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16. Abstract

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- A platform for "clinically" testing the perception of safety. This platform was a 3-dimensional interactive street environment that could be affected by alterations in the physical construct of the environment; the interactive street environment was constructed according to focus group findings.
- A measure describing the physical constructs of the walking environment on residential streets, defined as significant by the focus groups.

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1) Do different streetscapes influence parent's perception of safety?
2) Does lateral separation from the vehicular travel-way influence whether a parent will allow their child to walk to school?
3) How are perceptions of safety and spatial edge related to each other?
4) Are there consistencies in the way people measure and describe the walking environment in the field?

The results from the trials on-site and in the simulation laboratory suggest that people do perceive different levels of safety when the physical environment is altered and that this perception affects feelings about allowing their children to walk to school. Lateral separation from the traffic with a green buffer had a significant positive effect on perception that the sidewalk was safe for their children. However the decision to allow the child to walk or not is not based solely on the physical characteristic of the environment; economic and social reasons are important determinants as well.

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CORRELATES OF ENVIRONMENTAL CONSTRUCTS AND PERCEIVED SAFETY ENHANCEMENTS IN PEDESTRIAN CORRIDORS ADJACENT TO URBAN STREETS

by

Byoung-Suk Kweon, PhD
Assistant Professor
Department of Landscape Architecture
Texas A&M University

Jody Rosenblatt Naderi, MLA
Assistant Professor
Landscape Architecture And Urban Planning
Texas A&M University

Praveen Maghelal
Graduate Assistant
Texas Transportation Institute

and

Woo-Hwa Shin
Graduate Assistant
Texas Transportation Institute

April 2004

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas   77843-3135

ABSTRACT

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EXECUTIVE SUMMARY

Encouraging people to walk is a primary thrust of the Surgeon Generals office and health related foundations such as the Robert Wood Johnson' Active Living Policy and Environmental Studies Program (ALPES) program. There is a growing mandate for transportation professionals to accommodate alternative means of transport, particularly walking and cycling, yet most transportation corridors are so threatening and environmentally discouraging that people are disinclined to walk or cycle. The safety and health performance objectives of these groups present a design challenge to transportation professionals that present a challenging research opportunity. The opportunity to examine what the desired health outcomes and how pedestrians and cyclists try to achieve these outcomes in response to the environmental and safety challenges posed by a typology of urban sites will help researchers and practitioners in both health and transportation fields to deliver environments that will facilitate and encourage walking and cycling.

The objectives of the study were to:

- Identify key components of the physical environment that will increase pedestrian perception of safety
- Verify physical environmental characteristics identified in the field with controlled simulations
- Demonstrate the use and benefits of simulator supported pedestrian research

Motivated by growing national health concerns related to early onset of obesity and obesity related diseases, the research team at Texas Transportation Institute asked parents of young children to describe the ideal street where their child could develop the habit of walking, as well as connecting with the earth, and themselves. This series of focus group interviews led to the creation of two tools for studying pedestrian design and walking as it relates to behavior of children in the street. The first was a field measure based on assessing whether the physical components described as critical by the focus group could be used to audit the quality of the pedestrian facilities. The second was a series of pedestrian design typologies that were simulated in a real-time interactive simulation of traffic inundated pedestrian worlds.

A socially and economically diverse focus group of Texas residents who were parents of elementary school age children were asked about the opportunities and inhibitors of the local physical pedestrian environment as it impacted their decision to allow their children to walk to school. Our hypothesis was that perceptions of safety attached to the physicality of the pedestrian landscape could be generalized and that a typology of particular urban design form would emerge. We tested the initial grass-roots observation of the parents in two modalities:

- A platform for "clinically" testing the perception of safety. This platform was a 3-dimensional interactive street environment that could be affected by alterations in the physical construct of the environment; the interactive street environment was constructed according to focus group findings.
- A measure describing the physical constructs of the walking environment on residential streets, defined as significant by the focus groups.

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4) Are there consistencies in the way people measure and describe the walking environment in the field?

The work involved the following tasks:

1. Identification of locations on collector and or arterial streets in College Station where there is a significant amount of pedestrian or the potential for pedestrian activity.
2. Based on the results of intercept surveys conducted in previous SWUTC sponsored work and a series of interviews with focus groups of parents, develop a simulator pedestrian world in the current driving simulator that will allow manipulation of key safety related elements identified by the pedestrians. Using an appropriate interface to control navigation through the simulator, test a group of subjects in the simulator as a means of correlating environmental constructs

and perceived safety. Participants in the experiment would also be parents of small children.

3. Develop a measure that could be taken into the field by a group of students to determine the reliability of the measure for recording field conditions related to the environment of the pedestrian on two streets typical of the study area around local elementary schools.

During the course of the simulation phase, it became apparent that we benefited from the use of the driving simulator at TTI to study pedestrian behavior in the real-time environment of a traffic-filled street. Although there are several problems with the lack of pedestrian sentience in the interface (we only had sight and had to show the film of the walking movement within the real time driving activity), the potential to overcome the obstacles is clear and the advantage of having the real time traffic in a safe relationship with people walking would clearly support study of pedestrian design and advancing our knowledge of walking within the physical constructs of the urban environment. The results indicated that the simulation was validated and consistent with the focus groups findings. The three correlates tested – location of the sidewalk, presence or absence of buffer and presence or absence of trees - showed a significant relationship with perceptions of safety and willingness to walk.

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INTRODUCTION

1. BACKGROUND

This study examined the physical constructs of the environment that discourages and/or encourages walking. This is a study of parent's willingness to allow their children to walk to school in a typology of pedestrian environments typically provided within transportation corridors in south-central suburban Texas. By conducting a focus group of parents that crosses ethnic and economic demographics of the study area, researchers identify physical constructs of the street environment of concern to the parents of young school children. Two measures are developed from the results of the focus group in the form of parallel pilot studies. The first is an on-site measure of physical constructs and the second is a simulation of pedestrian worlds.

The expertise and insights of the parents continue to significantly impact whether their children develop a walking habit. Lack of physical activity is a major health concern potentially alleviated by considering the design of safe walking habitats linking home to school (Torres, et al. 2001). The lack of activity in children is a precursor of obesity, early onset of diabetes and is linked with a series of cardiovascular and psychological disorders (U.S. Department of Health and Human Services[HHS], 2001). Obesity is linked with diseases such as diabetes, coronary problems and cancers. Interdisciplinary teams of physicians, environmental designers, and health practitioners are involved in developing alternatives to traditional suburbanization. This focus on promoting the health benefits of walking bridges health, design and transportation specializations so that on-going development and retrofits to the physical environment can contribute to the public health of the community (Handy, et al., 2002).

While the question of the physical activity is ecological in nature, this study focuses on the physical constructs of the walking environment in residential neighborhoods. Our study area spans two school districts in the South Texas twin city area of Bryan and College Station.

2. LITERATURE REVIEW

Disaggregating the landscape into component units for study has been a central theme to landscape analysis and ecological design since McHarg popularized the method in the 1960's and 70's and Ndbusi synthesized the evolution of several decades of thought on the evolution of ecological design last year (McHarg, 1969; Ndbusi, 2002).Understanding how elements of a landscape can affect human behavior has been the subject of environmental behavior and architectural studies (Helbling, 2001; Jacobs, 1993; Kaplan, 1982; Berlyne,1971; Appleyard, 1965; Lynch, 1960) such that designers know that being sensitive to particular human behavioral needs can be sensitively translated into the design of built environments.

Pedestrian needs and geo-spatial perception of the landscape by users of public space and landscape depends on setting. Walking is a phenomenological experience that is emphatically site specific and culturally driven (White,1980; Hillier,1990; Hall,1966; Meinig, 1979). Generalities in the form of national design guidelines for pedestrians by their very nature have to be so generic as to be nearly meaningless in terms of usefulness, although examination of artistic trends can produce thematic preferences (Jacobs, 1993; Isaacs, 2000). However, the transportation authorities are mandated to provide modality improvements to their facilities to incorporate the pedestrian. The federal, state and local officials have a long history of the development of design standards to govern the design of accessible transportation (this is not an oxymoron) such that pedestrians can manage in the transportation corridor, which is culminating in works filled with standards adapted to the vehicular model of design standards (USDOT, 2001; Landis, 2001). Even with themes in best practices, the spatial recommendations by the authors within these built environment domains conflict with one another and don't seem to be providing enough pedestrianization to satisfy the health and safety needs, leading professionals from other domains to step up to the challenge of improving pedestrian access (Sallis, 1996, 1997, 1998).

Metaphorically, the understanding of pedestrian spatial needs and pedestrian behavior is akin to the level of understanding that one seeks of any endangered species. Multi-disciplinary research teams of scientists and artists study the impact of demographic, biological, psychological, cognitive, emotional, behavioral, social, cultural, physical, and environmental variables that are the constructs of people walking (Mori, 1987; Seneviratne, 1985; Giles-Corti, 2002; Humpel, N., 2002)**.** Here we are concerned with the pedestrian and not the driver or the bicyclist; the pedestrian who is not a generic "one" that behaves one way all the time, but represents a full spectrum of human needs and behaviors and seeks multiple outcomes as they move through their habitat.

Following doctor's orders, people are walking. They understand the importance of daily activity for their children's long term health. Yet, children's use of the street is akin to allowing a kangaroo into a crocodile habitat with no dry land. Children are at great risk (Transportation Research Board[TRB], 2002) The car flourishes in its home territory; up until very recently, the federal guidelines in what is affectionately called the "green book" admonished designers to make "allowances" for pedestrians that had to be accommodated within the scarce land area of the right-of-way (AASHTO, 1994). There is no mention of accommodation of children in transportation design until recently (U.S. Department of Transportation, 2002).

What are the habitat requirements of children within the transportation corridors? Do parents make the primary determination as to whether children can walk to school and with whom? We can understand the street and its operation and how pedestrians have been "accommodated" over the years (Untermann, 1984; USDOT, 2002). And we can understand that the street is not always functioning well for the homosapien who walks for health purposes (HHR, 2001). We need tools to measure, understand, and predict use by children (Raman, 2003). With an aging population and obesity on the rise, the United States must upgrade its transportation landscape to encourage parents to allow their children to walk by incorporating landscape change that reflects didactic a better understanding of the ecological requirements and habitat design needs for children.

3. RESEARCH QUESTION

The perception of the environment occurs holistically (Abrams reference), so it is essential to stitch the elements together in patterns that are relevant to both the gestalt of the pedestrian experience, as well as the design of the pedestrian world. This study focuses on two questions:

1) What, according to parents, is the gestalt of a safe walking experience as part of a healthy community (Hancock, 1993)?
2) How do aspects of the physical design of the pedestrian environment influence (both encourage and discourage) parent's decision to allow their children to walk to school?

In order to address these questions, the research team developed methods to measure and model safety in relation to the physical constructs of the walking environment. These measures will aid in determining the relationship of parent's bias towards the environment and their willingness to let their children walk to school. This is not a direct study of children's perceptions but of parent's willingness to allow their children to walk, and of parent's concerns about the environment when they do allow their children to walk.

RESEARCH METHODOLOGY

The overall research design utilized focus group data as the basis for testing safety perceptions in two conditions: simulated and field testing perceptions of safety. The research methodology includes three sections:

- Focus groups on perception of children's walking safety
- Testing simulation of results of focus group on perception of children's walking safety in simulated pedestrian environments
- Measuring pedestrian environments regarding features defined as influential in perception of safety by focus group members

PART 1. FOCUS GROUPS

The research team recruited initial focus group members from selected schools. The team sent information letters to both the school boards and then the principals of target schools. The focus group consisted of three volunteer parent groups of elementary school children recruited from selected elementary schools in the Bryan and College Station Independent School Districts. Schools were selected on the basis of neighborhood demographics, location, and existence of pedestrian infrastructure connecting the school property with the adjacent neighborhoods within ¼ to ⅓ mile. All volunteers were accepted. Volunteers were solicited to achieve a representative demographic distribution of the neighborhood population. The final composite focus group consisted of 12 participants representing three schools whose ethnic mix and economic status represented the full range of the Bryan/College Station, Texas, community (see Table 1). All of the parents who participated in the focus group interviews have at least one child who is attending an elementary school. Within each school district the study had three to six participants and the majority of them were mothers.

Table 1. Schools selected for study.

