an average of 1500 bicycles/day/year use the heavily trafficked streetscape (Macbeth, 1999). Bicycle-traffic volumes increased on streets with bicycle lanes, while remaining static or possibly declining citywide (Macbeth, 1999). This study suggests when bicycle lanes are added and traffic calming mechanisms are implemented, cyclists feel safer and will use these streets, which has implications for active transportation and social interaction.

In November 2007 and again in November 2008, Parker, Gustat, and Rice (2011) manually counted cyclists before and after a bicycle lane was added on Highway 46 in New Orleans. Highway 46 had a speed limit of 35 mph and average daily traffic of over 23,000 vehicles. The streetscape modifications were among a mix of schools, businesses, a police station, and private residences (similar to the context of East Blvd.). Data showed a 57% increase in the number of riders per day, with a 133% increase among female adult riders and a 44% increase among adult male riders. Similar to the Toronto study, these results suggest that bicycle lanes can help create a safer and healthy physical environment that promotes active transportation and social interaction.

Evenson, Aytur, Satinsky, Kerr, and Rodriguez (2011), which surveyed municipal officials and staff in N.C. jurisdictions with populations greater than 5,000,
found that more than half of NC municipalities reported policies regarding footpaths or crosswalks (64%) and building of these amenities (57%). Actual implementation of programs and infrastructure-related practices were more prevalent in municipal areas that had such programs and policies than those that did not. The study also found that urban areas were more likely than rural to implement programs and infrastructure that encourage active transportation. These findings show that individuals who live in municipalities that encourage policies and infrastructure-related programs that promote active transportation are most likely to be physically active. Also, this suggests that similar national efforts such as Complete Streets have more potential to influence local governments and result in infrastructure that encourages active transportation than not having a program or effort at all.

Studies above indicate that adding bicycle lanes increases the number of cyclists who use the street. However, this could increase the number of collisions between cycles and vehicles. A recent quasi-experimental study by Chen et al. (2012) evaluated how on-street bicycle lanes installed prior to 2007 in New York City have affected different categories of crashes, including total crashes, cyclist crashes, pedestrian crashes, multiple-vehicle crashes, and injurious or fatal crashes. A two-stage design was conducted to compare the incidence of several types of collisions on streets having bicycle lanes to that of a treatment group that did not have bicycle lanes. Results indicated that installation of bicycle lanes did not lead to an increase in crashes, despite an increase in the number of cyclists who used the street. These
findings are similar to findings in the present study. These findings could be attributed to (i) reduced vehicle speeds because of an increased awareness of bicyclists or lane narrowing or (ii) reduced conflicts because of separation of vehicles and bicyclists.

2.7.3 Road Diet and Public Safety (Drivers)

Road diet is a physical conversion of the street, wherein one or more travel lanes (also known as carriage way) are converted to another use, often to support the use of other modes (CDOT, 2007). It is also a narrowing of the motor vehicle travelway (CDOT, 2007). Road diet converts excess vehicle capacity on a street into useable space for other modes and helps calm traffic (CDOT, 2007). The following empirical studies address how road diet influences driver behavior.

Pedestrian collisions occur more in neighborhoods with high traffic levels and higher percentages of street space (Loukaitou-Sideris, Liggett, & Sung, 2007). Lane reduction (number of travel lanes) can increase safety for pedestrians, bicyclists, and motorists while improving the quality of life (Tan, 2011). Road diets are usually implemented because pedestrians have difficulty crossing wide roads that have multiple lanes in both directions and where crossing opportunities are located only at signalized intersections that are spaced at uncomfortable walking distances (Tan, 2011). They are also useful for creating bicycle lanes to help cyclists become more comfortable with using the streetscape (Tan, 2011).

Road diets are also used to calm traffic by slowing speeds or inhibiting aggressive passing by drivers (Tan, 2011). Their effective implementation can decrease
number and severity of automobile collisions and conflicts between automobiles and other road users (Tan, 2011). The reconfigured street environment afforded by road diet heightens awareness of shared space. By doing so, quality of life and livability improves because “the messaging given by a street is: slow down, this is a neighborhood, a place to respect bicyclists and pedestrians” (Tan, 2011).

A road diet was implemented on Edgewater Drive in Orlando, FL. The 1.5-mile section had an average daily traffic of 20,000 at the time project work was initiated. Improvements included placing utilities underground and installing new crosswalks, new traffic signals, safer parking, bicycle lanes, and wider sidewalks (Tan, 2011). Researchers used an average of three years of “before” data and four months of “after” data annualized to one year to examine crash rates, vehicle speeds, and traffic volumes. The road diet reduced crash rates by 34% and injury rates by 68% per million vehicle miles driven on the reconfigured road segment (Tan, 2011). Daily traffic volume ranged from 20,500 to 21,000. The overall number of pedestrians using the space increased in a range from 23-56% per day. Cyclists' use of the space increased 30-48% per day. This study suggests effective implementation of road diet can calm traffic, increase pedestrian and cyclist activity, and reduce injury rates between motorists and between pedestrians, cyclists, and motorists.

Tan (2011) also discussed a road diet implementation at Stone Way North in Seattle. Common concerns among stakeholders in the planning stages included increased congestion, diverted or cut-through traffic, and impeded exits from
driveways. As of 2011, the Seattle Department of Transportation (SDOT) found that there was a gain in efficiency because left turns had been removed from travel lanes, cut-through traffic was not a problem, and left turns into driveways and side streets were facilitated because drivers had only one opposing lane of traffic to cross. The results also showed that bicycle volume increased by 35 percent, average daily traffic dropped by 6 percent, total crashes decreased by 14 percent, injury crashes went down by 33 percent, and pedestrian crashes declined 80 percent. The study demonstrated that affordances provided by road diet may increase pedestrian and cyclist safety and activity and has minimal implications on traffic congestion and cut-throughs in neighborhoods.

Taken as a whole, research on individual microscale physical elements of complete streets provides the theoretical and empirical basis of how these environmental, street-scale variables may influence active transportation, social interaction, and quality of life. Methods and findings used in this body of literature may be useful in understanding, both individually and collectively, the behavioral influences of urban street modifications on behavior.

To date, no studies have considered the elements of bicycle lanes, pedestrian refuges, crosswalks, and road diet of a modified complete street to determine their influence on active transportation and social interaction in the context of quality of life. This study aims to address this gap by focusing on the influence of street scale modifications (bicycle lanes, pedestrian crosswalks, pedestrian refuges, and road diet)
in determining influences on human behavior relative to active transportation, social interaction in context of quality of life.
CHAPTER 3: RESEARCH METHODOLOGY

3.1 Methodological Approach

This study is situated within the Environment-Behavior and Ecological Psychology research domains. It uses behavior setting and affordance features to explain complete street modifications on behavior of pedestrians, cyclists, and drivers. This work utilized a single-case empirical inquiry that “investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin, 1989). In case study research, each case is a single-experiment (Yin, 1989).

The purpose of the present study is to provide empirical evidence as to how physical microscale modifications added to an incomplete street influence behavior of drivers, cyclists, and pedestrians. Street users who experienced East Blvd. before and after modifications, were interviewed to investigate how behavior changed and determine which modifications of the streetscape contributed to the changes. Interviews also provided in-depth information to help understand the users’ feelings, perceptions, and attitudes toward streetscape modifications. Informal site observations were conducted to examine the context in which change occurred and the causes or conditions associated with the change. Collision and traffic analyses were conducted to link perceived changes in number of collisions and traffic volumes with objective data obtained from staff at the City of Charlotte. Finally, historical documents of before and after physical changes of the East Blvd. streetscape were examined. This study’s
methods were used in the studies discussed in Chapter 2 to determine how behavior changed in response to physical changes to a streetscape. This study especially focuses on pedestrian and cyclist activity relative to active transportation and social interaction in the context of quality of life.

3.2 Research Question

One primary research question guided this investigation.

*Research question 1:* How do microscale streetscape modifications (complete streets) support behavioral changes in active transportation and social interaction in the context of quality of life?

3.3 Research Methods

The following research methods were used to investigate this research question. Because this is an exploratory study, open-ended interviews were conducted to investigate the phenomena. Informal site observations, traffic and collision analyses, and use of archival documents were also utilized in previous literature on the influence of street-scale modifications on active transportation and social interaction.
### Table 2-1: Overview of Methods and Analysis

<table>
<thead>
<tr>
<th>Methods</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semi-structured interviews</strong></td>
<td>1. To provide an in-depth understanding of how streetscape modifications influence behavior of street users.</td>
</tr>
<tr>
<td>Analysis: Coding</td>
<td>2. To determine which features of the streetscape contributed to changes in behavior for respondents.</td>
</tr>
<tr>
<td></td>
<td>3. To help understand users’ feelings, perceptions, and attitudes toward a streetscape environment.</td>
</tr>
<tr>
<td><strong>Informal site observations</strong></td>
<td>1. To examine the context in which change occurred and the causes or conditions associated with the change.</td>
</tr>
<tr>
<td>Analysis:</td>
<td>2. To link observations with data obtained from interviews.</td>
</tr>
<tr>
<td>1. Setting (East Blvd.)</td>
<td></td>
</tr>
<tr>
<td>2. Pedestrian, cyclist, and driver behavior</td>
<td></td>
</tr>
<tr>
<td><strong>Collision and traffic analyses</strong></td>
<td>1. To link perceived changes in number of collisions and traffic volumes with data obtained from interviews and site observations to help determine the influence of the factors on active transportation and social interaction in the context of a complete street.</td>
</tr>
<tr>
<td>Analysis:</td>
<td></td>
</tr>
<tr>
<td>1. Pedestrian and cyclist collision with vehicle count (2001-2005 and 2011)</td>
<td></td>
</tr>
<tr>
<td><strong>Examination of archival documents</strong></td>
<td>1. To supplement data from interviews, site observations, and collision and traffic analyses to examine which, why, and how specific microscale physical modifications contributed to changes in behavior.</td>
</tr>
<tr>
<td>Analysis: Before and after physical changes to streetscape of East Blvd.</td>
<td></td>
</tr>
</tbody>
</table>
3.5 Criteria for City Selection

Selecting an appropriate city was critical to effectively investigating effects of complete street modifications on behavior. Hundreds of communities of all sizes and in all parts of the country have adopted complete-streets policies. By the start of 2012, more than 350 policies were in place at all levels of government, directing the transformation of community transportation networks into complete streets. Over half of state governments or Departments of Transportation (26) had some form of complete streets policy, and more than 20 percent of cities with over 100,000 residents had also committed to this approach (National Complete Streets Coalition, 2012).

The National Complete Streets Coalition promotes a comprehensive policy model that includes 10 ideals divided into four categories. The four categories cited below were used for criteria selection in this research:

1. “Pre-policy” work of establishing a compelling vision;

2. Creating a strong core commitment to providing for all users and modes in all projects;

3. Rounding out that directive with supporting best practices; and

4. Planning next steps for policy implementation.

The cities that best met these criteria were the following:

1. Baldwin Park, CA, adopted 2011

2. New Hope, MN, adopted 2011

3. Azusa, CA, adopted 2011
4. Roanoke, VA, adopted 2008

5. Big Lake, MN, adopted 2010

Because these cities were not convenient to me, it was necessary to select a city within North Carolina that met the above criteria. Charlotte, NC has been at the forefront of the Complete Streets movement (North Carolina Department of Transportation [NCDOT], 2012).

3.6 City Selection: Charlotte, NC

The City of Charlotte was selected as an appropriate case study for several reasons:

First, in 2007, the city adopted an Urban Street Design Guidelines (USDG) policy that seeks to match flexible street designs standards with land use. This met the *compelling vision* criterion.

Second, in 2009, the city was awarded a Smart Growth Achievement Award by the Environmental Protection Agency (EPA) for its USDG because (1) the guidelines were innovative; (2) the guidelines served as a model for other communities across the nation; (3) the guidelines are enforceable and enforced; and (4) land use and comprehensive planning are integral components of the guidelines. This met the *core commitment* and *best practices* criteria.

Third, respondents who participated in pilot study interviews stated that East Blvd. was the modified street in the City of Charlotte that was most likely to influence their behavior as pedestrian, cyclist, or driver. This met the *implementation* criterion.
Fourth, Charlotte’s location was convenient and its very helpful city staff provided access to many of the city’s data resources.

Last, the completion of interventions on East Blvd. was coincident with this study.

3.7 Defining the Context: Charlotte

The City of Charlotte is North Carolina’s largest metropolitan area, with a population of over 700,000 (CDOT, 2012).

It is the 17th most populous city in the US. Charlotte administers more than 200 capital improvement projects each year, including roads, intersections, sidewalks, transit lines, stormwater systems, and fire and police stations (CDOT, 2012). The year 2011 marked the 10-year anniversary since Charlotte began implementing complete-streets policy, design standards, and guidelines (CDOT, 2012).

3.8 Original Design of First Pilot Study

Preliminary stages of this study attempted to employ a quasi-experimental research design with survey and behavior mapping as methods. Two streets similar in land use, population density, and traffic would be identified through consultations with staff at the City of Charlotte. Surveys would be administered to residents on these streets to investigate changes in behavior. Street 1 (the control street) would be an incomplete street. Street 2 would be a complete street. Behavior mapping would be used to investigate human activity patterns.

This study design was not feasible for several reasons. First, streets are quite
dissimilar in physical characteristics and context. Differences in land use, population density, traffic volumes, and physical-street elements made it challenging to adequately compare an incomplete street with a complete street in Charlotte. Even identifying streets that were similar in land use, population density, traffic volumes, and physical characteristics (e.g., dimensions) was not feasible because streets in Charlotte were designed and built at various times—some were built in the mid-1900s, and others were recently built under Charlotte’s revised street regulations. Additionally, surveying residents on these two streets would not yield an adequate response rate for statistical analysis. Further, behavior mapping attempts were unsuccessful because the entire length of East Blvd. was the setting. Also, behavior mapping is most useful for recording stationary and lingering activities, which would not have applied to bicycle lanes. If one segment or block of East Blvd. was the site of interest, behavior mapping would have been more appropriate.

As a result, an alternative pilot study was undertaken to determine which street(s) would be studied and which methodological approach (interviews or other) would be most appropriate for an exploratory study on the behavioral impacts of urban street modifications.

3.9 Implemented (Second) Pilot Study

A pilot study was implemented to test the proposed research design and methods and to identify any issues related to interview questions and protocol.

The pilot study was conducted in Charlotte, NC during the months of
November and December, 2011. I met with staff at the City of Charlotte’s Transportation Department to discuss Charlotte’s complete-streets program and obtain a list of which streets had been modified under the program’s policies. A map of 24 modified (road conversions) streets was obtained, shown in Figure 2.

Figure 2: Charlotte Road Conversions, courtesy of City of Charlotte (2011)
From this map, city staff was asked to provide a subset of streets that in their expert opinion was deemed to most influence changes in behavior for pedestrians, cyclists, and drivers.

3.9.1 Selecting a Subset of the Candidate Streets

City staff narrowed the list of 24 modified streets to 8. These streets were deemed to most influence pedestrian, cyclist, and driver behavior because of the total number of people who could be potentially be affected by street modifications. Total number of people affected consists of the following variables: traffic volumes, land use, and density. The final list of streets included the following:

- Selwyn Avenue
- Park Road—Tremont Avenue to Ideal Way
- Magnolia Avenue—South Boulevard to Euclid Avenue
- Euclid Avenue—Iverson Way to McDonald Avenue
- McDonald Avenue—South Boulevard to Euclid Avenue
- Mint Street—West Boulevard to Park Avenue
- Scaleybark Avenue—South Boulevard to Woodlawn Avenue
- East Blvd.

3.9.2 Ethical Issues

Research that includes human participants is subject to review and approval by the University’s Institutional Review Board (IRB). Because this research did not include any federal funding and consisted only of adults at least age 18 who voluntarily
consented to participate, administrative review by the IRB was required. Application and supporting documentation, including informed consent agreement, was submitted to the IRB in early November, 2011. Administrative approval was obtained on November 22, 2011, as shown in Appendix D.

The Informed Consent Agreement approved by the IRB, which was read to the respondents, included the researcher’s contact information, the nature of the research, and a statement that any personal information provided was completely confidential and would not in any way be associated with the research results. Respondents were asked to sign the consent agreement if they were willing to participate.

3.9.3 Preliminary Interview Guide

The interview design and questions stemmed from actual streetscape changes coupled with consultations with the dissertation committee. During the pilot, an initial interview guide was developed and tested (refer to Appendix B) to determine which street in Charlotte respondents deemed to most influence their behavior as pedestrian, cyclist, or driver. The guide and strategy were tested. A total of 30 interviews were conducted from the list of candidate streets. Four face-to-face interviews were conducted on seven of the streets, and two interviews on the remaining street.

Subsequently, the dissertation committee assisted with modifying the initial guide to include questions specifically related to behavior change and the streetscape selected as a case study.
3.9.4 Selecting Respondents

Respondents were approached by convenience along the entire length of each streetscape at shopping centers, restaurants, and local coffee shops and were asked to participate in a brief interview. This group represents individuals who actually experienced and remembered the streetscape before and after completion of modifications.

3.9.5 Conducting Pilot Study

Visits were made to Charlotte on three different occasions during November and December, 2011 to interview potential respondents along the selected streets. The order in which interviews were conducted was based on the geographical location of the street. For example, initial interviews took place on the street nearest my entrance into the city (near Graham Street).

Interviews that followed occurred on streets nearest the reference location, and so on, until interviews had been conducted on all streets. This pattern was implemented until 30 interviews had been conducted.

I approached potential respondents using convenience sampling along the streetscape shown in Figure 3 or while at shopping centers, restaurants, and local coffee shops and asked them to participate in a brief interview.
3.9.6 Conclusions from Pilot Study

As a result of the pilot study, (1) East Blvd. (situated within the Dilworth Neighborhood) was selected for my case study because respondents said it was the most likely modified street in Charlotte to influence their behavior as pedestrian, cyclist, or driver; and (2) the interview guide was modified to include questions specifically related to modifications to the East Blvd. streetscape and behavior.

3.9.7 Defining the Context: Dilworth Neighborhood

Situated near the center of the city is the Dilworth Neighborhood, a historic, walkable area that had been divided by automobile traffic many decades ago. As a result, the neighborhood essentially existed as two separate areas where traffic
volumes and speeds made it unsafe to walk or cycle from one side of the neighborhood to the other. Residents who lived on the south side of East Blvd. could not safely walk to school, the neighborhood park, or shopping areas. Residents who lived on the north side did not cross East Blvd. to visit friends or to shop.

Median real estate price for the Dilworth area is approximately $500,000. East Blvd. / Dilworth Rd. real estate is primarily made up of small (studio to two-bedroom) to medium sized (three- or four-bedroom) single-family homes and apartment complexes/high-rise apartments (Location, Inc., 2012). Most of the residential real estate is occupied by a mixture of owners and renters (Location, Inc., 2012). Many of the residences in the East Blvd. / Dilworth Rd. neighborhood were built no later than 1939, and in some cases, quite a bit earlier. A number of residences were also built between 1940 and 1969 (Location, Inc., 2012).

Real estate vacancies in East Blvd. / Dilworth Rd. are 6.5%, which is lower than in 61.5% of American neighborhoods. Demand for real estate in East Blvd. / Dilworth Rd. is above average for the US and may lead to either price increases or new construction for this neighborhood (Location, Inc., 2012).

3.9.8 Defining Case Selection Context: East Blvd.

As a result of the pilot study, East Blvd. was selected as the focus of the main study (refer to Appendix F). East Blvd. was selected also because it was the most suitable complete street in Charlotte to study the implications of specific microscale physical modifications on behavior. East Blvd. is a neighborhood commercial street
located in the heart of the historic Dilworth Neighborhood. East Blvd. was modified under Charlotte’s USDGs in three phases spanning 2006–2011, as shown in Figure 3.

The East Blvd. corridor developed in the pre-automobile era, when the primary modes of transportation were walking, trolley, bicycling, and horse-drawn carriage. Over the last 75 years or more, automobiles have become the predominant transportation mode, and development along East Blvd. has changed to accommodate the car (CDOT, 2007). The city's East Blvd. Pedscape Plan, a precursor to implementation of modifications, was intended to make East Blvd. multi-modal and pedestrian-friendly. In spite of this commitment, automobiles still dominate the streetscape.