Name of Elementary School		Pebble Creek[1]	Rock Prairie[1]	Milam[2]	Jones[2]	Fannin[2]
No. of Students		708	649	558	503	447
Grades		Grade K-4	Grade K-4	Grade K-2	3-5	Grade K-5
Ethnic Character	Asian	9.9%	12.0%	0.0%	0%	0.2%
	African American	8.9%	16.9%	21.8%	31.8%	29.9%
	Hispanic	6.8%	10.5%	72.6%	64.8%	51.7%
	White	74.4%	60.4%	5.6%	3.4%	18.3%
No. of Participants		5	1	3	2 (Their kids are also attending at Milam)	3
Discussion Site		Sweet Eugene Coffee Shop	Sweet Eugene Coffee Shop	Lincoln Rec. Center	Lincoln Rec. Center	Fanin

[1] Source: College Station ISD, http://www.csisd.org/intro.php?BODY=schdistrict2&MENU=sch

[2] Source: Bryan ISD, http://www.bryanisd.org/default.asp?pageID=24

The focus groups each met once to initiate discussion on children's health, walking, and the perception of safety in the pedestrian environment of the neighborhood. Each group met within the school neighborhood during the early evening. A voice recording of the discussion was made and transcripts were developed. The discussions lasted between one and two hours. The research team used two questions to lead the discussion;

- Why would you be willing or not willing to let your child walk to your school?
- What would you do to the environment to improve it so that you would let your child walk to school?

Focus group members were invited to participate in the pedestrian simulation trials to react to the physical constructs of the simulation. Researchers explained that the pedestrian simulation worlds would be designed based on the physical constructs that the focus group defined as significant. Members from the focus group and the community at large were asked to participate in the simulation trials.

PART 2. ON SITE MEASUREMENTS

The objective of this part of the research was to consistently evaluate the physical constructs identified by the focus group with some reliability. Based on the information gathered from the focus group, the research team developed a standard landscape architectural inventory "check-list". To the extent possible these measures deal with both spatial and temporal pedestrian landscape variations. Several versions were developed using the work from transportation engineering, as well as site inventory documentation checklists used in the landscape architecture design process (Landis, 2001; McHarg, National Parks Service). After several iterations the draft scale was field tested. This scale was field-tested by a two-person research team who had an introductory understanding of the physical components of the environment. These students observed and measured the physical condition of the landscape elements in children's walking environments along streets within the study areas familiar to the focus group members. The categories investigated included: street intersection, sidewalks, lateral separation between sidewalks and curb, trees and landscaping, furniture, the curb condition and the vehicular travel way.

Tests began in October 2003. The scales were tested by five teams on each of two sites. One street was a newly constructed residential street with curb and gutter and concrete sidewalk on both sides. The other was an older residential street with a mixture of rural cross-section and curb and gutter and had dissimilar treatment on either side of the street. A fifteen minute explanation to the research team was provided prior to beginning the experiment, and opportunity to ask questions was afforded at this time prior to using the scale. The two-person teams went to their respective sites and applied the scale towards describing the street. Each research duo had a tape measure, pen and clipboard with the scale attached.

The measure is attached in full form as it was used in the field at both locations (see Appendix 1).

PART 3. SIMULATION EXPERIMENT

The simulator experiment was designed to emulate the safe and unsafe conditions described by the focus group as street conditions they face in their neighborhoods. Validation in this simulator has already occurred for automobile use. Part of this experiment was to continue development of pedestrian simulation inquiry started one year ago (TRB).

Researchers briefed each participant about the experiment. Participants provided general statistical information about age, ethnicity, number of children, gender, and previous experience with traffic accidents. The participants were seated in the simulator where they were subjected to five different pedestrian sequences developed for the simulator experiment. The participant was asked to rank various aspects of the environments they experienced. The number of scenarios or conditions was limited to an experience where the total time in the simulator did not exceed fifteen minutes. This time limit enabled
researchers to prevent fatigue and simulation sickness for the majority of participants (reference).

1. Participants

The participants in the experiment were volunteers solicited from the community around College Station, Texas. Total 26 parents participanted in our study. All participants were parents of young children who were currently enrolled in elementary school. Mean age of the participants was 36.1 ranged from 25 to 48. Seven participants were male while 19 participants were female. Among 26 participants, 21 participants had at least college dagree. The total annual income before tax was measured in $20,000 intervals with a mean value between $40,001 and $60,000.

2. The Simulated World based on Focus Group Themes

Reference to the City of Bryan and College Station development statutes guided the dimensions assigned to the landscape elements in the simulator. Residential block lengths were dimensioned and arranged so that each landscape condition could be experienced in 1.5 minutes. In this way, the entire exposure of participants in the simulator would not exceed fifteen minutes, and the entire experiment would not exceed one hour of a participant's time.

At approximately 3.0 feet/sec, researchers developed a simulated world that filled an area 4 blocks by 6 blocks in dimension.

This world was developed to include features that could be manipulated to look similar to a College Station/Bryan neighborhood:

- residential land use including single family and duplex/quadraplex,
- one school for each two blocks of consistent pedestrian environment,
- greenery in the neighborhood consistent with a thirty year old street in the study area,
- cars which were "smart" and virtually responded to driving interactions (set at the maximum ADT the simulator would carry),
- cars which were not smart moving bumper to bumper in the curb lane to simulate the traffic conditions around the school during peak time when the children would be walking to school,
- sidewalks,
- parked cars, and
- people walking.

The dominant land type conditions around the elementary schools in the two districts are suburban in character; this was the environmental character that researchers wanted to recreate for the experiment. The six scenarios or conditions the participants would "walk" through in the simulated world needed to as accurately as possible represent the physical constructs identified by the focus groups. Each landscape experience was designed based on the themes identified by the focus groups. This was desirable because the focus group had identified a distinct theme around the subject of proximity to traffic.

The fact that the Driving Environment Simulator (DES) had the capacity to test various physical constructs of the pedestrian environment right next to an "active" vehicular lane added an essential realism to the experiment. The study area included representation from a wide socio-economic range. Residential landscape features were dramatically different in many respects across the region. However, grass and trees with understory height shrubs and small trees was a consistent theme and represented the working landscape palette.

The dimension of each block (200 meters X 200 meters) had to match the blocks of the automobile world if we were to use the DES at a cost level consistent with a pilot study. To create pedestrian length experiences, we created alley intersections at the mid-block. (see Figure 1: AutoCAD file with final layout)

The interface mechanism in the form of a joystick was not successful and was abandoned in favor of consistency in evaluating the landscape and not the participant's comfort/capacity to handle a joystick. A treadmill had been used as a viewing platform in past experiments, but the triplex projection was mounted too low for the DES automobile configuration to function. Since funds were not available to set the cameras higher so that a treadmill could be brought in, the "walk to school" was taped using the DES at TTI. Researchers conducted a driver pre-trial run to test and refine the procedure for the pilot study. Six, 1.5-minute simulated experiences were pretaped with pedestrians and vehicles. Five out of six of the tapes were good; one of the tapes was walked through at a slight tilt (These tapes were played for the participant on the triplex screen of the DES.

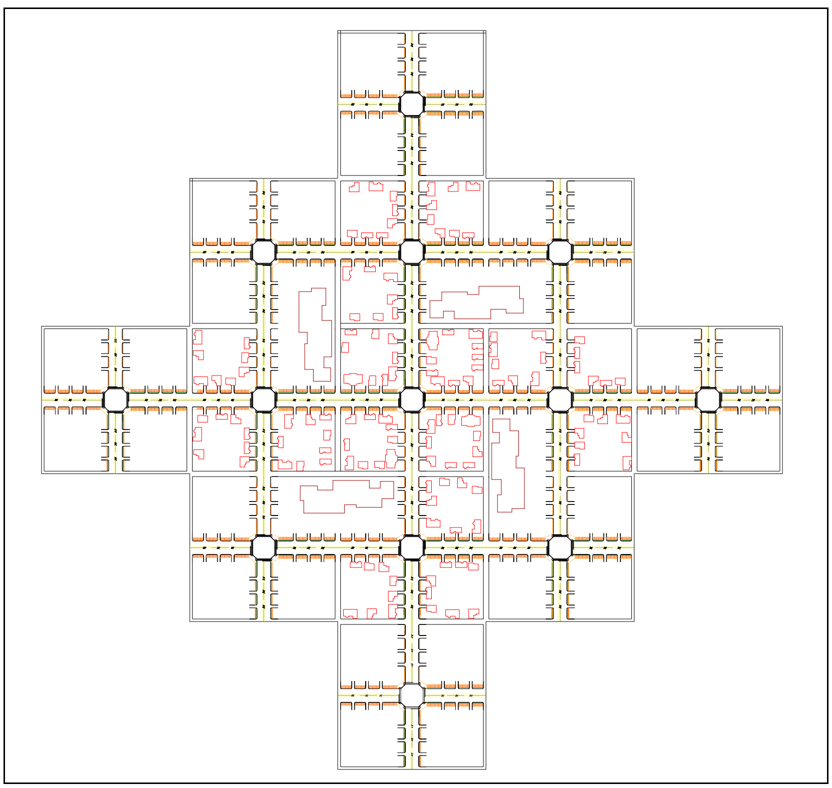


Figure 1. AutoCAD file with final layout of simulation worlds for pedestrian trials

3. Measurements in Simulation

Researchers queried participants about attitudes during the briefing session before the first scenario was viewed. Researchers asked a series of questions at the start of the simulation regarding whether the participant liked to walk, and how willing they were to allow their children to walk to school. These were asked once (Appendix 2A).

The second measures were taken during the first exposure to the physical constructs of the particular scenario being tested (Appendix 2B). Then the researcher presented the participant with questions specific to their impression of one of six environmental conditions in the simulator.

These measurements were taken during a 35 to 45 second period when the traffic was moving and the participant is "standing" on the sidewalk, looking but not moving. Measurements during this simulation included ranking each physical construct using a 3-point scale. The third measures were taken while the participant was performing the simulated walk or immediately after completing his/her walk. We queried regarding sense of overall safety, safety of environment for each of their children, overall edge conditions. To determine these responses, researchers asked the participants the following questions:

- Is this environment safe to walk in?
- Would you let your child walk to school in this environment
- What is the overall sense of safety in this environment?
- What is your sense of the edge of this environment?

Researchers encouraged the participants to make margin notes or add in anything they want throughout the pages of questionnaires. The experiment terminated when participants were debriefed by researchers (See Appendix 3).

4. Manipulation of Environmental Variables in Simulator

The variables studied in the simulator included lateral distance between the walking facility and the curb lane of traffic (0 feet, 4 feet and 8 feet), the presence or absence of sidewalks and the presence or absence of curb side trees (on 20 foot centers) (see Table 2). The residential landscaping on the far side of the walking facility, width of sidewalk, traffic, number of driveways and number of cars parked in the driveways are independent variables kept the same for each of the walking sequences. Six conditions or scenarios tested for perception of safety and willingness to walk or bike to school.

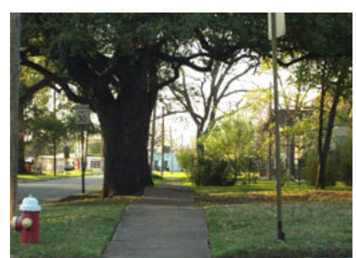
Table 2. Summary (Buffer, sidewalk, and tree) of six environmental conditions

	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5	Condition 6
Buffer	No	No	4’	8’	4’	8’
Sidewalk	No	Yes	Yes	Yes	Yes	Yes
Street Tree	No	No	No	No	Yes	Yes

The order of the conditions were set in a systematic way so participants experience each condition in six different orders . This is a within group experiment so all participants were exposed to all six conditions.

Table 3. Images of pedestrian simulation tile conditions vs. real walking environment near elementary schools in the cities of Bryan and College Station, Texas.

Conditions		Pedestrian Simulation Tile Image	Real Walking Environment Image
Condition 1	Only Curb & No Buffer & No Sidewalk	 	 Caddio(Both side)  Hickory(Both side)
Condition 2	No Buffer & Sidewalk	 	 Welsh Ave(Left side)  East 29th St. (Both sides)

Condition 3	Narrow Buffer & Sidewalk	 	 Westchester Ave. (Right side)  Venture(Both side)
Condition 4	Wide Buffer & Sidewalk	 	 Dover Dr. (Right side)  East 30th bet. Hutchins st-Baker st.(Right side)
Condition 5	Narrow Buffer W trees & Sidewalk		 East 30th bet. Baker st.-Hill st.(Right side)

			
Condition 6	Wide Buffer W trees & Sidewalk	 	 South Hutchins(Left side)  Palasota Dr. school area(Right side)

RESULTS

PART 1. FOCUS GROUP RESULTS

The results of the focus group indicate important thematic aspects of the physical environment and parental perception of walking safety for children. The focus group interviews were analyzed by using the QSR "NUD·IST" program. In the pre-trial, researchers developed the procedure and were able to determine that tree-lined streets in the simulator were affecting driver behavior. These findings were used to finalize the structure of the roadside landscape and the research design for the simulation phase.

How did participants bring their children to school and what motivated or hindered them choose their commute methods?

Table 4. Participants and Children's Commute Methods

Participants	Children	Walk	Bike	Drive	School Bus
Pebble Creek					
Mom 1	Unknown		Yes		
Mom 2	3rd Grade			Yes	Yes
Mom 3	Kindergarten & 4th		Yes	Yes	
Mom 4	6, 9, 12 &14 years old			Yes	Yes
Mom 5	9th &10th Grade	Occasionally	Occasionally		Yes
Mom 6	Unknown	Yes			
Fannin					
Mom 1	5th Grade			Afternoon	Morning
Mom 2	7, 10 years old, & 7th grade				Yes
Mom 3	5th Grade	Yes			
Milam-Jones					
Mom 1	6 years old	Afternoon		Morning	
Mom 2 & Dad	Kindergarten & 2nd	Yes			

Approximately, half of the participants' children walked or biked to school while the other half either rode a school bus or road in a car (see Table 4). Primary motivations to walk or bike to school were proximity to school, saving time, and seeing friends.

> I know that, when he went to Pre-K, not this last year, but a year before, and the teacher said, and, and he'll be riding the bus or you'll pick him up?, and I said he'll walk home, and , and I swear it head a tree on the spot. She said, you're letting a 4 year old walk home by himself. I said, he's always got his sister in 1st grade and we live 4 houses from the school (Milam-Jones, Mom 2 & Dad).

> It's all about time. If it's faster to go on foot and on bike, then that's what they would do (Pebble Creek, Mom 4).

> They, they will walk. Their friends walk. My job, I, I don't have to get to job till 10:30, like so I can take them and I am off it 1:30. And so that why I have that job, so that I can come and get them up. Yeah they would love to, the first one is a 5th grader, I mean, he is a 5th grader, and he see all his friend walk, u know, he can instead (Fannin, Mom 3)

Major barriers to walking or biking to school were the lack of sidewalks, dangerous crossings, highways, no designated bike lanes, heavy traffic volumes, high traffic speeds, long distances to schools, and weather. Another barrier was the age of children. Some children were too young to walk or bike to school by themselves.

> It is very difficult for them to ride their bike. If that's the only place that they can really ride their bike is that new sidewalk, yeah, where the neighborhood is good. Once they cross the street, off the crossing guard, they much have to walk their bike (Milam-Jones, Mom 1).

> Yeah, which is lack of sidewalk and lack of crossing pedestrian sidewalks with the light thing in a car, that would be my main concern and Ian we are very close to Sam Rayburn, and he is going into 7th grade and he could ride his bike to school, but the feeder road right there, there is no road for him to safely cross those bridges, and there is no riding areas on those bridges (Fannin, Mom 2).

> We also take the bus, and occasionally we walk or bike, not very often at all. Because we have to go past a crosswalk, that needs a Stop sign and people rarely stop for you or slow down to turn around the curb, so I am just not very comfortable at Spearmen and Parkview (Pebble Creek, Mom 5)

> We ride the bus for the distance mainly. It is almost 3 miles. It would take them 4 hours to walk to school (Fannin, Mom 2).

> Yeah, same with walking because it's so hot (Fannin, Mom 1).

> I think some of it is maturity. My six year old doesn't think twice about stepping out into the road and I think that's a common fictional problem. They just don't remember. You can tell them the minute they are walking out the door, "be sure to look both ways twice before stepping into the road" and you can follow them and watch that they step right into the road without looking in either direction and I think its just a six year old's thing (Milam-Jones, Mom 2).

What were the environmental barriers to walk and bike to school and what are environmental conditions that would enable walking and biking rather than riding a bus or driving?

As shown in the frequency table (see Table 5), there are a total of 20 themes discussing the environmental characteristics that both foster and discourage walking and biking. Participants also suggested a number of desirable solutions that might improve the safety of their children walking or biking. We will report physical barriers and desirable solutions to walk and bike to school for each segment of pedestrian environments in this result section.

Table 5. Frequency of themes

	Total	Pebble Creek	Fannin	Milam-Jones
Commute to School				
Walk	29	11	5	13
Bike	31	23	5	3
Drive	7	2	2	3
School Bus	6	2	4	0
Sidewalks				
Width	23	6	7	10
Lack	23	2	10	11
Conditions/Maintenance	10	1	2	7
Sharing with Bicycles	13	9	4	0
Street				
Width	6	1	4	1
Pedestrian Crossing	33	17	9	7
Curbs and Ramps	17	9	2	6
Intersections	3	2	1	0
Signals	23	12	8	3
Street lights	6	0	5	1
Traffic				
Volume	16	5	8	3
Speed	18	4	12	2
Landscape Buffer	10	3	6	1
Trees	10	4	1	5
Off-road Paths	29	9	3	17
Weather	14	7	2	6
Total	328	129	100	99

1. Sidewalks

The biggest problem with sidewalks was their absence. Many streets had no sidewalks for children to walk on. Often time sidewalks were present on only one-side of the street. Discontinuity of sidewalks was another factor that discouraged walking and biking. It appears that the lack of sidewalks was less of an issue in new neighborhoods than in old ones. Participants indicated that continuous sidewalks on both sides of the street might increase the chances that participants would encourage their children to walk and bike.

Barriers

There is no sidewalk and a lot of kids walk there. The teachers would walk, would take the students to, across the street, leave them, and come back and, u know, to drop off the other kids. And the kids would walk in the grass or on the road down the street (Milam-Jones, Mom 1).

On the other side of the school, we have no sidewalk, there are kids walking and they are on the street, first on the muddy day, they kept walking in the grassy area. And so, I mean, they are, they are in the street with the cars, yeah (Fannin, Mom 3).

Desirable Solutions
It would be good to have them [sidewalks] on both sides though (Pebble Creek, Mom 3)

Even though there are sidewalks, they are too narrow for children to walk on together with their friends. Participants would like to have wider sidewalks than currently exist. Providing sidewalks wide enough for multiple children to walk or bike side-by-side might be safer and more desirable.

Barriers
Yeah, you see them coming up Beacon. I see them, when I pick up the kids and when they walk home, I see so many of them 3 or 2 or 3 of them walking on the sidewalk, an other one walking on the street, and just popping on the sidewalk, when there is a car coming (Fannin, Mom 1).

Desirable Solutions
The width, I think, should be at least that 3 children can walk next to each other ….. (Fannin, Mom 1)

We need it wide enough so that 2 or 3 bikes can go (Milam-Jones, Dad).

2-3 wheel chair width (Milam-Jones, Mom 2)

Have you been to the neighborhood in sugarland, it has sidewalks that are, that accommodate about 2 people with strollers walking side by side, yeah, walking is so nice, because it (21:41-21:48) u know, one person can go up and go over, but….. (Pebble Creek, Mom 3)

The condition of the sidewalk did not support children who walked to school. This was especially true for children living in older neighborhoods than those living in newer neighborhoods. It was an important safety issue to participants. They were worried that their children might be injured by tripping and falling. Better maintenance might reduce potential risks of children being injured on sidewalks.

Barriers
Its, its just about ankle deep. It's a matter of, that area of sidewalk really needs to be rehabilitated in a better, you have the drainage under the sidewalk, rather than having it there, because the water just stands there, until it finally dries up….. (Milam-Jones, Mom 2).

Pavement in the sidewalk and they can just stumble over and fall and just roll over to the street (Fannin, Mom 1)

Participants felt that sharing sidewalks with bicycles was not always safe for children. Even though they encouraged their children to bike on the sidewalk instead of a bike lane or street. There was not a unanimous agreement on how to improve the situation. Some Participants wanted separate bike lanes while others just wanted wider sidewalks.

Barriers

If the biker has to pass me, he can't. I have to get off on to the road practically. So, and I have done that. I have actually got off from the curb. (Pebble Creek, Mom 6).

[Bike] on the sidewalk, off the street (Fannin, Mom 2).

Desirable Solutions

We need a separate bike lane (Pebble Creek, Mom 3).

Even if we have 2 separate lanes, I don't think the kids would take it seriously that they would stay in the bike lane. If somebody is there, they just go anyway which they just want to go (Fannin, Mom 1).

You make it[sidewalk] wider and have some of it for the bicycle to go. You have to avoid people on the street. Avoid the people, go around them (Pebble Creek, Mom 6).

2. Streets

The biggest threat of walking and biking came from the street. Wide streets, dangerous pedestrian crossings, lack of traffic signals and street lights, curbs, ramps, and intersections were the major barriers of children walking and biking. Participants indicated that they want smaller streets, more creative ways to cross the street, wheelchair ramps at intersections, and a dual curb system to separate, cars, bicycles, and pedestrians.

Barriers

Well, they take the bus in the morning and I pick them up in the afternoon and the reason is William J Bryan. Its too busy, too fast, its 4 lane and its just scary. If one side is clear the other is not and you have to wait for the right point and I am not going to let them sit in the middle of the road cross 2 lanes and then cross the other 2 lanes (Fannin, Mom 1).

In almost every street in the town and no crossing signals. There is none. Even on Texas Avenue, there is no crossing signals of that I know of (Fannin, Mom 2)

Well, in the mornings when they start for the school, they leave the house by 7:30 and it's still dark and William J Bryan doesn't have too many street lights. I guess I am lucky. I've got one right at the corner (Fannin, Mom 1).

Actually in our street there is not even a curb. It's grass straight into the road with nothing (Milam-Jones, Mom 1).

Design wise, yeah, at the end of sidewalk and a crosswalk, you need to have a ramp that will be a plus (Pebble Creek, Mom 2).

More on the attitude How many intersection they have to cross and how many of those intersections are 4 way stops or not or manned or not (Pebble Creek, Mom 3).

I don't let him walk alone. I am not comfortable with the traffic (Milam-Jones, Mom 1).

Desirable Solutions

I feel safer cutting through the smaller street, we can get off earth wine as soon as we can and go through the neighborhood to get to William J Bryan, because there isn't much traffic back on there, but the streets are very narrow and I don't feel unsafe there, because there is not a lot of traffic and the cars back there, because the street is narrow, they go a little slower, I think (Fannin, Mom 2).

We lived in a community that closed off with no major road, parks everywhere, big trees offer shade and so everyday we walk. And there were lots of mothers who strolled over the place. And lots of people all the time. Like its safe, u know. Like if my child is in the playground, there are other mothers to watch them too (Pebble Creek, Mom 6).

That's what they do in London, in London. They go down under, you don't cross anything. You go under or you go over and you do not cross any street. There are really really big roundabout. I tried to cross it. Then I realized there was this tunnel. I dint know, because I dint know what it was used for, because I'm not used to it (Pebble Creek, Mom 6).

And I don't know if this may be on beck, having a separate curb, with a bike area, bike-walk area, where you have an other curb that the cars are so removed and then there is a dual curb system between which bicycles and children can walk. So having a, having a larger curb barrier to keep the car from up against the edge (Milam-Jones, Mom 2).

Design wise, yeah, at the end of sidewalk and a crosswalk, you need to have a ramp that will be a plus (Pebble Creek, Mom 2).

3. Traffic

The speed and number of cars on the street were also major barriers. The traffic volume was too high and the traffic speed was too fast for Participants to allow their children to walk or bike. Public awareness of walking and biking, slower traffic, speed bumps and four way stops near school zones, and lower speed in the school zones were suggested to deal with the traffic issues.

Barriers

Yeah, I have that too, with my 5th grader, her were taking the bike, she wanted to take her bike, I said you are not crossing that William J Bryan with that bike, and its just that, I don't know, what they could do right there, but I see people walking the St. Joseph across William J Bryan and they are having the same problem. Traffic is just too fast and too much. I don't know, I don't know what they could do (Fannin, Mom 2).

There is not any way that we would ride a bike and the traffic is really heavy on Greens Prairie and that's why (Pebble Creek, Mom 2).