The complex modification of East Blvd. included significant reconstruction to reconfigure travel lanes for automobile and effectively reduced the vehicle travelway (carriageway) from four lanes to two and added bicycle lanes, landscaped medians, pedestrian crosswalks, refuges, and road re-striping (also known as road diet) to calm traffic and produce a more pedestrian and cyclist-friendly environment.

During 2001–2005, which immediately preceded modifications, East Blvd. had an average daily traffic count of 19,700-25,000 vehicles. It has a mix of land uses that support pedestrian activity, including a community grocery store, coffee shops, local boutiques, restaurants, and a mixed-use residential development located at the intersection of East Blvd. and Scott Avenue. The mix of commercial development and high-intensity residential made this an ideal setting to examine the behavioral impacts
of urban street modifications, specifically as they relate to active transportation and social interaction.

3.9.9 Final Interview Guide

The interview guide was modified to include eight primary questions aimed at identifying a relationship between street user behavior and the streetscape. These questions asked respondents to share perceptions, attitudes, and behavioral changes resulting from modifications.

Questions 1 through 4 were general and designed to assess the respondent's familiarity with the demographics, geography, and history of East Blvd. before it was modified. Questions 5 through 8 were designed to assess behavioral changes relative to active transportation, social interaction, attitude, and perception of the modified arrangement and experience of East Blvd. versus the pre-modification arrangement and experience. The primary interview questions were as follows:

**Familiarity and Experience of East Blvd. Prior to Modifications**

1. How long have you lived in Charlotte? (This question was designed to investigate the respondent's familiarity with Charlotte, NC.)

2. Do you live on or near East Blvd? (This question was designed to investigate the geographical proximity of the respondent to East Blvd.)

3. Were you familiar with East Blvd. prior to modifications? (This question was designed to investigate respondent familiarity with East Blvd. prior to modifications.)
4. What do you remember about East Blvd. before it was modified? (This question was designed to initiate conversation on physical modifications that influenced behavior change.)

**Familiarity and Experience of East Blvd. after Modifications**

5. How would you identify yourself as a primary user of East Blvd.—pedestrian, cyclist, or driver, or some or all of the above? Other? In which order? (The purpose of this question was to investigate user perspective.)

6. Do you do anything differently since the street was modified? If so, what do you do differently? If not, why not? (The aim of this question was to investigate how behavior changed in response to user perspective and modifications, especially with regard to active transportation and social interaction.)

7. Do you see or interact with more people since the street was modified? (The aim of this question was to further investigate influence of street modifications on social interaction.)

8. Has the amount of time you spent shopping or dining in the East Blvd. area changed since the street was modified? (The aim of this question was to deepen understanding of street modifications on social interaction.)

These primary questions were supplemented with probing questions throughout the interview. Probes help provide clarification, amplification, or refocusing or reveal intensity of feelings. Any probing utilized during the interview linked the conversation
with variables and topics of interest to the research.

3.10 Potential Obstacles to Research Implementation

Street users: Fear or perception of crime and personal characteristics of potential respondents made approaching many individuals to ask for an interview intimidating to both the potential respondent and me. Not all potential respondents will commit to an interview. To neutralize this fear, I gently approached potential respondents, introduced myself, and discussed the nature of my approach. Only two potential respondents who were asked chose not to participate.

Soliciting: Many businesses discourage soliciting. To address this obstacle, I asked business owners and managers for permission to conduct research in or on the premises of the business. All business owners and managers agreed because I “was not trying to sell something.”
CHAPTER 4: DATA COLLECTION

4.1 Interviews with Street Users

Interviews with street users were administered at the research site from December 2011 to April 2012, during six field visits of three or four days each. The days were a mix of weekdays and weekends. Individuals were approached along the full length of the street, at shopping centers, restaurants, and local coffee shops and asked to participate in a brief interview. If a respondent found that moment inconvenient for an interview, he or she was then asked for an interview via phone or Skype® at a later time. If the potential respondent did not want to participate at all, he or she was cordially thanked for his or her time.

Street user interviews were administered during the daytime between the hours of 8:00 a.m. and 6:00 p.m. or late evening between the hours of 6:00 pm and 8:00 pm in public areas or at a local coffee shop or restaurant. Each interview lasted from 5 to 45 minutes. The average interviews duration was approximately 15 minutes. A total of 66 interviews (n=66) were conducted (in addition to the 30 interviews (n=30) conducted during the pilot study used to develop final interview guide and select East Blvd.).

Although a digital recording device was purchased and available for use at each interview, none of the respondents allowed an electronically recorded interview. Therefore, I captured information by hand-written notes and added confirmation questions to ensure that what was captured coincided with what was stated by the
respondent. To mitigate this limitation, each interview was transcribed within 24–48 hours of when it ended. This method was also useful in citing notes regarding the interview relative to how future interviews could be improved.

Transcribed interviews were examined for recurring themes, categories, perspectives, subcategories, and sub-themes. Any anomalies found were reported and detailed as well. Anomalies are topics that may not be directly related to the variables or research questions but may bear on future research on streetscape design.

Respondents were categorized by self-identified ranking of their use of East Blvd.: (1) pedestrian; (2) cyclist; or (3) driver. This set of categories was also applied to each statement made by a respondent.

4.2 Interviews with City Staff

Interviews were arranged with city staff that were involved in planning, designing, constructing, and overseeing the new arrangement for East Blvd. These interviewed were intended to determine the city’s goals and objectives in undertaking modifications, whether they perceived the project as successful, and what they would have done differently. The interviews took place at the Charlotte Municipal Building, downtown Charlotte, NC. These interviews provided a different perspective from that of street users. Representatives from four departments were interviewed separately: (i) Charlotte Area Transit System (CATS); (ii) Engineering & Property Management; (iii) Planning; and (iv) Department of Transportation Customer Service Center.

Although city staff was aware of the general nature of this study and provided
traffic and collision data along with technical assistance, detailed components of the project were not discussed with them until after results had been analyzed. The researcher chose this direction to ensure minimal bias in crafting questions for the interview guide, conducting interviews, and analyzing results.

A representative from the CATS Department was interviewed to determine the impact of modifications, if any, on public transportation. A representative each from Planning and Engineering was asked the overall goals and objectives of the project and whether they felt that these goals and objectives have been achieved. The Department of Transportation’s Customer Service Center was interviewed to discover what customer complaints, if any, had been logged for East Blvd.

4.3 Informal Site Observations

East Blvd. was observed on five occasions while conducting interviews from December 2011 to April 2012. No formal observation methods were undertaken. Pedestrian, cyclist, and driver activities were recorded using annotated field notes. Some notes were taken immediately after a drive-by, while other notes were taken while walking to conduct face-to-face interviews along the streetscape. Notes were taken on days with temperatures between 50° and 77°. Cloud cover and wind conditions varied. It rained on one occasion.

Additionally, photographs were taken of the modifications that were added to the streetscape. During the time period when photographs were taken, participant observation was used. Field notes were also taken at several segments to understand
how modifications were used, an example of which appears in Appendix E.

4.4 Traffic and Collision Data

Staff at the City of Charlotte’s Planning, Transportation, and Geographical Information Systems (GIS) Departments were asked to provide traffic volume and collision data for 2001–2005 and 2011. This time period 2001–2005 was chosen for the following reasons: (1) Previous studies used traffic volume data for a one-year period prior to modifications. However, I wanted to get a broader scope on traffic volumes for comparison. (2) January 2006 to January 2011 was the time period for implementation of construction modifications. These years would have yielded skewed or incomplete data because modifications were not complete. (3) February to December 2011 was the time period immediately following completion of modifications. Finally, (4) GIS data beyond five years and into year 2012 were not available at the time of the request.

Traffic data for East Blvd. were obtained from the city staff in March 2012. Staff were asked to comment on the reliability and accuracy of the data. In effect, I asked whether the data available from the city was compatible with the objectives of the study and whether the data could yield valid results after analysis. The data and methodology for analyzing data were deemed compatible, reliable, and valid. The number of collisions and average annual traffic volumes for 2001–2005 and 2011, before and after modifications of East Blvd., were calculated.
4.5 Archival Documents

Archival documents were obtained from staff at the City of Charlotte’s Transportation, Planning, and GIS Departments.

Documents included before and after drawings and photos of East Blvd, aerial photographs, and historical GIS data for collisions that occurred on East Blvd. Staff stated that data were true and accurate representations of East Blvd.—before and after modifications.
CHAPTER 5: FINDINGS

5.1 Summary of Analytical Steps

The following sections summarize the analytical steps taken to code interviews, describe site observations, describe traffic and collision data, and review archival documents. This section also includes findings from these analyses.

5.1.1 Analytical Steps for Semi-Structured Interviews

The following steps are derived from Sommer and Sommer (1997).

1. Skimmed the final data set of responses and generated a set of categories in which they could be classified.


3. Assigned responses to a respective perspective (pedestrian, cyclist, driver, or other (unspecified)) and a category (summary of coded responses). A pedestrian is a person who travels by foot, a cyclist is a person who rides a bicycle, and a driver is an operator of a motor vehicle. Selected responses were arranged into several perspectives and categories.

4. Coded responses were then inserted into a matrix arranged by perspectives and categories and quantified as to how many times each category was mentioned from a particular perspective.

5. The frequency that each particular category was mentioned was then generated. Frequency is defined as the number of times a response was mentioned for each category.
6. A mode was then determined for each perspective. Mode refers to the value that occurs most frequently in a perspective (refer to Table 1-1).

7. The final perspectives and categories were then grouped into active transportation and social interaction dimensions (where applicable).