Desirable Solutions

The bike work day that we have in college station, I think it's a good step, because it raises the awareness a little bit. But if the car people understood, that for every people that bikes, one mad crazy woman behind those steering wheel that they have to navigate through to get their child to school, that they can recognize the bicyclist as a positive thing, then immediately they would put a share, u know, I think public awareness can really go a long way for helping us share our resources and then they can view each other as companions in the transportation and not as a barrier, and u know what I think public awareness. We can build all the things we want, but, instead of people view it as convenience and acceptable mode of transportation, whether we are riding it or not. U know, the money that we spend on bike lanes and the special sidewalks, benefits everyone. Even the person who has no intention of getting on bicycle benefits from those expenses. Because that one less car that they have to deal with (Pebble Creek, Mom 4). .

Environment with good sidewalk and slower traffic and … (Milam-Jones, Dad)

Speed bumps in the school zone… (Milam-Jones, Mom 1)

On my street is, on area wise, I would like to get that, in fact people having that, try to get lower to the school zones. Alternatively our neighbors have painted it themselves this summer. Adding 4 way stop or adding lane system (Pebble Creek, Mom 1).

4. Landscape Buffer

Proximity to the street was frequently a concern of participants. Participants wanted their children to be physically separated from the street. A landscaped mowing strip might address this issue as both a physical and mental buffer between the street and sidewalk.

Barriers

The sidewalk, the strip there, that wide. Ok, that puts the child not right at the road (Milam-Jones, Mom 2)

Or they have, when they are taking their bikes and fall, they have something to fall on (Milam-Jones, Dad)

Yeah, they are not falling into the road (Milam-Jones, Mom 2).

Desirable Solutions

A tree lawn would be nice. And you make it sure that it's more safe. The tree lawn would it more safe. And I think we neer to put in trees (Pebble Creek, Mom 2).

Even a little grass strip (Fannin, Mom 3).

Yeah. That kind a, I think the visual effect that it will have on the kids. This is the end; this is the end of the sidewalk. I think it's better for the kids (Fannin, Mom 3).

5. Trees

Lack of trees was mentioned throughout the interviews. The main purpose of wanting the trees was providing shades and improving scenic quality. No one mentioned the trees as a vertical buffer between the street and sidewalk.

Barriers

There is that one other thought, the other thing is, when they've got shading and other things around it, it's a little cooler to walk than it general sidewalk is, where you have the road, you have the sidewalk, (27:35 - 27:37), but you have no tree (Milam-Jones, Mom 2).

Desirable Solutions

I have been thinking, what if there some beautiful trees in that route (Pebble Creek, Mom 6).

That would be nicer (Pebble Creek, Mom 6).

Well, trees may not be safer, but they will give shade (Pebble Creek, Mom 6).

6. Off-road Paths

Participants expressed that their children liked to use off-road paths. Often time off-road paths were located away from street and separate their children from vehicular traffic. The paths were also usually more direct and continuous as commute routes to school than public streets. Children can also avoid rush hour traffic. However, off-road paths had disadvantages also. Parents worried about their children's safety since off-road paths are away from public eyes and this lack of visibility perceived to be dangerous place. Often time these off-road paths were privately owned and children did not have rights to use. The maintenance of the paths was also participants' concerns. Public off-road paths that facilitate both walking and biking are preferred by participants. Also they want the paths to be away from the cars so children can safely use them to go to school. They also want continuous off-road path network linking neighborhoods to school rather than isolated paths.

Barriers

My kids go through the alley to the bus station, but it's kind of dark. Hey it's dark up there, don't go, don't go through the alley. (Fannin, Mom 1)

I live 2 miles away, the school is here and adjacent to the school is the park, the city park, and there are cul-de-sac that back up to the park and one day I noticed that there were a little fine prints that tell kids that they cant go from the cul-de-sac to the park to the school, they have to go around. Because this is all home-owners property and I see, how sad that somebody, the city or the pebble creek homeowners association did not buy 5 feet of land right there and right there, so that the kids could walk that way (Pebble Creek, Mom 4).

And miss all the traffic to the school (Pebble Creek, Mom 5).

And miss all the traffic to the school. There are boards there that tell you, you are not allowed to do that (Pebble Creek, Mom 4).

The tripping. The risk for injury if she were running and fall and trip, you know, Get cuts and scratch from glass, its just that simple, the men of the cleanup thing can take care of, if someone were to keep up with that lot. It tends to get overgrown and then so you'll come in and boil it down and then it overgrows and so being rightfully maintained. I don't know who owns the land, who's responsible for the land (Milam-Jones, Mom 2).

Desirable Solutions

If you take the Victoria street that goes up to the Junior High, its just a walking lane and bike lane, through that whole neighborhood, and all the kids can speed in there, and just bike and walk safely with no auto traffic (Pebble Creek, Mom 3).

7. Weather

The hot temperature in Texas provided a major barrier for walking. Also, accumulated rain water made it difficult to walk where there were no sidewalks.

Barriers

Yeah, same with walking because it's so hot. It cools them off when they take the bikes home, instead of walking (Fannin, Mom 1).

> There is areas with no sidewalk so when it's rainy, or whenever you are either walking in the gutter of the street or in mud (Milam-Jones, Mom 2)
>
> **Desirable Solutions**
>
> Well, trees may not be safer, but it will give shade (Pebble Creek, Mom 6).

In summary, parents who participated in the focus group sessions express their concerns for their children's walking environments. Unsafe sidewalks, streets, heavy traffic, no separation between traffic and their children, lack of shades, dangerous off-road discouraged parents to let their children walk or bike to school. The parents who live in newer neighborhoods with good pedestrian environments were more likely let their children to walk to school than others who live in older neighborhoods with poor pedestrian environments (e.g., absence of sidewalk, un-maintained sidewalk, no pedestrian crossing etc.). Parents also had great ideas to improve their children' walking environments and increase their children's physical activity and improve physical health.

Focus Group Meeting I -
Transcribed in part from audio tapes
Meeting Notes

Date of Mtg: 29 May 2003

Location: Sweet Eugene Coffee Shop, College Station Texas

Attendees: Dr. H. Landphair, P.I., Program Manager
Praveen Maghelal, Research Assistant
Jody R. Naderi, Research Assistant

Participants: Kim McGrew and Reni Clayton (daughter), Rock Prarie Elementary
Linda Pinnet, Pebble Creek Elementary
Macy Jones, Pebble Creek Elementary
Michele Jeanberre, Pebble Creek Elementary
Teresa Smith, Pebble Creek Elementary

Number of participants who walk to school

1. take the bus or drive to school; do bike to other places but not during
2. used to bike but second child in kindergarten was driven so 4th grader chose to drive with mom
3. drive, too unsafe at one of the intersections to allow child to bike
4. too far to walk or bike – live 5 miles away, would have to cross Texas 6
5.
6. walk everyday

Physical constructs mentioned during conversation

Add to record:
Age of children
Locations associated with good and bad comments

Themes:
ADT at peak hour around the school
Sharing of the facility with cars who don't share
Sharing of the sidewalk with multi-modal users and multi-age
Convenience of getting around by foot/bike (visibility, access, offroad)
Intersections (crossing, regulating, signalization)
Off – road system (shortcuts through private property, link between the two schools, separate by height)
Miscellaneous
Counter 158

Table 6. Summary of Focus Group Meeting I

Barrier to walking	Location stated by focus group member related to barrier	Opportunities for improvement
Can't negotiate curves with training wheels		Intersection requires signalization
Unsafe crosswalk because people rarely stop their car to yield	Intersection Spearman & parkview	Cross walks
Too far	On Greens prairie	Stop signs
Traffic is heavy		Walk sign not associated with traffic light but needed for walking route
Hwy 6 crossing is not possible		
Unsafe for child to walk on her own because of traffic conflicts		ramps
Road (Greens Prarie from Wellborn) is not wide enough to accommodate bike or walking infrastructure		Walkway separate from the street with a tree lawn
Distance from school		Sight lines to mid-block pedestrian crossings are not considered in traffic design
How many intersections do they have to cross		Adding 4-way stops
Is there a bike lane		Completely off road routes
Do you have to jump curbs when using the sidewalk as a bike lane		Connections for kids paths
Having to get off and on bike in order to use the infrastructure	Spearman & parkview	Create visible bike lane connections to improve speed and access;
Private property preventing direct access from origin to destination; especially at cul de sac adjoining park	School& adjacent city park	Make it more efficient to patrons (walking and biking people)
Not fast enough; takes too long; is too indirect	Cypress groove & college station middle school bikeway across Graham rd	Make it convenient (make walking faster better choice than driving)
Kids on Bicycles use sidewalk and makes it dangerous for walkers	Victoria st. to Junior high	Policy to change limitation on school zone distances to include major crossings for pedestrian network
Landscape alongside sidewalk prevents bicyclist from negotiating past strollers that are occupying the full width of the sidewalk		Need to accommodate two strollers side by side and still have room for bicyclist to pass
Too much foot traffic for bicyclist to use sidewalk	Welsh Ave.	Install extended school zone designation

Cars don't respect bike lane they use it as part of car lane		Put bike lane at different height
Sharing space or lane with car		Pedestrian cross light
Length of route may require parent to join to protect child along the route		Locate the route for pedestrians to minimize driveway conflicts (one side of the street may be better than another because of land use adjacency)
Visibility along whole length of route would be needed	Graham Rd	Need visibility along off-road paths
Litter on the road pushed off to the side		Beautiful big trees for shade
Right on red combined with left turners at T intersection		Ped/bike completely separate from any car would be ideal
Kid falls into road if biking on road		Parks, less car access, limit speed to 10mph speed bumps
(no)Company to walk to school		Separate lane from street through elevating the path for kids with tree lawn,
		Rolled curbs
		Bike racks are good at destinations so you can park the bike safely
Designated traffic lanes		Places for bikes to pass without going into road
Lack of supportive land use (single family home?) along route		Put stripes on paths to regulate
Access to neighborly help		Bee creek is nice because it is wide, has stripe, fun
Places for kids to go, then more would go, then they would watch out for each other		Like the handicap ramp for bicycle access across intersections; curb is difficult to navigate
Total lack of infrastructure support		Walkway through shortest route and away from road n traffic
Lack of time to destination		Planning of route from residential area to school
Traffic route		Signage needs to be made prominent and visible from long distance
Sidewalk bumpy and not comprehendible		Natural Environment like parks and trees available at comfortable distances.
Walk sign not associated with traffic light	Bee Creek Park	Dotted line in sidewalk for walkway and pedestrian
	Brian Ridge	High street with connecting streets.(Planning)
	Woodlands for Trees & walkways	

Table 7. Summary of Focus Group Meeting II

S.No	Barriers to pedestrian(or bicycle?) use	Opportunities for improvement
1.	**Location of the bicycle and pedestrian facility**	
	High volume of the traffic	• Enforce speed limit strictly • Introducing speed bumps 30 mph needs to be reduced in the residential area • Increase the school zone of 20mph • Speed limits to be made gradually decreasing near the school zone
	People ignore signals and signs while they are driving	
	No alternate route available for the vehicular traffic and hence one street gets highly congested with vehicles	
	Children, while walking and biking on the street can trip and fall in the road	
	During Peak Hours people are in hurry and do not follow the speed limit	
	Traffic regulations not followed by the drivers	
	Nobody stops for pedestrian crossing	
2	**Sharing of the sidewalk with multi-modal users and multi-age**	
	Difficulties of sharing the walkway and bike lane with the road	• Width should be wide enough for 3 children to walk together • Bikeways to be designed along with walkways
	No room for both biking and walking together on the pavement	
	Kids will not take seriously the separation of bikeway and walkway	
3	**Convenience of getting around by foot/bike (visibility, access, off-road)**	
	Absence of Pavements (sidewalks) for children to walk	• An extra strip that separates walkway and the street like tree lawns needs to be introduced • Fence should not be too close to the pedestrian walkway • Biking is better than walking in hot weather • Provide shaded walkways in summer • More street lights required for illuminating the street • Sidewalks need to be paved
	Absence of Traffic island in-between two way lanes on the road	
	Pavements are bumpy and cracked	
	Children walk on the street and in the ditch	
	Width of the walkway is not wide enough	
	Sidewalks are present only on one-side of the street	
	Unpaved sidewalks not good during bad weather (rainy)	
	Sharp corner not comprehendible for the children while they are biking	
	Walking takes longer time than driving	
4	**Intersections (crossing, regulating, signalization)**	
	There are no Crosswalks and Crossing signals	• Teach kids to use the walk signal • Signals for walking and not walking needs to be introduced at all intersections near school
	Flashing lights required at school hours to reduce speed	
	Left turning vehicles interrupt cross walks and dangerous for the children to cross road	

5	**Off – road system**	
	Scare of being snatched by somebody while they walk through short-cuts	• Smaller streets are safer and hence provide alternate route for people to walk • The off-road preferred when it is visible or lighted
	They use alley to the bus station, and alley may be dark and dangerous	
6	**Miscellaneous**	
	Distance children have to walk	• School zone to be extended
	Presence of Highways in the route makes it dangerous to walk	
	People's perception (make you paranoid abt safety)	

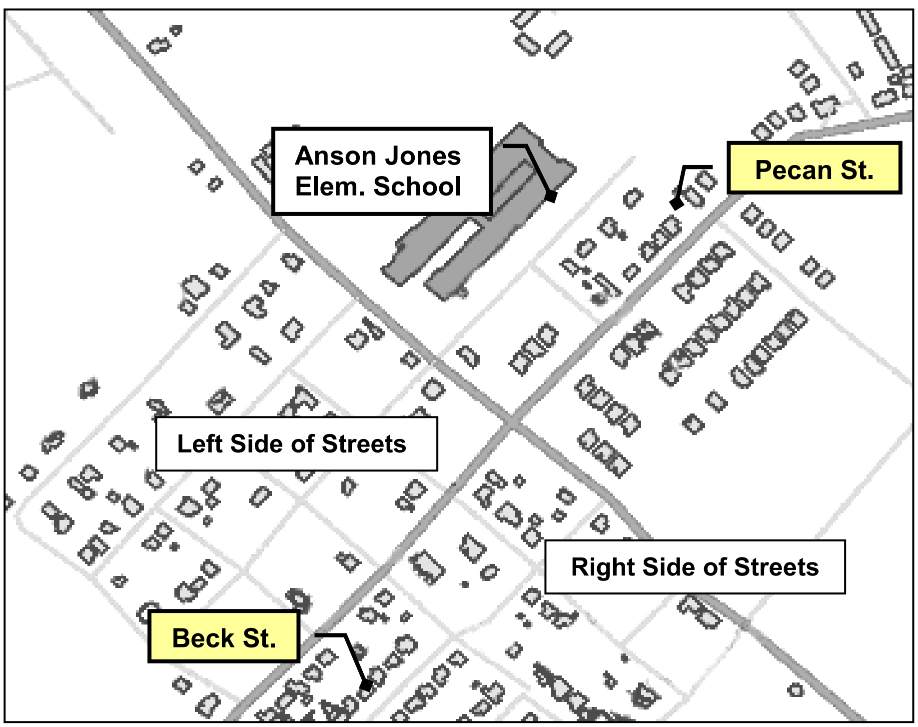
PART 2. ON SITE MEASUREMENT RESULTS

1. Descriptive Analysis

Physical environment measurement is developed to examine the walkability in a variety of urban street settings. The questionnaires consist of largely eight sections and a number of variables in each section are focused on measuring the characteristics of target streets.

Two streets(Pecan St. and Beck St.) near Jones Elementary school were measured by 20 students. These students, at first, divided into two groups with 10 students for Pecan St. and Beck St. and then 10 students for each street subdivided again into 5 small groups. The investigated section for Pecan St. is from Commerce St. to Palasota Dr. and for Beck St. is from Birch St. to Palasota Dr. The survey was conducted from 1:20p.m. to 2:30p.m. in September, 03, 2003 and the weather condition was hot, humid and cloudy. Figure 2 shows the location of the Anson Jones Elementary School and investigated sections for two streets.

Figure 2. On Site Measurement Location Map



The Pecan St. has relatively clear and well-defined shape compared to Beck St. so that the outcomes represent that street structures of the Pecan St. was more legible for the students who used the scale. In addition, the street structure for both sides of the Pecan St. is similar while the Beck St. has sidewalk in only one side of the street. For most questionnaires, the standard deviation ranges are narrow from .00 to 1.41, especially concerning about presence, type and size of street structure except the width and depth of ditch on Beck St. which are19.80 and 7.78 respectively). However, standard deviation ranges for distance and spacing between street elements vary from .71 to 458.21, which represents surveyors seemed to be not clearly understood the definition of each street element.

2. Reliability Analysis

Based on the survey data, a reliability test was conducted to test consistency among five groups for each street and to examine related answers. For a variety of variables in eight sections, the overall reliabilities between five groups for both Pecan St. and Beck St. are acceptable. Overall reliability score for Pecan St. is α = .9979 based on N of Items = 95 and 5 groups. The overall rating of Beck St. is α = .9879 based on N of Items = 64 and 5 groups. Table 8 shows the reliability scores of each section for both Pecan St. and Beck St. As it is seen from the table, most reliability test results for each section are acceptable. The physical environment measurement, thus, could be replicated to measuring other urban streets and it is expected to yield similar outcomes.

Table 8. Reliability Analysis.

Street Measurement Variables	*Total*	Street Name					
		Pecan St.			Beck St.		
	N of Items	*Cronbach's α*	N of Items	Reliability Coefficients (No. of groups)	*Cronbach's α*	N of Items	Reliability Coefficients (No. of groups)
1. Street	17	.9892	10	5	.9464	6	5
2. 1st Intersection	30	.9883/ 1.0000	23/ 27	5/ 4	1.0000	14	5
2. 2nd Intersection	30	.9197	25	5	1.0000	22	5
3. 3rd Intersection	30	N/A	N/ A	N/A	1.0000	22	5
4. Right side of Tree Lawn	42	.9999	13	5	.9980	12	2
6. Right side of Sidewalk	52	.9957	23	5	.9995	6	2
7. Left side of Tree lawn	42	.9998	18	4	No Output	1	
8. Left side of Sidewalk	52	.3838/ .5371	13/ 26	4/ 3	.6387	19	2

PART 3. SIMULATION EXPERIMENT RESULTS

Researchers investigated the effects of six different pedestrian environments on parent preferences for walking, willingness to let their children walk, overall safety, children's safety, and edge conditions. All five major variables are significantly correlated with each other. The correlation coefficients ranged from .53 to .81(see Table 5).

Table 9. Correlations among major variables.

	1	2	3	4
1. Parents' Walking	1.00			
2. Children's Walking	.76***	1.00		
3. Overall Safety	.81***	.72***	1.00	
4. Children's Safety	.68***	.80***	.76***	1.00
5. Edge	.64***	.53***	.62***	.47***

***p<.0001

In general, participants who walked through the pedestrian environment with a wide buffer (8 feet) with street trees in the buffer area rated this the highest on all five major variables (ranged 2.52 to 3.39) while participants who walked through the pedestrian environment with no buffer and no sidewalk rated the it lowest (ranged from 1.15 to 2.19) (see Table 6). Also, participants rated more conservatively for their children's walking and safety than their own.

Table 10. Means and standard deviation for major variables.

Buffer	No	No	4'	8'	4'	8'	Mean
Sidewalk	No	Yes	Yes	Yes	Yes	Yes	
Street Tree	No	No	No	No	Yes	Yes	
Parents' Walking	1.54(.76)	1.81(.85)	3.00(.69)	2.81(.80)	2.89(.77)	3.29(.60)	2.55(.98)
Children's Walking	1.15(.37)	1.33(.60)	2.19(.72)	2.29(.84)	2.17(.76)	2.64(.78)	1.96(.87)
Overall Safety	1.40(.58)	1.65(.63)	2.76(.60)	2.52(.82)	2.65(.75)	3.04(.72)	2.34(.90)
Children's Safety	1.15(.37)	1.26(.47)	2.28(.77)	2.31(.75)	2.23(.86)	2.52(.78)	1.96(.87)
Edge Conditions	2.19(.98)	2.35(.94)	3.19(.57)	3.19(.69)	3.23(.51)	3.39(.57)	2.92(.86)

Note: Values enclosed in parentheses represent mean standard deviations.

1. The Influence of Existence of Landscape Buffer

Does the existence of landscape buffer influence parent's preference for walking and perception of safety for themselves and their children?

<u>1-1. Walking</u>

Repeated measures analysis of variance revealed that participants' preference for walking is significantly different among six pedestrian environmental conditions (See Table 7). Scheffe' post hoc comparison tests indicated that participants preferred to walk in the pedestrian environments with a landscape buffer than to walk in the pedestrian environments without a landscape buffer. We also investigated experimental order effects since participants walked through the six environments in different orders. There were no significant main order effects but significant interaction effects existed between experiment orders and pedestrian environmental conditions. When participants walked the environment with no buffer and no sidewalk first, their preference for walking in other environmental conditions was higher than those who walked the pedestrian environment with trees first.

Table 11. Repeated measures of analysis of variance for major variables.

	Between Subjects				Within subjects					
	Order (O)		Error		Pedestrian Environments (PE)		Interaction (O x PE)		Error	
	df	F	df	MSE	df	F	df	F	df	MSE
Parents' Walking	5	1.85	19	1.27	5	40.89***	25	1.64*	95	.32
Children's Walking	5	1.17	19	1.40	5	30.71***	25	.95	95	.30
Overall Safety	5	.85	16	1.36	5	31.42***	25	1.56	80	.28
Children's Safety	5	1.46	19	1.08	5	27.26***	25	.91	95	.34
Edge Conditions	5	1.64	19	1.51	5	22.61***	25	1.22	95	.29

Note. MSE: Mean square error.
*p<.05, **p<.01, ***p<.0001

Repeated measures analysis of variance of participants' willingness to let their children walk were also significantly different among six pedestrian environments ($F(5, 25)=30.71$, $p<.0001$). Scheffe's post hoc comparison tests indicated that participants preferred to walk in the pedestrian environments with a landscape buffer than the pedestrian environments without a landscape buffer with or without a sidewalk. However, there are no significant order effects or interaction effects.

1-2. Safety

We also investigated participants' perceptions of overall safety and the safety of their children to walk or bike to school. Results indicated that perception of overall safety is significantly different among the six pedestrian environments ($F(5, 25)=31.42$, $p<.0001$). Significant differences also exist for the perceived safety of children to walk or bike to school ($F(5, 25)=27.26$, $p<.0001$). There were no significant order effects or interaction effects for either of the safety variables.

2. The Influence of the Width of Landscape Buffer and Street Trees

Do the width of landscape buffer and street trees influence parent's preference for walking and perception of safety for themselves and their children?

2-1. Walking

There were no significant main effects of trees and buffer widths on participants' preference for walking. We found, however, that interaction of trees and buffer widths was significant effect on participants' preference for walking. The effect of buffer widths differed according to the existence of trees. Participants were most likely walking when there were street trees in an eight feet buffer compared to no street trees in the same width buffer. On the contrary, the effect of trees in a four feet buffer was slightly negative.

Table 12. Repeated measures of analysis of variance for participants' preference for walking.

	df	F	Power
Between Subjects			
Subject	25	(1.19)	
Within Subjects			
Trees	1	1.82	.24
Trees*Subject	25	(.49)	
Buffer Widths	1	.97	.15
Widths*Subject	25	(.30)	
Trees*Widths	1	23.08***	.99
Trees*Widths*Subject	25	(.10)	

Note. Values enclosed in parentheses represent mean square errors.
***p<.0001

There was a significant main buffer width effect on participants' willingness to let their children walk or bike to school while the main tree effect was not significant. We found, however, that interaction of trees and buffer widths was significant. Participants were most likely let their children walk or bike when there were street trees in an eight feet buffer compared to no street trees in the same width buffer. However, the effect of trees disappeared in a four feet buffer. The existence of trees in a four feet buffer did not increase participants' willingness to let their children walk or bike to school.

Table 13. Repeated measures of analysis of variance for participants' willingness tolet their children walk

	df	F	Power
Between Subjects			
Subject	25	(1.40)	
Within Subjects			
Trees	1	2.08	.27
Trees*Subject	25	(.34)	
Buffer Widths	1	4.20*	.49
Widths*Subject	25	(.48)	
Trees*Widths	1	4.39*	.51
Trees*Widths*Subject	25	(.20)	

Note. Values enclosed in parentheses represent mean square errors.
*p<.05

2-2. Safety

There were no significant main effects of trees and buffer widths on participants' overall safety. We found, however, that interaction of trees and buffer widths was significant. The effect of buffer widths differed according to the existence of trees on participants' perception of overall safety. Participants' perception of safety increased when there were street trees in an eight feet buffer compared to no street trees in the same width buffer. However, the effect of trees in a four feet buffer was slightly negative.