8. Sixty-six (n=66) total interviews were coded.
Table 3-1: Summary of Coded Interviews

<table>
<thead>
<tr>
<th>Code #</th>
<th>Coding Category</th>
<th>Pedestrian</th>
<th>Cyclist</th>
<th>Driver</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Familiar with East Blvd. prior to modification</td>
<td>Perspective</td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Not familiar with East Blvd. prior to modification</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Traffic congestion worse prior to modification</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Traffic congestion worse after modification</td>
<td></td>
<td>Moore</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>It's easier to cross East Blvd. now</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>Tend to navigate through neighborhood to avoid East Blvd.</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>10</td>
<td>Shop more now</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>See or interact with more people now</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>13</td>
<td>See or interact with less people now</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>15</td>
<td>Easier to walk now</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>16</td>
<td>No difference in amount of frequency in shopping</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Aesthetics</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>Street safer for pedestrians</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Left turns difficult</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>No difference in traffic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Like bike lane</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Street safer now for cyclists</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>No difference in safety for cyclists</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Calms traffic</td>
<td>1</td>
<td>16</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Easier to shop now</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Less accidents</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>More accidents</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Pedestrian Refuge</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>No change in behavior</td>
<td>71</td>
<td>12</td>
<td>73</td>
<td>63</td>
</tr>
</tbody>
</table>

| n=60   | Percentage                                            | 92.9% of respondents identified with a pedestrian perspective | 5.5% of respondents identified with a cyclist's perspective | 90.4% of respondents identified with a driver's perspective | 1.6% identified a general perspective or statement |

1 out of 2 respondents made specific reference to avoiding East Blvd.

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5.1.2 Analytical Steps to Informal Site Observations

Field notes were examined for pedestrian, cyclist, and driver patterns of activity, particularly, where along the streetscape the behavior took place and its nature. For example, when pedestrians crossed the street, did they cross at mid-block, at an intersection, or neither? Did cyclists use the bicycle lane instead of the sidewalk? Did drivers appear to speed when given opportunity to do so (e.g., when vehicles were widely separated)? Was there traffic congestion? These brief informal annotations were linked with data from interviews and from traffic and collision analyses.

5.1.3 Traffic and Collision Analyses

Traffic and collision data for East Blvd. were obtained from the city staff in March 2012. Total average annual traffic volumes were averaged for the entire length of East Blvd. for 2001–2005 and 2011. This time period was chosen because (1) 2001–2005 was the five-year period preceding modifications, (2) 2011 was the year immediately following completion of modifications; and (3) GIS data beyond five years preceding modifications and into year 2012 were not accessible.

The average annual number of collisions for (1) pedestrian-vehicle; and (2) cyclist-vehicle was calculated for the same time period and reasons cited above.

5.1.4 Review of Archival Documents

Maps, before-and-after drawings, and photographs were examined at the City of Charlotte’s Municipal Building on three occasions from August to December 2011. Brief hand-written notes were taken regarding location and nature of physical
modifications. Notes were used to provide further insight into the context surrounding behavior change.

5.2 Overview of Findings from Perspectives on Behavior Change

The following sections distinguish selected findings by perspective. Perspectives are arranged by (1) pedestrians; (2) cyclists; (3) drivers; and (4) others (unspecified).

Data are illustrated in tables. Tables are arranged by Code Number, Code Category (coded statements), Number of responses within a respective perspective that referenced the category, and Percentage of responses within a perspective that referenced the category.

Subsequent sections of the Findings addresses findings from interviews with city staff from four departments: (1) Charlotte Area Transit System (CATS); Engineering & Property Management; Planning Department; and Department of Transportation Customer Service Center; (2) influences of modifications on active transportation and social interaction; (3) traffic volumes and collision counts; and (4) informal site observations.

5.3 Pedestrian Perspectives on Behavior Change

Referring to Table 5-1, the majority of respondents who mentioned behavioral change from a pedestrian perspective felt that the modifications facilitated crossing East Blvd. (42.3%; code 5). Some also felt the street was safer (29.6%; code 18), which has led to a more walkable environment (18.3%; code 15). Over 5% (5.6%; code 28) referred to pedestrian refuges as a reason for behavior change relative to walking, in
regards to crossing the street. A small number (4.2%; code 10) stated that streetscape modifications created an environment that increased opportunities for them to take advantage of walking to shopping destinations, which may also include dining.

Table 5-1. Pedestrian Perspectives on Behavior Change

<table>
<thead>
<tr>
<th>Code Number</th>
<th>Code Category</th>
<th>Number/Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>It's easier to cross East Blvd. now</td>
<td>30/42.3%</td>
</tr>
<tr>
<td>18</td>
<td>Street safer for pedestrians</td>
<td>21/29.6%</td>
</tr>
<tr>
<td>15</td>
<td>Easier to walk now</td>
<td>13/18.3%</td>
</tr>
<tr>
<td>28</td>
<td>Pedestrian refuges</td>
<td>4/5.6%</td>
</tr>
<tr>
<td>10</td>
<td>Shop more as pedestrian now</td>
<td>3/4.2%</td>
</tr>
<tr>
<td>(n=66)</td>
<td></td>
<td>71/100%</td>
</tr>
</tbody>
</table>

5.4 Cyclist Perspectives on Behavior Change

Cyclist perspectives on behavior change were least represented in feedback from respondents (refer to Table 5-2). Only 12 out of a total of 219 total responses within the perspectives referred to behavior for cyclists. Cyclists said the street was safer (66.7%; code 22). They also liked bicycle lanes (16.7%; code 21). One respondent each felt there was no difference in behavior change for cyclists and that the modifications calmed traffic (8.3%; code numbers 23 and 24).
Table 5-2. Cyclist Perspectives on Behavioral Changes

<table>
<thead>
<tr>
<th>Code Number</th>
<th>Code Category</th>
<th>Number/Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Street safer for cyclists</td>
<td>8/66.7</td>
</tr>
<tr>
<td>21</td>
<td>Like bike lane</td>
<td>2/16.7</td>
</tr>
<tr>
<td>23</td>
<td>No difference for safety for cyclists</td>
<td>1/8.3</td>
</tr>
<tr>
<td>24</td>
<td>Calms traffic</td>
<td>1/8.3</td>
</tr>
<tr>
<td></td>
<td>(n=66)</td>
<td>12/100%</td>
</tr>
</tbody>
</table>

5.5 Driver Perspectives on Behavior Change

Table 5-3 shows that the modifications prompted drivers to navigate through neighborhoods to avoid East Blvd. during peak traffic times (30.1%; code 6). Drivers also felt traffic congestion was worse after modification (24.7%; code 4). Some drivers felt modifications had a calming effect on traffic (21.9%; code 24). Others said left turns were difficult (13.7%; code 19). A smaller percentage (2.7%; codes 16 and 17) said there was no difference in frequency or amount of shopping and said aesthetics were better after modification (1.4%; codes 3, 26, and 27).
<table>
<thead>
<tr>
<th>Code Number</th>
<th>Code Category</th>
<th>Number/Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Prompted navigation through neighborhood to avoid East Blvd.</td>
<td>22/30.1</td>
</tr>
<tr>
<td>4</td>
<td>Traffic congestion worse after modification</td>
<td>18/24.7</td>
</tr>
<tr>
<td>24</td>
<td>Calms traffic</td>
<td>16/21.9</td>
</tr>
<tr>
<td>19</td>
<td>Left turns difficult</td>
<td>10/13.7</td>
</tr>
<tr>
<td>16</td>
<td>No difference in frequency or amount of shopping</td>
<td>2/2.7</td>
</tr>
<tr>
<td>17</td>
<td>Better aesthetics after modification</td>
<td>2/2.7</td>
</tr>
<tr>
<td>3</td>
<td>Traffic worse prior to modification</td>
<td>1/1.4</td>
</tr>
<tr>
<td>26</td>
<td>Fewer accidents after modification</td>
<td>1/1.4</td>
</tr>
<tr>
<td>27</td>
<td>More accidents after modification</td>
<td>1/1.4</td>
</tr>
</tbody>
</table>

*(n=66) 73/100%*

### 5.6 Other (General) Unspecified Perspectives on Behavior Change

Table 5-4 refers to categories that either: (i) did not fall into any of the other perspectives referenced above (e.g., 22.2% of category mentioned in the unspecified perspective were “see or interact with more people.” Yet, these individuals may have self-identified as pedestrians, cyclists, and drivers of East Blvd). This difficulty was also similar for, “better aesthetics after modifications” at 15.9%; Or (ii) during the process of coding, it was not feasible to ascertain which perspective a respondent was referring to. For example, over 28% of coded statements in this perspective referenced, “No difference in amount or frequency of shopping or dining.” This statement was not
positioned within any particular perspective.

Data from this group showed there was no difference in amount or frequency of shopping (28.6%; code 16). Some respondents (22.2%; code 12) saw or interacted with more people. Over 17% (17.4%; code 14) saw no difference; while close to 16% (15.9%; code 17) said aesthetics were better after modification. Just over 6% (6.3%; code 29) had no change in behavior. Fewer than 5% of responses in this perspective showed respondents shopped more after modifications and felt modifications calmed traffic (4.8%; codes 10 and 24).

Table 5-4. Other (Unspecified) Perspectives on Behavior Change

<table>
<thead>
<tr>
<th>Code Number</th>
<th>Code Category</th>
<th>Number/Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>No difference in amount or frequency of shopping</td>
<td>18/28.6</td>
</tr>
<tr>
<td>12</td>
<td>See or interact with more people</td>
<td>14/22.2</td>
</tr>
<tr>
<td>14</td>
<td>No difference in the number of people seen or interacted with or can’t recall</td>
<td>11/17.4</td>
</tr>
<tr>
<td>17</td>
<td>Better aesthetics after modification</td>
<td>10/15.9</td>
</tr>
<tr>
<td>29</td>
<td>No change in behavior</td>
<td>4/6.3</td>
</tr>
<tr>
<td>10</td>
<td>Shop more after modification</td>
<td>3/4.8</td>
</tr>
<tr>
<td>24</td>
<td>Calms traffic</td>
<td>3/4.8</td>
</tr>
<tr>
<td>(n=66)</td>
<td></td>
<td>63/100%</td>
</tr>
</tbody>
</table>
5.7 Findings from Interviews with City Staff

A representative from the CATS Department was interviewed to determine the impact of modifications, if any, on public transportation. A representative each from the Department of Planning and Engineering & Property Management was asked what the overall goals and objectives of the project were and whether they have been achieved. The Department of Transportation’s Customer Service Center was interviewed to discover what customer complaints, if any, had been logged for East Blvd. All interviews were face-to-face and took place at Charlotte’s Municipal Building in June 2012.