Table 14. Repeated measures of analysis of variance for overall safety

	df	F	Power
Between Subjects			
Subject	23	(1.28)	
Within Subjects			
Trees	1	1.96	.26
Trees*Subject	23	(.34)	
Buffer Widths	1	.61	.15
Widths*Subject	23	(.28)	
Trees*Widths		10.53**	.89
Trees*Widths*Subject	23	(.19)	

Note. Values enclosed in parentheses represent mean square errors.
**p<.01

DISCUSSION

The research question for our team was to determine whether a clear set of physical attributes in the pedestrian environment along the roads could be manipulated to increase a perception of safety in the streets of residential neighborhoods of small town Texas. In particular we concentrated on how these constructs affected the way parents of young walking children (TRB, 2002). The work by Giles-Corti already indicated that the street may be a preferred environment for many choices around physical activity and as such, the pedestrian safety within the street environment could be a major influence on health as it relates to access to physical activity. The particular population group we were concerned with were parents making the decision on whether or not to let their children walk to school. Our reason for studying this aspect of pedestrian design was driven by a health concern related to the lack of activity in children leading to severe health problems such as early onset of diabetes and cardiovascular disease later in life (Sallis, Bauman and Pratt, 1998, US Dept of Health and Human Services, 2003, US Dept of Health and Human Services, 2001).

The literature review informing the basis of the work here included research by both health practitioners and transportation professionals from various disciplines who have studied walking and pedestrian design (Tsai et al 2003, Sallis, Prochaska and Taylor, 2000). Within this framework, the results from local focus groups were conducted with parents of young children to identify themes related to the perception of the pedestrian environment and willingness to allow their children to walk to school. Landis' work on pedestrian perception of the physical attributes of the walking environment offered insight into the constructs that were likely affecting perceptions of safety.

From these two data sources, two measures were developed: a simulation of the world described by the focus groups within the bio-physical context of the study area and a measure to be used in the field also tuned to the physical condition of the study area.

FOCUS GROUP RESULTS

As indicated on Table 3 earlier in this report, there were eight themes identified in the analysis of the focus group discussions: commuting modality (walking, biking, driving, going by bus) to school, sidewalks, street, traffic, landscape buffer, trees, off-road paths and weather.

The results of the focus group were affected by the socio-economic status of the sub-groups interviewed. The Pebble Creek community could be characterized as white upper income, the Fanin community could be characterized as middle income and the Milam/Jones community could be characterized as lower income. The physical characteristics of the community and adjacent land use affected parents' concerns ranging from streets with sidewalk facilities in the upper income neighborhood to streets with a rural cross-section and no sidewalk facility in the lower income neighborhood where the children walk on the shoulder or in the ditch.

It is clear that the sidewalk is a multi-modal facility. It is currently used by both bicyclists and pedestrians from the school age group. Both modalities have distinctly different demands and are incompatible in the same facility as currently identified by the parent focus groups. In the upper income community, more respondents indicated their children biked than walked, while in the middle income it was split equally between the two and in the lower income the respondents indicated more of their children walked than biked. As a result, the concept of sidewalk use and purpose for their children changed from a bicycle facility to a walking facility. As a bicycle facility, more of the respondents in the upper income neighborhood were concerned about curbs and ramps than in the middle and lower income neighborhoods because the curbs and ramps were used by the bicycles.

There was increased concern over street crossing and signalization in the upper income community and a greater concern over lack of sidewalks in the middle and lower income communities. Parents generally felt that the traffic management was a responsibility of the government while in the lower income neighborhoods, the parents felt more empowered to create safe access using off road paths if necessary.

Off road paths were of greater concern in the lower income community where sidewalks were non-existent. Maintenance was an issue identified as a theme in the lower income respondents where maintenance was not a significant theme in the upper income respondents. This may be in part due to the more informal quality of the walking environment in the lower income neighborhood and the availability of maintenance in landscapes along the city sidewalks in the upper income neighborhoods.

Using the themes identified from the focus group inquiries, a simulation study was conducted and a field study was conducted. These two concluding studies were designed based on expertise within the research team and literature around simulation and field measurement methods (reference).

While the use of focus group methodology is well-documented as a means of establishing thematic needs of a user group (reference), the innovation here was to use the data from the focus group to inform the design of the simulation study and the design of the field measure used in the field survey.

A larger population in the focus group from each of the socio-economic groups would enhance a better understanding of the type of physical constructs that would encourage walking. In the lower income neighborhood, walking to school was often the only option and the issues of how to increase safety were more relevant to the parents. In the upper income group it appeared that the physical constructs for a healthy and safe walking environment were in place and that the themes focused on improving the opportunities for walking by controlling the traffic behavior in the environment.

SIMULATION RESULTS

The simulation experiment was conducted using an existing simulator originally designed for driving environment. The biggest advantage to adapting the Driving Environment Simulation program for use by pedestrians was the opportunity to include real-time traffic that was "smart" in the experiment. This allowed perception of physical attributes to be examined in what might otherwise be potentially unsafe conditions. Many of the respondents in the initial focus group study had indicated that proximity to traffic as well as volume of traffic affected their perception of whether the roadside walking environment was safe for their children and this had emerged as a major theme.

The ADT for the simulation was set at a peak hour condition because the time that most children would be walking to school would be a time when the LOS would be at "E" or "F". The presence of random traffic movement in the curb lane emulated the visual impact of traffic in close proximity.

The simulator was fairly realistic in simulating motion through the landscape and we were able to set the perception of the landscape at the feet per second of the average pedestrian (reference). However, the simulator was limited in providing other cues important to the gestalt of the pedestrian perception including neurological impact of motion, smell, sound and other sentient content. This weakness could be overcome with further investment in the simulation capacity of artificial intelligence and computer technology.

We were surprised by the lack of effect that the trees in the narrow buffer width had on perception of safety compared with the effect that the buffer width had on perception of safety. It was consistent with Landis findings that the lateral separation from the road was an important factor in pedestrian preferences (Landis et al, 2001).

Weather conditions were indicated as a major factor in encouraging walking but the simulator was not able to simulate climatic conditions. The other limitation in the simulator was that the trees, which may have been perceived as providing shade and cooling effect was limited. We were not able to cast shadows from the trees on the ground which meant that the perception of the presence of the tree was not associated with a perception of better walking weather.

The results from the simulation trials were fairly consistent with the findings of the focus group. People felt safer in the environments that the focus group indicated would be considered a safer environment. In this regard, the experiment in the simulator confirmed the findings of the focus group. Funding limitations restricted the amount of adaptation we could make on the pedestrian simulation use of the driving simulator. Future use of the simulator might incorporate improvements to the graphic card to allow greater control of the sidewalk width, use of shadow and light and the addition of sound to the experience.

FIELD MEASURES

The purpose of the field measures was to take the input from the initial focus groups, develop a checklist type of survey measure to be used in the field for assessing the physical constructs of the pedestrian environment. The measure worked very well in condition where the sidewalk was continuously present in the form of physical features (concrete, edge definition of path, etc.) but became more difficult to use in circumstances where the walking area was ill-defined in physical terms.

The results from the field measures showed an acceptable level of inter-reliability. We have face validity of the measurement of lateral separation, presence of sidewalk and so on, that were incorporated into the physical design of the simulation experiment. However, we did not assess the construct validity of the measure used in the field. This would require comparison with other measures such as those identified in Moudon's study (Moudon and Lee, 2003) and field tested in more locations than the two selected.

CONCLUSION

Physical environments influence parents' decision to let their children walk or bike to school. Childhood obesity is considered as a modern epidemic and lack of physical activity has been one of major contributors to this epidemic (Torres et. al. 2001), increasing physical activity has become a national public health concern. Walking and biking to school may alleviate this problem since less than 10% of children walk or bike to school (CNN, 2003, June 23). Creating safe environments for children and parents to walk or bike to school is a critical issue for the future of American Children.

This study was built upon three methodologies that complement each other: focus group, field measurements, and simulation study. Through the focus group sessions, we found that parents were concerned about their children's pedestrian environments such as lack of sidewalks, high traffic volume, proximity to the street, dangerous intersection and so on. Even though parents were aware of many health benefits of walking and biking, they were reluctant to let their children to walk or bike to school. The result of the field measurements were consistent with the result of the focus group. The inter-reliabilities among experimenter in the field measurement experimenter ranged from .38 to 1.00. The part of the environment which was consistently measured by the experimenters in the field were those physical constructs identified as significant by the initial focus group. From the findings from the focus group and field measurements, we developed a series of pedestrian designs.

The design proposals in the simulator were based on the input of a focus group of parents with young children and the results of the simulation experiment confirmed the validity of the focus group results. A consistent result from the focus group input and the respondents perception of the design proposals emerged out of the study in the form of generalizeable conclusions in spite of the small study sample. The rules that emerged are as follows:

1. Parents are more willing to let their children walk or bike to school when there is a landscape buffer separating the "sidewalk" facility from the vehicles.
2. Parents perceived the highest degree of safety when there was a wide buffer with trees separating the children's walking area from the vehicular traffic.
3. Parents perceive the same degree of safety from narrow buffers (four feet) with or without trees.

Improving pedestrian environments consistent with these findings would reduce parents' concern for their children's walking safety, although we acknowledge that there are other factors which influence path choice for various child modalities. Children's walking and biking may take a critical role improving children's physical health and reducing childhood obesity. The importance of this study is that applying the findings may lead to the development of an early habit of higher physical activity which would lead to a more active and healthy adult lifestyle.

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APPENDIX 1
On Site Measurement

Researcher ______________________________

Age:_____________

Sex:_____________

Date:_______________ Starting Time: ________

Ending Time: ________

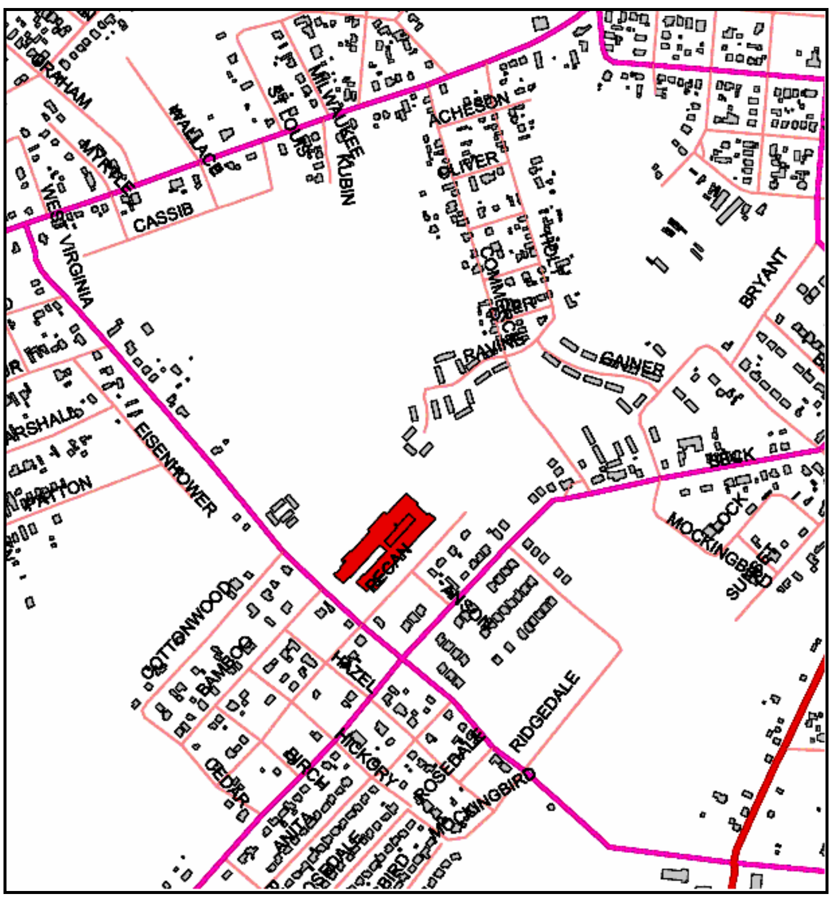
Weather Condition (Light, Temperature and wind): ____________________________

City:____________________________

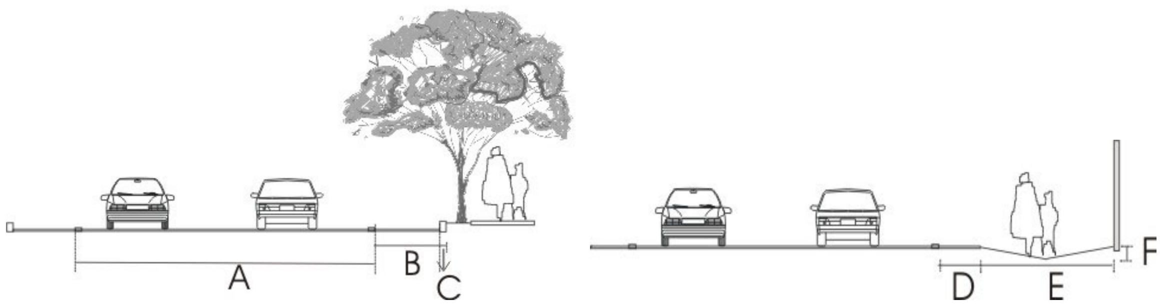
Location: _________________________

Measuring from : _________________________ to:_____________________________

This measure is being developed to record the walkability of various urban environments. Physical environment has a very important impact on people's health. Please be as precise as possible with all the answers. Please use measuring tape for all questions asking for dimensions.