Both the Departments of Planning and Engineering & Property Management stated that the goals and objectives of the project were to calm traffic, narrow travelway, and shorten crosswalk lengths to create a more pedestrian-friendly, walkable, cyclist-friendly environment. In general, the interviewed city staff believed that cycling was better off, more people walked, vehicle speeds had slowed considerably, and traffic is better controlled. Staff also stated that they would further research perceived issues with traffic congestion and signal timing.

The CATS representative said there was no discernable change in the number of riders in response to modifications. He thought this was because so many other factors influence ridership decisions, including destinations, routes, traffic, and demographics. Also, several transit routes service East Blvd. and none services the entire length of the street.
The staff member of the Customer Service Department stated that there had been no complaints logged for East Blvd. since modifications had been completed. In fact, the city had received a few positive comments from street users. Several complaints were logged during construction, which is to be expected.

5.8 Categories from Perspectives that Influence Active Transportation and Social Interaction

Table 5-5 shows categorized responses in descending order that are associated with changes in active transportation and social interaction. For pedestrians, it’s easier to cross now (code 5; 42.3%), street is safer (code 18; 29.6%), easier to walk (code 18; 18.3%), easier to cross with refuges (code 28; 5.6%) and has affected their frequency of shopping as a pedestrian (code 10; 4.2%).

For cyclists, the street is safer now (code 22; 66.7%), they cycle more on East Blvd. (code 21; 16.7%), and modifications calmed traffic (code 24; 8.3%). Others (unspecified) saw or interacted with more people (code 12; 22.2%).
Table 5-5. Influences of Modifications on Active Transportation and Social Interaction

<table>
<thead>
<tr>
<th>Pedestrian Code Number</th>
<th>Pedestrian Code Category</th>
<th>Pedestrian Number/Percentage (%)</th>
<th>Active transportation</th>
<th>Social Inter.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>It’s easier to cross East Blvd. now</td>
<td>30/42.3</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Street safer for pedestrians now</td>
<td>21/29.6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td>Easier to walk now</td>
<td>13/18.3</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>28</td>
<td>Pedestrian refuges make crossing safer</td>
<td>4/5.6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Shop more as pedestrian now</td>
<td>3/4.2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Cyclist Code Category</td>
<td>Cyclist Number/Percentage (%)</td>
<td>Cyclist</td>
<td>Cyclist</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>Street safer for cyclists now</td>
<td>8/66.7</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>Cycle more on East Blvd. now</td>
<td>2/16.7</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Calms Traffic</td>
<td>1/8.3</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>See or interact with more people</td>
<td>14/22.2</td>
<td>X</td>
</tr>
</tbody>
</table>

5.9 Traffic and Collision Data Analyses

East Blvd. was modified in phases from January 2006 to January 2011. Before completion of modifications, the average daily traffic (ADT) count of East Blvd. ranged from 19,700 to 25,000 vehicles. GIS software was used to query average annual traffic and total number of collisions from 2001 to 2005 and for 2011. The sums of each of
these data sets were calculated. These data were compared with respondents’ perception of safety relative to traffic counts, collisions, and traffic calming with data obtained from city records. Table 5-6 summarizes the number of collisions for pedestrians and cyclists.

5.9.1 Findings from Traffic Volume Counts

The average traffic volume (Table 5-6) for East Blvd. ranged from 19,700 to 25,000 vehicles per day prior to modification. Years 2001 and 2002 had annual average traffic volumes of 19,700 and 19,800, respectively. Years 2003 and 2004 had annual average traffic volumes of 24,700 and 25,000, respectively. City staff felt data for years 2004 and 2005 were not completely accurate, but there was no way to verify this. Year 2005 had no data available because the city did not conduct a traffic study of East Blvd. that year. From 2006 through January 2011 was the construction period. These years were not used in the dataset. Average annual traffic volumes were counted twice in 2011, due to completion of modifications. The year 2011 had volumes of 16,600 and 16,300.
Table 5.6. Average Annual Traffic Volumes for East Blvd. from 2001 to 2011

<table>
<thead>
<tr>
<th>Year or Range of Years</th>
<th>Average Number of Vehicles per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>19,700</td>
</tr>
<tr>
<td>2002</td>
<td>19,800</td>
</tr>
<tr>
<td>2003</td>
<td>24,700</td>
</tr>
<tr>
<td>2004</td>
<td>25,000</td>
</tr>
<tr>
<td>2005</td>
<td>No data available</td>
</tr>
<tr>
<td>2006–2011</td>
<td>Construction period</td>
</tr>
<tr>
<td>2011*</td>
<td>16,600</td>
</tr>
<tr>
<td>2011*</td>
<td>16,300</td>
</tr>
</tbody>
</table>

* Year opened

5.9.2 Findings from Collision Analyses

Table 5-7 shows the number of pedestrian and bicycle collisions with vehicles for East Blvd. (2001-2005 and 2011). For pedestrians, collisions peaked at two (2) in 2001 and 2002. One (1) collision occurred in 2003 and 2005. No collisions were recorded in 2004 and 2011.

There were no collisions for cyclists from 2001 to 2003, and one collision in each of the years 2004 and 2005. Cyclist collisions with automobiles peaked at two (2) in 2011.
Table 5-7. Number of Pedestrian and Bicycle Collisions with Vehicles (2001–2005 and 2011)

<table>
<thead>
<tr>
<th>Year</th>
<th>Pedestrian</th>
<th>Bicycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2002</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2004</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2005</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2011</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

5.10 Informal Site Observations

Site observations showed that pedestrians used modifications of mid-block crosswalks and refuges when crossing the street. Most pedestrians and cyclists were adults. The majority of cyclists used bike lanes. However, some preferred to use the sidewalk instead, especially parents with small children. Drivers did not appear to speed, even when there was opportunity (wide spacing between vehicles) to do so.
CHAPTER 6: DISCUSSION

This case study investigated the behavioral influences of urban street modifications relative to active transportation and social interaction within the context of quality of life, using East Blvd., located in Charlotte, NC. Four microscale physical changes to the urban streetscape were selected as variables. The independent variables were: (i) addition of bicycle lane; (ii) addition of pedestrian crosswalks; (iii) addition of pedestrian refuges; and (iv) implementation of road diet program for traffic calming.

This study uses behavior setting to explain standing patterns of behavior in physical settings (Barker, 1968). It also makes use of the concept of affordances (Gibson, 1979), which explains how humans (agents) respond to opportunities afforded by the physical environment. The findings of this study are interpreted in light of these concepts.

Three approaches were used to investigate the influence of street modifications on human behavior. First, semi-structured interviews of street users were conducted to provide an in-depth understanding of how streetscape modifications influenced behavior of street users and to determine which streetscape features contributed to changes in behavior. Second, site observations investigated the context in which behavior change occurred and the nature of the causes or conditions associated with the change. Site observations were useful also in interpreting data obtained from interviews. Third, traffic and collision analyses were conducted to link perceived changes in number of collisions (between pedestrians, cyclists, and vehicles) with
objective data obtained from city staff. Finally, an examination of archival documents was undertaken to help determine which, why, and how specific microscale physical modifications contributed to changes in behavior.

The following sections discuss the findings in the context of the theoretical framework, the research questions, and implications for active transportation, social interaction, and quality of life. Afterward, limitations and implications for design and policy will be addressed.

6.1 Pedestrian Crosswalks and Refuges (Pedestrian Perspectives)

Similar to the state as a whole, nearly 30% of Charlotte crashes involve pedestrians crossing, dashing, or darting out from behind other vehicles or objects across roadways into the path of oncoming, through vehicles (CDOT, 2012). Mid-block crashes occur when a pedestrian crosses the street in the middle of a roadway block, not at an intersection. Mid-block crashes are typically more severe because the motorist is not likely to be slowing for an intersection or turn. Pedestrians typically want to cross mid-block if distances are far between signalized or protected crossings or if conflicts at intersections prohibit crossing. Overall, 40% of Charlotte’s pedestrian crashes occur at mid-block locations where no pedestrian crosswalk and refuge is provided (CDOT, 2012). City staff felt it was important to include mid-block crossings with pedestrian refuges as part of the re-design of East Blvd.

How mid-block pedestrian crosswalks and refuges affect street users’ crossing the street and walking more was evident from the interviews and site observations.
Prior to modifications, most street users did not attempt to cross, even at traffic signals, because it was unsafe, as depicted in Figure 4. Most respondents stated that crosswalks were key to crossing and to navigating through the streetscape for exercise, shopping, or visiting friends and neighbors, as noted in the following quotes:

“Before the city changed East Blvd., it was difficult to cross at any point, even at crosswalks with a signal because there was always a constant flow of traffic. We walk more now and definitely cross the street more.”

“I feel more comfortable letting my kids walk to the park and cross the road. Before redevelopment, I would not allow my kids to cross the street.”

“I now let my children cross East Blvd. I did not before. My children are 8 and 11 years old. They now cross the street alone. Never before! They go to school across the street and also have friends that live over there.”

Although pedestrians may cross at any given point along a street segment, site observations showed that most pedestrians who crossed the street did so at mid-block crossings. Also, when traffic flow was high in both travelways, most pedestrians utilized the pedestrian refuges. Even when traffic flow was not high, many pedestrians paused at the pedestrian refuge before proceeding to cross the additional travelway.
Pedestrians may now cross one lane of traffic, pause at the pedestrian refuge, wait for clearance, and then cross one more additional travelway where vehicles are traveling at a significantly lower speed. Furthermore, the pedestrian crossings are referred to as “Z-style.” A Z-style crossing creates an additional opportunity for safe crossing because it allows eye contact between pedestrians and vehicle drivers. This eye contact is an added measure to increase awareness of shared space.

Interviews with city staff revealed the Z-style design as an important aspect of overall safety for pedestrians who use East Blvd. However, none of the respondents specifically mentioned this nuance, perhaps because they considered it an overall component when they mentioned “crosswalks.”

These findings confirm other studies in similar settings. Sisiopiku and Akin (2003) studied East Lansing, Michigan and showed that unsignalized crosswalks were
the treatment (modification) of preference for pedestrians desiring to cross. Observational data from this study also showed more pedestrians crossing at mid-block crossings than elsewhere along the streetscape.

This study also confirms findings from another study on behavior change relative to pedestrian refuges. Li et al. (2010) conducted a survey in Beijing and found that 89% of respondents supported installation of pedestrian refuges to safely complete a two-stage crossing.

Further research should be conducted on the influence of the Z-style refuge on behavior. Li et al. (2010) showed when these crossings are installed, people spend significantly less time crossing (wait time) and cross more slowly. However, the present study lacked the baseline data to try to corroborate that finding. Also, there was no apparent pattern in the number of pedestrian collisions with vehicles before and after modifications. A more long-term, in-depth study on pedestrian collisions on complete streets should be undertaken.

6.2 Bicycle Lanes (Cyclist Perspectives)

Cyclist perspectives yielded several valuable observations. Although respondents found the bike lane important for safety, they felt that its most significant contribution to cyclists was that it “increased the awareness of shared space.” Respondents felt that drivers navigated with more caution and respected cyclists to a greater extent once the bike lane was present. Informal site observations on five different occasions showed that a majority of cyclists on East Blvd. used the bicycle
The bicycle lane also helped calm traffic and tended to heighten driver awareness. For example:

“I drive slower through the area now because I know that I am sharing the road with people crossing and riding bikes. Before [modifications], there were only cars.”

The addition of the bicycle lane also prompted respondents to “cycle on East Blvd. now.” Before, they stated, they would cycle elsewhere only. This makes it difficult to ascertain whether overall active transportation increased for cyclists.

However, several respondents felt that the streetscape hadn't become safer for cyclists after the modifications. One stated the following:

“I do not think the street is safer now because people are still too distracted and drive too close to the bike lane. They do not give us enough space, even with the bike lane.”

The primary reason for this assertion was that Charlotte does not have a “culture for cyclists yet.” People still honk at them, yell at them, or simply drive too close. Several individuals said they either have collided with at least one vehicle or knew someone who had. The latter statements were not specific to East Blvd. but were nonetheless important when considering behavior influences of urban street modifications on cyclists.

The findings of this study confirm findings of a similar study on the use of bicycle lanes as mechanisms to promote cycling. Tin Tin et al. (2009) found that out of 2,469 leisure cyclists in New Zealand, 88% reported that provisions of bicycle lanes
would prompt them to cycle more, especially to work. The bicycle lane, in addition to reducing vehicle speeds, gave the cyclists a greater sense of safety. Macbeth (1999) found similar results in Toronto. With this in mind, future studies of this type could focus solely on cyclists in relationship to bike lanes and urban street modifications.

6.3 Road Diet (Driver Perspectives)

The road diet of East Blvd. reduced the vehicle travelway (carriageway) to two lanes with landscaped medians and turn lanes at certain block segments. According to the Charlotte Department of Transportation, the average speed for vehicles decreased from more than 55 mph under the previous street arrangement, to about 40 mph under the present street arrangement, thus creating a streetscape that is actually and perceptually safer (CDOT, 2012). Road diet was key to the effectiveness of the other modifications (i.e., crosswalks, refuges, and bicycle lanes). This modification mostly influenced driver behavior, which calmed traffic and afforded a safer street for pedestrians and cyclists.

The majority of coded responses showed respondents had some experience as a driver of East Blvd. (73 out of 219 coded statements). Prior studies have noted the influence of traffic volumes and speeds on human behavior relative to use of the streetscape (Appleyard, 1982; Moore, 1991; Bosselmann, MacDonald, & Kronemeyer, 1999; Mehta, 2007). The concept of behavior setting also helps explain how drivers adapt to the built environment and modify their behavior in response to it. Modifications may include navigating the redesigned travelway implemented as part of
the subject streetscape (East Blvd.) or as found in this study, avoidance of East Blvd. in order to find a more convenient route to a destination.

Findings from this study show that most drivers (30.1% in perspective) tended to navigate through the Dilworth neighborhood to avoid segments of East Blvd. because of traffic congestion and slower speeds along the modified streetscape. This was an unintended consequence of the design. Because modifications calmed or congested traffic, affordances for drivers were reduced, which explains why many drivers cut through neighborhoods to avoid East Blvd. during rush hours. The context in which East Blvd. is situated makes these alternatives possible. The Dilworth neighborhood surrounding East Blvd. is a well-connected and interconnected urban grid system. This system allows drivers to access other streets and thoroughfares by avoiding East Blvd.

Several explanations may substantiate this claim:

1. Over 22% of drivers who responded to a category within this perspective said that traffic congestion was worse after modification.

2. Avoidance as a response to the redesign may be substantiated in that several respondents perceived they saw more traffic “cutting through” their neighborhood now than before the street was modified.

3. Additionally, the most recent traffic counts for East Blvd. show a decrease of nearly 6,000 vehicles per year. This reduction may partly be due to drivers avoiding segments of East Blvd. by taking alternative routes through
neighborhood streets.

These findings were not substantiated through site observations. Traffic congestion was typically most acute near the intersection of Scott Avenue and East Blvd., which is a mixed-use, major intersection. I could not distinguish whether traffic that entered the neighborhood was “cutting through” or going to a destination within the neighborhood (such as home or a friend’s house).

Other findings include that drivers who favored the streetscape changes referred to the road diet effect as “traffic calming.” These respondents were also most likely pedestrians or cyclists as well. Drivers who did not favor modifications referred to the effect of streetscape changes on traffic as, “traffic congestion.” Calming had a positive connotation, congestion a negative one.

Those who referred to traffic as congestion were also most likely to mention that left turns onto East Blvd. from side streets were difficult. Although this was true, it was not exclusively the case. There were some others who stated it was difficult to make left turns onto East Blvd.

There was also a general consensus that traffic back-ups were not exclusively the result of narrowing the travelway. City staff stated that traffic light timing is often adjusted, but timing changes could not be precisely matched with respondents’ statements of when such changes occurred.

Tan (2011) found that road diet implementation in Orlando, Florida, reduced crash rates by 34% and injury rates by 68%. Before the road diet, this section
experienced a crash every 2.5 days (146 crashes per year) and, after the road diet installation, a crash every 4.2 days (87 crashes per year). In contrast, this study found no discernable pattern in crash rates relative to road diet. Tan also found that road diet decreased driver speeds and increased the number of pedestrians and cyclists who used the street.

Tan (2011) also cited results from a road diet implementation in Seattle. Although neighborhood cut-throughs was a concern among stakeholders in the planning stages, cut-through traffic was not a problem and left turns into driveways were easier for drivers. These results are opposite of what the present study found. The present study found implementation of road diet modifications prompted most drivers to navigate through the neighborhood to avoid segments of East Blvd., especially during peak traffic times such as morning rush hours, lunch hour, and evening rush hours.

6.4 Influences of Modifications on Active Transportation and Quality of Life

The following coded statements (categories) indicated by respondents during interviews corresponded with a change in active transportation in response to modifications to the urban streetscape:

- It’s easier to cross East Blvd. now
- Street is safer for pedestrians now
- It’s easier to walk now
- Pedestrian refuges make crossing easier now
- Street is safer (minimal risk of collisions with automobiles) for cyclists now
- Like bike lane and as a result, “cycle more on East Blvd.” now

Semi-structured interviews indicated higher levels in active transportation in response to urban streetscape modifications. Some of the most successful approaches to increasing active transportation occurs in environments where individuals (i) feel safe doing the activity; (ii) can easily access the activity on a regular basis; (iii) can fit the activity in their regular schedule; and (iv) feel the activity does not generate financial or social costs that he or she is unwilling to bear (Miles, 2007). Walking is the most commonly reported leisure-time active transportation, followed by jogging and cycling (USDHHS, 1996).

Interventions to increase active transportation (i.e., change behavior) are most successful when individuals may gradually increase levels by integrating them as part of the landscape in everyday settings (Leydan, 2003). Safe environments are those that have or are perceived to have minimal risk of injury and a sense of security (USDHHS, 1996).

This study suggests that as a result of added bicycle lanes, pedestrian crosswalks, and refuges, respondents engaged in more frequent walking than they did before. It may also suggest respondents walk further than they did prior to modifications.

For cyclists, there was also potential for increased active transportation. It was unclear as to whether there was a true increase or if cyclists simply changed cycling
location in response to addition of the bicycle lane and traffic calming measures (such as the road diet). These implications may influence active transportation and quality of life if indeed cyclists engage in more cycling than they did before modifications.

6.5 Influences of Modifications on Social Interaction and Quality of Life

Social interaction is defined as the social networks and interactions that inspire trust and reciprocity among citizens (Putnam, 2001; Leydan, 2003). Research suggests a physically well designed and maintained street with a variety of land uses in close proximity to one another helps create opportunities for social interaction (Mehta, 2007). A socially active street is a lively street (one in which many pedestrians and cyclists creates patterns of activity; one in which many “eyes on the street” help to create a sense of safety and security (Jacobs, 1961; Mehta, 2009). It has been well documented that environments in which individuals are most likely to walk, shop, or dine are those which have some degree of liveliness (Jacobs, 1961; Appleyard, 1982; Mehta, 2007; Mehta, 2010).

Semi-structured interviews from this study suggest that pedestrians experience a greater degree of social interaction through the experiences of seeing or interacting with more people and/ shopping or dining more along the East Blvd. corridor because they can safely walk to a desired destination versus drive. They “see more people using the street now.” As such, there are more “eyes on the street” (Jacobs, 1961), which gives pedestrians a greater sense of safety by creating a “lively” environment (Appleyard, 1982; Mehta, 2010). This heightened sense of safety has encouraged street
users, specifically residents of the Dilworth Neighborhood, to walk to shopping and dining destinations more than they did under the previous arrangement.

Other respondents stated there is no significant difference in the amount or frequency of shopping or dining they engage in or no difference in the amount of people they see or interact with. Most of the latter were primarily drivers who used East Blvd. as a conduit rather than a place for activities such as shopping, dining, exercise or leisure activities.

Cyclists also felt the current arrangement of the streetscape was safer for cyclists and they saw more cyclists using the streetscape as a complete street. This perceptual increase is important for cyclists because it helps to create awareness that complete streets are multi-modal, multi-use streets designed to accommodate all users. Social interaction is a component of quality of life.