Street ☐ Yes ☐No (Skip to the Off-Road Path Question)



A. Total Number of Lanes (including turning lanes) ________________

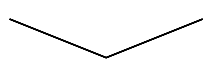
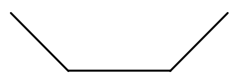
B. Designated Bike Lane on the Street ☐ Yes (if yes, width: ________________) ☐ No

C. Street Curb ☐ Yes (if yes, width: ________________) ☐ No

D. Paved Shoulder ☐ Yes (if yes, width: ________________) ☐ No

Unpaved Shoulder ☐ Yes (if yes, width: ________________) ☐ No

E. Ditch ☐ Yes ☐ No(Skip to Designated Mid-Block Crosswalk question)

Type (Shape) of ditch ☐  ☐ 

(E) – Width ____________________

(F) – Depth ____________________

Designated Mid-Block Crosswalk ☐ Yes (if yes, width: __________________) ☐ No

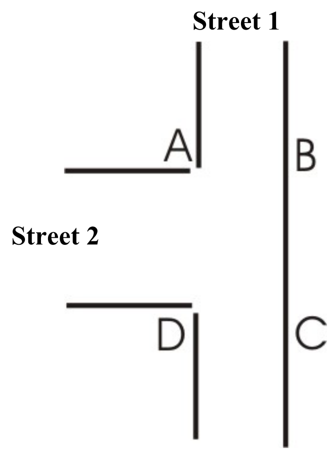
Designated On-Street Parking ☐ Yes ☐ No

Type of parking
☐ Parallel
☐ Diagonal
☐ Perpendicular

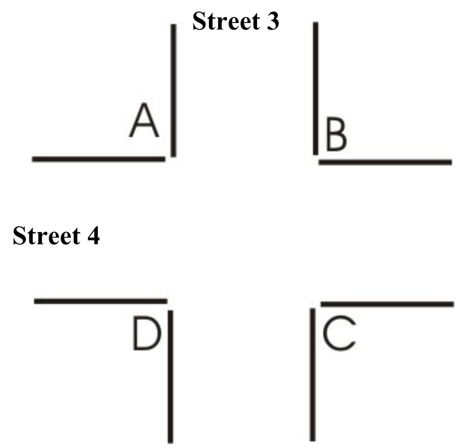
Intersection 1 ☐ Yes ☐ No (Skip to the Tree Lawn Question)

What type of intersection is there?

☐



☐



Street Names **1:** ________________ **3:** ________________

2: ________________ **4:** ________________

Elements in the intersection

Elements	A-B	B-C	C-D	D-A
Traffic Signal Lights	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Handicap Ramps	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
“WALK” Lights	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Cross Walks	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
“STOP” signs	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Number of Lanes Across	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4

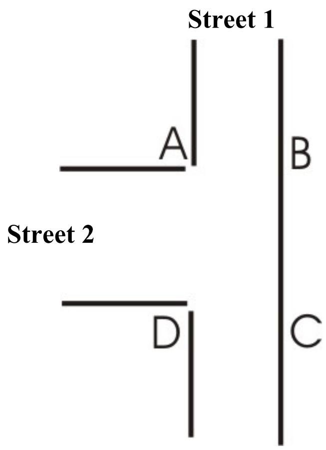
Handicap Ramps (◆)

A-B	B-C	C-D	D-A
☐ A◆———◆B	☐ B◆———◆C	☐ C◆———◆D	☐ D◆———◆A
☐ A◆——— B	☐ B◆——— C	☐ C◆——— D	☐ D◆——— A
☐ A ———◆B	☐ B ———◆C	☐ C ———◆D	☐ D ———◆A

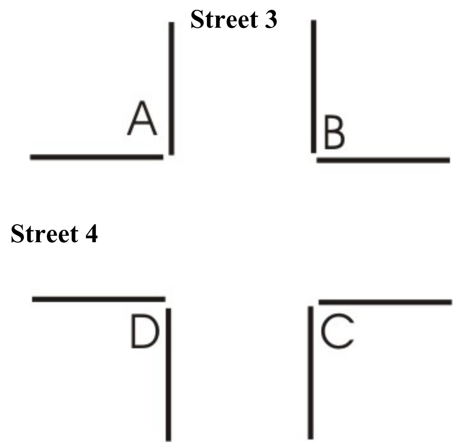
Intersection 2 ☐ Yes ☐ No (Skip to the Tree Lawn Question)

What type of intersection is there?

☐



☐



Street Names 1: ____________________ 3: ____________________

2: ____________________ 4: ____________________

Elements in the intersection

Elements	A-B	B-C	C-D	D-A
Traffic Signal Lights	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Handicap Ramps	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
"WALK" Lights	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Cross Walks	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
"STOP" signs	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Number of Lanes Across	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4

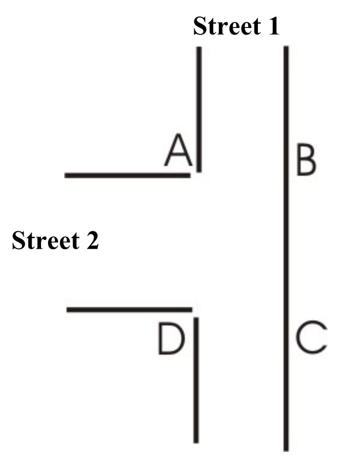
Handicap Ramps (◆)

A-B	B-C	C-D	D-A
☐ A◆———◆B	☐ B◆———◆C	☐ C◆———◆D	☐ D◆———◆A
☐ A◆——— B	☐ B◆——— C	☐ C◆——— D	☐ D◆——— A
☐ A ———◆B	☐ B ———◆C	☐ C ———◆D	☐ D ———◆A

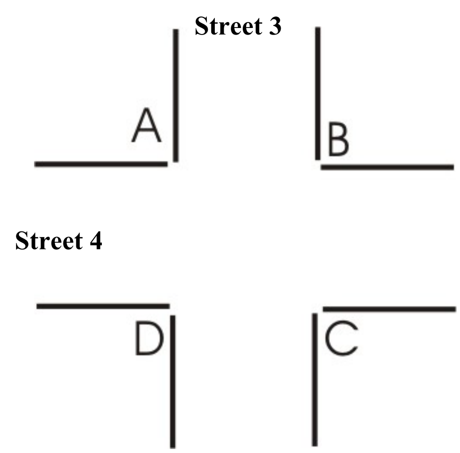
Intersection 3 ☐ Yes ☐ No (Skip to the Tree Lawn Question)

What type of intersection is there?

☐



☐



Street Names 1: ________________ 3: ________________

2: ________________ 4: ________________

Elements in the intersection

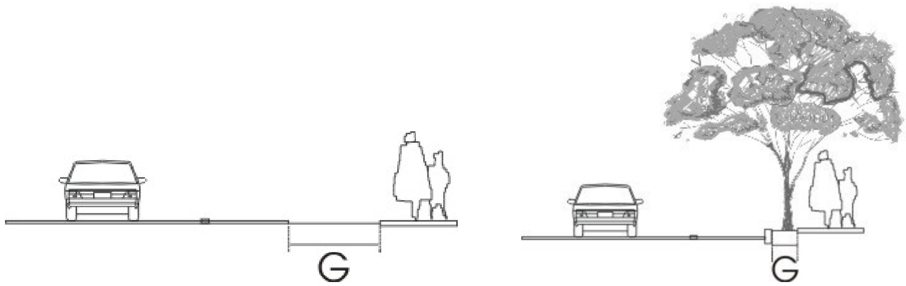
Elements	A-B	B-C	C-D	D-A
Traffic Signal Lights	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Handicap Ramps	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
"WALK" Lights	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Cross Walks	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
"STOP" signs	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Number of Lanes Across	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ 1 ☐ 2 ☐ 3 ☐ 4

Handicap Ramps (◆)

A-B	B-C	C-D	D-A
☐ A◆———◆B	☐ B◆———◆C	☐ C◆———◆D	☐ D◆———◆A
☐ A◆——— B	☐ B◆——— C	☐ C◆——— D	☐ D◆——— A
☐ A ———◆B	☐ B ———◆C	☐ C ———◆D	☐ D ———◆A

For the following measures, please use the RIGHT side of the street.

Tree Lawn (G) ▢ Yes ▢ No (Skip to the Sidewalk Question)



G. Tree Lawn Width (Start from back of the curb) ____________________

If there is Tree Lawn between the street and sidewalk, what materials are there?

Lawn ▢ Yes ▢ No
Weed ▢ Yes ▢ No
Asphalt ▢ Yes ▢ No
Bare Soil ▢ Yes ▢ No
Gravel ▢ Yes ▢ No
Pavers ▢ Yes ▢ No
Others ____

Have the tree lawns been maintained?

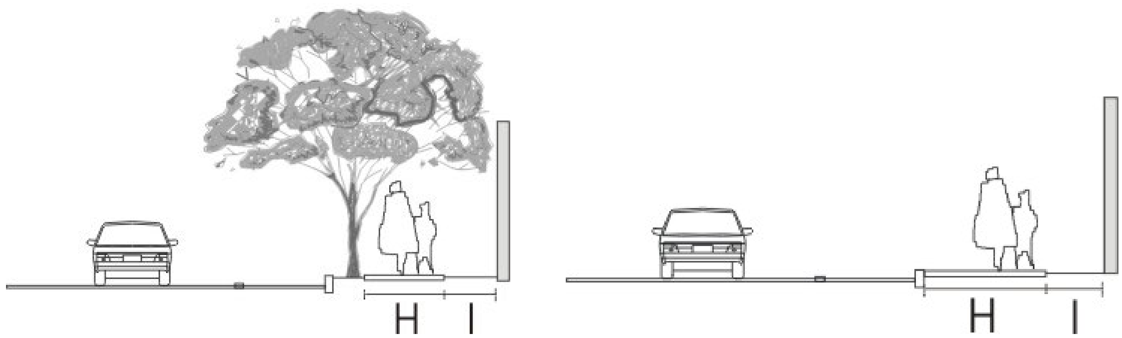
▢ Not at all
▢ A Little
▢ Somewhat
▢ Quite a Bit
▢ Very Much

Elements within Tree Lawn

	Presence	App. Spacing	Quantity	Distance from face of curb
Street trees	▢ **Yes** ▢ **No**			
Random trees	▢ **Yes** ▢ **No**	NA		
Shrubs	▢ **Yes** ▢ **No**			
Street lights	▢ **Yes** ▢ **No**			
School Zone Warning Lights	▢ **Yes** ▢ **No**	NA		
Power Poles	▢ **Yes** ▢ **No**			
Street Light Poles	▢ **Yes** ▢ **No**			
Fire hydrants	▢ **Yes** ▢ **No**	**NA**		

Walls	▢ **Yes** ▢ **No**			
Raised Planters	▢ **Yes** ▢ **No**			
Others (list other elements)				

Sidewalk ▢ Yes ▢ No (Skip to the Off-Road System Question)



Sidewalk is located on:

▢ One side of the street ▢ Both sides of the street

Is this sidewalk continuous?

▢ Continuous ▢ Discontinuous

Is this sidewalk paved?

▢ Paved ▢ Unpaved

If the sidewalk is paved, have the pavement been maintained (damaged surfaces, patches, etc)?

▢ Not at all
▢ A Little
▢ Somewhat
▢ Quite a Bit
▢ Very Much

H. Sidewalk width ____________________

I. Distance from back of the sidewalk to property line _________________________
(e.g., fence, building, or other vertical enclosures)

If there is some space between the sidewalk and adjacent vertical edge, what materials are there?