6.6 Summary of Findings

The literature suggests that design of the built environment creates opportunities for influencing active transportation and social interaction and improving quality of life. Literature has also suggested that the streetscape is an integral component of the built environment and represents the largest portion of the public realm. Complete streets is a movement aimed at increasing the number of affordances provided by a streetscape in an attempt to provide safe and convenient access to the street for all users. In return, significant opportunities are created to influence active transportation, improve safety, and foster strong communities.
Findings from semi-structured interviews suggest that microscale physical modifications to the urban streetscape of East Blvd. support behavioral changes relative to active transportation and social interaction, especially in regard to pedestrian behavior and cyclist behavior. Affordances provided by road diet, addition of elements such as bicycle lanes, pedestrian crosswalks, and pedestrian refuges contribute to creating a safer environment for pedestrians and cyclists. Integrating modifications into the streetscape that were not present prior to modification increased affordances for street users to engage in alternative forms of behavior that either were not possible or were unsafe under the previous street arrangement. Street modifications also reduced affordances for drivers by reducing speeds and creating awareness of shared space.

Respondents who perceived that the environment was safer felt more comfortable walking and cycling along the streetscape, which affects active transportation. Because more people walk or cycle East Blvd., opportunities for encounters have also increased. These relatively undemanding, brief encounters give street users the perception of a safe environment, which in response, leads to active transportation.

This study commenced with semi-structured interviews of street users of East Blvd. to determine if and to what extent they changed behavior in response to modifications to the urban streetscape. The four variables primarily of interest to this study were bicycle lanes, pedestrian crossings, pedestrian refuges, and road diet.

Urban designers, planners, and transportation engineers should consider the
extent to which bicycle lanes, crosswalks and refuges, and road diet integrated into the streetscape can influence human behavior relative to active transportation and social interaction. Streetscapes can be designed to improve public health for generations to come.

6.7 Limitations of the Study

This research has five major limitations related to the conceptual framework, methodology, and interviews.

1. What people say is not always what they do. Information taken in interviews is limited to the spoken content and to inferences made by the interviewer. Interview data are often highly subject to bias, especially when interviewers inadvertently or inadvertently encourage or discourage certain responses. Other research methods are also subject to human interpretation and error. However, interviews tend to be subject to greater influence by the researcher. The researcher minimized bias as much as humanly possible by seeking to objectively respond to statements made in interviews by limiting emotional reactions. Proper training and experience is useful in managing human bias.

2. Time and resource constraints affected the respondents and me. Neither researcher nor research has unlimited time and is not bound by limitations on resources. I would have preferred to interview each respondent for at least an hour, and then conducted a follow-up interview for at least the same length of time. It would have been ideal to spend several additional months in Charlotte.
Just conducting interviews and observing behavior. These ideals were not practically or feasible. Yet, these constraints and limitations do not minimize the findings of this study. Henderson (2006) stated that interviews are complete when saturation occurs. Saturation occurs when no new data are being uncovered. The researcher did not cover anything new after interview number 30, yet interviews continued. These interviews confirmed what was found in the previous interviews.

3. The study was confined to the context of East Blvd., which is primarily middle-class/upper-class. Future research may consider differences in demographics, as the literature reviewed showed that differences in active transportation and social interaction for various groups. Additionally, the history of East Blvd. as a street initially designed for horse carriages and trolley cars plays a significant role in the feasibility of integrating improvements within the existing right-of-way. Other streets may be more constrained by right-of-way limits, setbacks, utilities, etc. This limits the transferability of the findings of this study.

4. The study did not take into account motivations and characteristics of a particular respondent. Individuals engage or do not engage in active transportation and social interaction for many complex reasons. This study focused on objective physical microscale modifications to the streetscape and human response to those changes. Humans were considered as respondents to
the environment. Therefore, it was not necessary to include personal characteristics as part of this study.

5. Respondents declined to be recorded with a digital recording device. Therefore, some information was not captured. I had to compensate by taking notes during the interview and asking for clarification on unclear issues.
CHAPTER 7: CONCLUSIONS

Complete street modifications may help reduce sedentary lifestyles and curb the obesity epidemic by providing convenient and safe options to engage in active transportation, effectively increasing affordances for pedestrians and cyclists and reducing affordances for drivers. Complete streets may also provide significant opportunities for creation of social capital by placing more eyes on the street (particularly pedestrians and cyclists), therefore creating a “lively” street.

This study suggests that by adding modifications of mid-block crosswalks and refuges, bicycle lanes, and road diet, functionality and use of a street for pedestrians and cyclists can be increased. These elements make the street actually and perceptually safer by calming traffic and creating a more “lively” street.

The study of specific microscale physical characteristics of modified streetscapes has implications for the millions of miles of streets in the US. Many of these streets will undergo modification at some point. Society is demanding multi-functional public spaces that can be used to facilitate non-motorized activities. Since street design and redesign is very expensive and local governments typically do not have funds to implement several iterations of a design, using best available data to design streetscapes is critical. Governments and streetscape designers would benefit from using the best data.

7.1 Implications for Future Practice and Policy

This research is situated in Transportation, Urban Design and Public Health,
and Public Policy. The independent variables selected were objective, physical microscale changes to an urban streetscape. The study responds to a need in the Complete Streets movement to create multi-user, multi-modal streetscapes that accommodate all users. Complete streets have the ability to accommodate all strata of society. However, empirical research is needed to strengthen the case for complete streets. The exploratory study presented here showed that increasing the number of affordances of a particular streetscape can influence active transportation and social interaction. Policy-makers and designers could consider contexts similar to that of East Blvd. for converting incomplete streets into complete streets. They may find critical partners within public health agencies and others. By integrating urban planning and urban design with public health and quality-of-life outcomes, more systematic efforts will likely result in designs to accommodate the needs of all users.

7.2 Implications for Future Research

Active transportation and social interaction have often been studied from an individual perspective rather than an ecological perspective. This study utilized an ecological psychology approach to determine the influences of complete street modifications on active transportation and social interaction. Because this exploratory study has developed outcome categories, future studies may utilize a different methodology such as survey. Due to the exploratory nature of this study, survey was not practical because it would limit the scope of information needed to fully understand the influences of modifications on behavior. Now that an exploratory
investigation has been undertaken, a future study could implement a survey instrument to quantify the outcomes.

Additionally, further research could include more in-depth analyses on the influences of traffic and collisions on human behavior to provide further insight into the outcomes Appleyard’s seminal investigation. Different contexts may yield different results. These analyses may include determining the types and nature of accidents and whether modifications to the streetscape would have an effect. For example, How many collisions involved pedestrians or cyclists? What role, if any, did the design of the streetscape play in these collisions? Was the severity of collisions more or less at mid-block crossings?

Further research could include pre and post pedestrian and cyclist counts on complete streets to objectively determine how opportunities created by complete streets influence the number of street users. This research could also include behavior mapping or structured observations at specific street segments to study pedestrian and cyclist activity patterns. Driver behavior should also be investigated as part of such a study. Several cyclists in the present study stated drivers were distracted and unfriendly toward them. This, they felt, created an unsafe environment for cyclists.

Further research could also be conducted on how crosswalks influence behavior to determine how the texture, type, dimensions, and location influence pedestrian, cyclist, and driver behavior. For example, do type, length, texture, and location influence behavior and to what extent? The primary methodology used in this
study, semi-structured interviews, should be utilized in settings where other streets have been converted into complete streets.

Quasi-experimental studies comparing conventional and complete streets may help determine what differences (land use, average daily traffic, speeds, etc.) make complete streets successful or unsuccessful. However, in practice, comparability may be a challenge.
REFERENCES


Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., Ramsey, L. T., & Task Force on Community Preventive Services. (2006). The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. *Journal of Physical Activity and Health, 3*(1), S55–S76.


APPENDICES
Appendix A: Interview Questionnaire Cover Letter

Dear Charlotte Resident,

I am conducting my doctoral dissertation research on the street design of East Blvd. I am a Ph.D. Candidate at North Carolina State University, College of Design, Urban Design Program and am the main investigator in the research.

I would like to ask your help with an interview, which should take about 15 minutes to complete. The interview is being conducted with individuals in your community (near East Blvd.) to solicit your response. The interview consists of about 5 questions on topics relating to street design and behavior. The interview is completely confidential. The results will be presented as summaries, and individual respondents will not be identified. Results from the interview will help us to design better streets that are safe and pedestrian-, child-, and cyclist-friendly.

Each resident from the sample of households who completes the interview will be entered in a random drawing to win one of two $40.00 value gift cards from Target. Participation in the drawing is completely voluntary.

Would you be willing to conduct a brief interview with me? The interviews can be conducted (1) face-to-face at a neutral, agreed-upon location, (2) via telephone, or (3) via Skype. If you are willing to participate, please feel free to contact Dwane Jones at [contact information] or dwane.jones@gmail.com. I will be in the Charlotte area conducting face-to-face interviews February 15-17, 2012. A phone or Skype interview may be scheduled at any time.

Thanks for helping in my research!

Sincerely,

Dwane Jones, Ph.D. Candidate in Design
Appendix B: Interview Guide for Pilot Study

Interview Guide:
The Behavioral Impacts of Urban Street Redevelopment: Case Studies from Charlotte, NC

1. Tell me a little about yourself.
2. Describe a typical weekday.
3. Describe a typical weekend.
4. Tell me a little bit about the importance of using the street in your life. (Probe: How do you use the street? Do you feel the street suits your needs?)
5. What activities do you enjoy using the street for? (How often do you do these? With whom?)
6. What do you like most about the street in your neighborhood?
7. What do you like least about the street in your neighborhood?
8. Which features or amenities would you like to see included in the design of neighborhood streets?
9. Which features or street amenities of the street would be best for children?
10. If you could choose to walk, bicycle, or exercise on any street in Charlotte, which would you choose? Why?
11. Which street in Charlotte is best for social activities/interaction? Why?
12. If you could change anything about the street you live on or a street you use often (as a pedestrian), what would you change? Which street are you referring to?

1. Do you prefer _______ _________’s current layout?
2. Would you like to see more schemes like _______ _______ elsewhere in the city?
3. How does your view of _______ _________ (modified design) compare with the previous (traditional) design?
4. What aspects of the street environment make you want to spend more time there?
5. What aspects of the street environment prevent you from spending more time there?
6. Which aspects of the street are most important to you?

Streets of Interest: (a) Selwyn Avenue; (b) East Boulevard; (c) Rozzelles Ferry Road; (d) Park Road; (e) Morehead Street; and (f) Davidson Street
Appendix C: Example Notes from Early Interview

Street: General
Interviewee: bicyclist, male
Interview method: phone call
Kids: grown, has grandchildren
Recorded device used: yes or no

Time began: 3:00 pm  
Time ended: 3:49 pm  
Date: 11/28/2011 (Monday)

Research Question

How does behavior, attitudes, or perceptions change in response to urban street redevelopment in Charlotte, NC?

How was the interviewee contacted?

This interviewee’s contact information was given to me by a staff member of the City of Charlotte as a good person who had a general knowledge of complete streets. I felt this was a good starting point. I subsequently contacted the interviewee via email and made an appointment for a phone interview. The interviewee was interviewed as a general street user, which served as a good starting point for future interviews.

Introductions

The interview began with preliminary discussion on the interviewer’s and participant’s background. This information will not be cited in the notes, to protect the identity of the participant.

Discussion

I described the nature of the research project to the respondent by explaining that this research is on the behavioral impacts of urban street redevelopment with a specific emphasis on case studies from Charlotte, NC. Reason being, Charlotte has USDG that are used as a model by other communities for urban street design guidelines. Then participant and interviewer proceeded into a general discussion about how the participant uses Charlotte’s streets as a pedestrian.
Participant: Participant is an avid cyclist and does not consider cyclists as pedestrians. There are two distinctions: Cyclists are a part of “active transportation.” Active transportation encompasses everyone outside of a car who is using some form of non-motorized transportation. The term “motorized” captures automobile traffic and the like.

Interviewer: Why is it necessary to distinguish between the two terms?

Participant: We distinguish for purposes of funding city projects. “Transportation” gets the attention of elected officials, while “recreation” often does not; especially if funding is involved.

Interviewer: What do you think is needed on streets to get children more actively involved in walking to school?

Participant: Sidewalks are needed. Sidewalks are needed on both sides of street. Charlotte’s USDG typically call for 8’ planting strip and 6’ sidewalk in many cases. If sidewalk is on one side of the street, is it on the correct side to minimize crossings? Often, where there are sidewalks, a major barrier to kids walking to school is lack of a tree canopy. Sidewalks alone are not enough to get kids walking to school. There are other considerations that must be taken into account such as: Where do sidewalks exist? What gathering points do we have (for a group of people to meet)? Are there enough stop signs? Traffic calming, crash statistics, painted crosswalks, other street features.

Interviewer: You mentioned crosswalks. Do you have a preference for crosswalks? Do you prefer painted crosswalks instead of crosswalks of a different texture, such as brick?

Participant: I am not convinced speed tables slow down traffic. Painted crosswalks give more bang for the buck. Piano style. The bigger the better. The only time texture plays a role is when a car is crossing it.

Interviewer: What do you mean by that last statement?
Participant: When a car crosses through a crossing with a different texture, it may alert them that there is a different texture. If a child is already in the crosswalk when a car enters, it is too late.

Interviewer: Which street in Charlotte would you choose to use/walk on?

Participant: Do you have a list or do you just want me to choose one?

Interviewer: I have a list of streets I am interested in, but I prefer to hear your objective assessment without the list.

Participant: As a bicyclist, I am always looking for better places to ride; lower volume, neighborhood, residential streets are best. They may or may not have street modifications. East Blvd. is a good example.

Interviewer: Why?

Participant: It has more pedestrian activity, dedicated bicycle lane... traffic volume has actually increased slightly since it was (modified) redeveloped by the city, yet it is a great place to ride. Other great streets for a cyclist are: S.Mint, Tuckaseegee, Clanton, and Selwyn. These streets are multi-modal friendly. The idea is to give people choices and make those streets safer.

Interviewer: Earlier you mentioned barriers to children walking to school safely. What is the greatest barrier to a safe routes to school program.

Participant: The greatest barriers are parents’ willingness to change and the convenience of the car. Another barrier is the perception of fear by parents. Fear includes fear of abduction and children crossing streets. The fear of abduction is greater although stats show that there is a much greater likelihood that a child would be hit by a car than by being abducted. Yet, the fear of abduction is real and often acute. In terms of street crossings, parents are afraid that their child will be hit by a car while crossing the street. This is where people don’t understand Z-style crossings. Z-crossings force pedestrians to face oncoming traffic. This also helps slow traffic, which makes it easier to coexist.
I should state that I do not advocate sending kids to school alone; I advocate parents walking with their children or perhaps the children meeting other parents to walk to school.

Other ways to get kids moving include bike safety classes for all ages. It only takes 30–35 minutes to learn. I teach my grandchildren to ride (age 3 or so) with no training wheels on scoot bikes. They first learn balance. This is a program that was actually incorporated into a kindergarten program at a school to get more kids comfortable with riding bikes. Scoot bikes are fairly expensive.

An alternative is to remove pedals from a standard bicycle and teach the child balance first. Then add the pedals and they will be riding comfortably in no time.

**Interviewer:** You mentioned parents’ perception as a major barrier to children walking to school. Are you saying that changes to the built environment are secondary to perception to getting more children to walk to school?

**Participant:** I often have to work at the individual school level (rather than district-wide) to get more children walking to school. Parents are different at each school and perceptions differ as well.

Other barriers include changes to roads that are limited by NCDOT. This is probably the biggest barrier (with reference to the built environment) to building better streets. NCDOT has many state roads in the city’s limit. Thankfully, they are beginning to consider complete streets and use Charlotte as a model.

Going back to perceptions, the biggest barrier outside the built environment is perception. “How do you get people feeling better about riding in traffic? It’s like taking someone to swim who has a fear of water (e.g., Providence Road).” Some potential ways of overcoming this is:

1. Have fun rides with groups showing people that groups of cyclists can coexist with traffic.
2. Need to expose people to it and reduce discomfort level. The only way they will overcome is to do it.
**Interviewer:** As a cyclist, do you have a preference for the width, length, and dimensions of bicycle lanes?

**Participant:** No personal preference for bicycle lanes. Some groups do not want bicycle lanes at all. They presume that motorized transportation is the same as active transportation. However, this is a misassumption. We don’t have that culture or climate here yet. As an avid cyclist, I personally don’t care whether there is a bicycle lane or not. I just want prefer my bicycle, with or without a bicycle lane.

Interview concludes with closing remarks and invitation by the interviewee to contact him anytime. He would like to meet me in person one day when I am in Charlotte.

**Interviewer Notes**

1. This interview was not recorded using a digital recording device for two reasons: (1) I had just purchased a new digital recording device just prior to the interview and I was not comfortable using it; (2) because I had purchased the device only recently, I had not previously asked the interviewee if I could record the interview using a digital device. I had asked to take handwritten notes from the interview. The interviewee granted permission to take handwritten notes from the meeting.

Because the notes from the interview would be handwritten during the meeting, I used the speakerphone on my computer in my home office to keep both of my hands free. Although I cited most of the major points from the interview, I was limited in writing everything that was said (including all of my transitional statements and questions). Hence, interviewer bias may be a limitation. I cited points I felt were critical to the research subject at hand, which meant that other statements were not recorded. The unrecorded statements may have been just as important to the interviewee. Examples include personal references to familial perceptions and fears.
I did not cite these because of limitations and note-taking and to protect anonymity of the interviewee. A digital recording device will be quite helpful in future interviews.

2. When a digital recording device is not used, the interview should be documented within 24 hours after the interview was conducted, to ensure that as much of the interview as possible is captured accurately.

3. Phone interviews do not allow behavioral observations and mannerisms during the meeting. Yet, phone interviews are ideal when the interviewee is physically distant or when a face-to-face meeting would be inconvenient. My goal was to capture the information from the interview as accurately as possible, not necessarily to study the interviewee’s behavior during the interview.

4. Noted barriers to increasing the number of children who walk to school: parent perception/fear of abduction and child being hit by car; and NCDOT.

5. Selected remarks by the interviewee:
   I. Z-crossings;
   II. active transportation versus motorized transportation;
   III. traffic volume has actually increased on East Blvd. (a modified street) since the street was modified, yet East Blvd. is one of the most pleasant streets in the city for this cyclist to use;
   IV. street modifications were seemingly not as important in and of themselves as street modifications in combination with other factors such as road diet, traffic calming, pedestrian activity, and perception;
   V. Interviewee asked if I had specific definition or notion of the term “redevelopment” at the outset of the interview during the introductions.

**How does this interview address the research question?**

It seems that street modifications make the journey of a cyclist more pleasant. It does not entice the person to cycle but may increase the appeal of the experience of cycling. Street modifications definitely play a role in changing behavior, yet overarching factors include perception and willingness to change.
If given equal traffic volumes (significant traffic) and choice of street to use (modified versus not modified), an avid cyclist may choose the modified street for a more pleasant experience. However, neighborhood residential streets with low traffic volume are best (modified or not). Traffic volume should be researched further.

Submitted: Wednesday, November 30, 2011
Appendix D: IRB Exemption Approval Letter

From: Carol Mickelson, IRB Coordinator
North Carolina State University
Institutional Review Board

Date: November 22, 2011

Title: The Behavioral Impacts of Urban Street Redevelopment

IRB#: 2392

Dear Dr. Jones,

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101. b.2). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review.

NOTE:
1. This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU projects, the Assurance Number is: FWA00003429.

2. Any changes to the research must be submitted and approved by the IRB prior to implementation.

3. If any unanticipated problems occur, they must be reported to the IRB office within 5 business days.

Please forward a copy of this letter to your faculty sponsor, if applicable. Thank you.
Sincerely,

Carol Mickelson
NC State IRB
Appendix E: Example of Field Notes

Date: 10/04/2011
Location: East Blvd.
Time began: 11:07 AM
Time ended: 11:47 AM
Observer location and direction:

Temperature: 67°
Weather conditions: Blue skies, mild

Remarks:

517 East Blvd. (Facing south toward Western Hotel)
Appendix F: Map of East Blvd.
Appendix G: Photographs of East Blvd.

The following photographs show East Blvd. before and after modifications.

East Blvd. before modifications

East Blvd. after modifications

Pedestrian crosswalk and refuge

Bicycle lane, crosswalk, road diet