Lawn ▢ Yes ▢ No
Weed ▢ Yes ▢ No
Asphalt ▢ Yes ▢ No
Bare Soil ▢ Yes ▢ No
Gravel ▢ Yes ▢ No
Pavers ▢ Yes ▢ No
Others ____

Elements between sidewalk and back of the sidewalk

	Presence	App. Spacing	Quantity	Distance from face of wall
Street tree(s)	☐ **Yes** ☐ **No**			
Random tree(s)	☐ **Yes** ☐ **No**			
Shrubs	☐ **Yes** ☐ **No**			
Street lights	☐ **Yes** ☐ **No**			
School Zone Warning Lights	☐ **Yes** ☐ **No**			
Power Poles	☐ **Yes** ☐ **No**			
Street Light Poles	☐ **Yes** ☐ **No**			
Fire hydrants	☐ **Yes** ☐ **No**			
Walls	☐ **Yes** ☐ **No**			
Raised Planters	☐ **Yes** ☐ **No**			
Others (list other elements)				

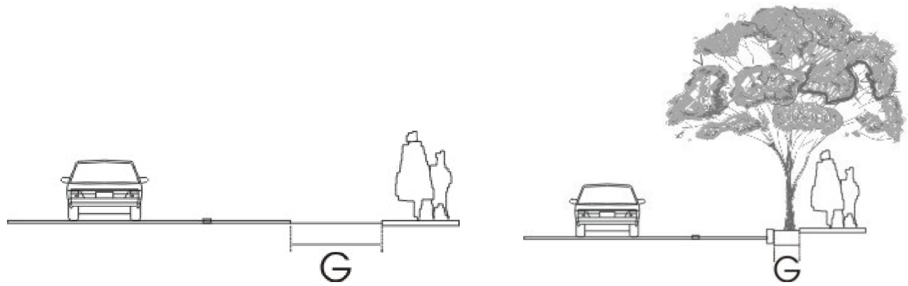
What Percentage of the sidewalk is covered by the shade? ____________________ %
(Please Measure the following on a sunny day at 3:30 PM)

Do you see the following objects on or adjacent to the sidewalk (check all that apply)?

☐ Graffiti
☐ Garbage
☐ Broken Glass, needles
☐ Unmaintained lawn
Others ____

For the following measures, please use the LEFT side of the street.

Tree Lawn (G) ▢ Yes ▢ No (Skip to the Sidewalk Question)



G. Tree Lawn Width (Start from back of the curb) ___________________

If there is Tree Lawn between the street and sidewalk, what materials are there?

Lawn ▢ Yes ▢ No
Weed ▢ Yes ▢ No
Asphalt ▢ Yes ▢ No
Bare Soil ▢ Yes ▢ No
Gravel ▢ Yes ▢ No
Pavers ▢ Yes ▢ No
Others ____

Have the tree lawns been maintained?

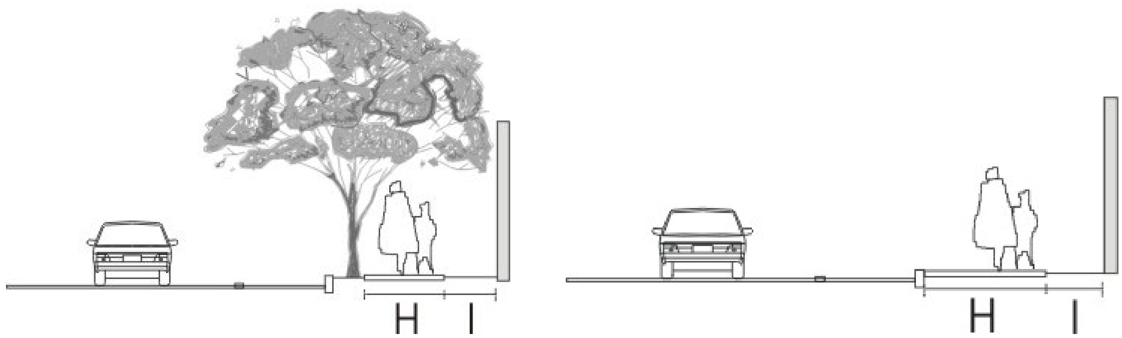
▢ Not at all
▢ A Little
▢ Somewhat
▢ Quite a Bit
▢ Very Much

Elements within Tree Lawn

	Presence	App. Spacing	Quantity	Distance from face of curb
Street trees	▢ **Yes** ▢ **No**			
Random trees	▢ **Yes** ▢ **No**	NA		
Shrubs	▢ **Yes** ▢ **No**			
Street lights	▢ **Yes** ▢ **No**			
School Zone Warning Lights	▢ **Yes** ▢ **No**	NA		
Power Poles	▢ **Yes** ▢ **No**			
Street Light Poles	▢ **Yes** ▢ **No**			
Fire hydrants	▢ **Yes** ▢ **No**	**NA**		

Walls	☐ **Yes** ☐ **No**			
Raised Planters	☐ **Yes** ☐ **No**			
Others (list other elements)				

Sidewalk ☐ Yes ☐ No (Skip to the Off-Road System Question)



Sidewalk is located on:

☐ One side of the street ☐ Both sides of the street

Is this sidewalk continuous?

☐ Continuous ☐ Discontinuous

Is this sidewalk paved?

☐ Paved ☐ Unpaved

If the sidewalk is paved, have the pavement been maintained (damaged surfaces, patches, etc)?

☐ Not at all
☐ A Little
☐ Somewhat
☐ Quite a Bit
☐ Very Much

H. Sidewalk width ____________________

I. Distance from back of the sidewalk to property line _________________________
(e.g., fence, building, or other vertical enclosures)

If there is some space between the sidewalk and adjacent vertical edge, what materials are there?

Lawn ☐ Yes ☐ No
Weed ☐ Yes ☐ No
Asphalt ☐ Yes ☐ No
Bare Soil ☐ Yes ☐ No
Gravel ☐ Yes ☐ No
Pavers ☐ Yes ☐ No
Others ____

Elements between sidewalk and back of the sidewalk

	Presence	App. Spacing	Quantity	Distance from face of wall
Street tree(s)	☐ **Yes** ☐ **No**			
Random tree(s)	☐ **Yes** ☐ **No**			
Shrubs	☐ **Yes** ☐ **No**			
Street lights	☐ **Yes** ☐ **No**			
School Zone Warning Lights	☐ **Yes** ☐ **No**			
Power Poles	☐ **Yes** ☐ **No**			
Street Light Poles	☐ **Yes** ☐ **No**			
Fire hydrants	☐ **Yes** ☐ **No**			
Walls	☐ **Yes** ☐ **No**			
Raised Planters	☐ **Yes** ☐ **No**			
Others (list other elements)				

What Percentage of the sidewalk is covered by the shade? _____________________ %
(Please Measure the following on a sunny day at 3:30 PM)

Do you see the following objects on or adjacent to the sidewalk (check all that apply)?

☐ Graffiti
☐ Garbage
☐ Broken Glass, needles
☐ Unmaintained lawn
Others ____

APPENDIX 2A.

General Questions asked at the beginning of the Pedestrian Simulation Trials to each Participant

Experiment Date ____________

Experiment Time ____________

First, we would like to ask you some background information. The information you provide is anonymous and will be used solely for this study.

1. Your Gender ☐ Male ☐ Female

2. Age ________________

3. Your Ethnicity ☐ White ☐ African American ☐ Hispanic ☐ Asian ☐ Other

4. Number of Children
   ____________ : 0 - 5 years old
   ____________ : 6 - 12 years old
   ____________ : 13 - 18 years old
   ____________ : 19 years old or older

5.Your Level of Education
   ☐ Less than high school
   ☐ High school/GED
   ☐ Community college/Technical school
   ☐ College degree
   ☐ Graduate degree

6.Your Level of Income(Total annual household income before taxes)
   ☐ Less than 20,000
   ☐ 20,001-40,000
   ☐ 40,001-60,000
   ☐ 60,000-80,000
   ☐ More than 80,000

7. Do you own a car or have an access to a car? ☐ Yes ☐ No

8. Have you ever personally affected by the severe traffic accidents?

☐ Never
☐ Once
☐ Several times

Now we would like to ask you about your children's background information and their commute to school. Please only provide information for elementary school age children.(Grade K - 6)

9.

Number of Children	Gender	Age	Race	Grade Level	Name of the school currently attending
1st Child					
2nd Child					
3rd Child					
4th Child					

10.How far is the school located from your house?

Child	Less than 1/4 mile (1- 5 blocks)	Between 1/4-1/2mile (6-10 blocks)	Between 1/2-1 miles (11-20 blocks)	Over 1 mile (More than 20 blocks)
1st Child				
2nd Child				
3rd Child				
4th Child				

11. Do you want your child to walk or bike to school?

☐ Very much
☐ Somewhat
☐ Very little
☐ Not at all

12. How does your child get to school?

Child	By bus	Drop off by parents/ siblings/friends or family members	Walking	Biking	Roller Blade, Skateboard And so on
1st Child					
2nd Child					
3rd Child					
4th Child					

13.How often does your child walk or bike to school?

Child	0 days/week	1-2 days/week	3-4 days/week	5days/week or more
1st Child				
2nd Child				
3rd Child				
4th Child				

14. How does your child walk or bike to school?

Child	Alone	With a friend	With group	With parent	With sibling
1st Child					
2nd Child					
3rd Child					
4th Child					

15. How would you rate overall health of your child?

Child	Excellent	Good	Fair	Poor	Very Poor
1st Child					
2nd Child					
3rd Child					
4th Child					

16. How would you rate activity of your child?

Child	Very Active	Active	Sedentary	Very Sedentary
1st Child				
2nd Child				
3rd Child				
4th Child				

17. If your child does not walk or bike to school, list the top reasons for not walking or biking to school

    1.

    2.

    3.

APPENDIX 2B.

Site Specific Questions asked during the Pedestrian Simulation Trials to each Participant (six conditions)

Experiment Date ____________ /Experiment Time ____________

Please put on "x" in the box which best describes the environment you are presently viewing, for each item.

	Too much	Just enough	Too little
Amount of overall greenery			
Amount of lawn			
Amount of tree canopy			
Number of tree trunks			
Amount of traffic			
Width of sidewalk			
Presence of parked cars			
Amount of driveways			
Level of maintenance			
Amount of parking			
Sense of enclosure			

	Too close	Just right	Too far
Proximity to houses			
Proximity to traffic			
Proximity to trees			
Proximity to road			
Proximity to parking			

Experiment Date __________ /Experiment Time __________

These questions are for the environment what you've just walked through.

Please answer these questions thoroughly and honestly. You may write margin notes and comments on the form.

1. Would you like to walk in this environment?
   - ☐ Very much
   - ☐ Somewhat
   - ☐ Very little
   - ☐ Not at all

2. Would you be willing to let your child walk in this environment?

Child	Very often	Often	Infrequently	Not at all
1st Child				
2nd Child				
3rd Child				
4th Child				

Comments: ____

3. What is your sense of the overall safety of the environment you just walked through?
   - ☐ Very safe
   - ☐ Somewhat safe
   - ☐ A little safe
   - ☐ Not at all safe

4. How safe is this environment for your child to walk or bike to school?

Child	Very safe	Somewhat safe	A little safe	Not at all safe
1st Child				
2nd Child				
3rd Child				
4th Child				

Comments: ____

5. What do you think about the overall edge conditions of the environment you just walked through?
   - ☐ Very well-defined
   - ☐ Well-defined
   - ☐ Ill-defined
   - ☐ Very ill-defined

Comments: ____

Is there anything you would do to the environment to make it safer?

Comments: ____

As soon as you are done, please let the experimenter know.

APPENDIX 3
Debriefing Questions - Simulation Participants

DEBRIEFING QUESTIONS

1. How do you feel after your experience in the simulator?

2. What part of your experience made you feel like you were walking?

3. What part of your experience detracted from feeling like you were walking down the street?

4. If you were going to change something about the experience you just had in the simulator, what would it be?

5. Please rank the following perceptions in terms of **how closely your simulation experience represented** your experience as a pedestrian in your neighborhood.

	Very much	Somewhat	Not very much	Not at all	comments
Your Activity Level					
Surrounding Activity Level					
Sequential Experience					
Speed					
Visuals					
Sidewalk					
Overall Street Environment					
Buildings					
Tree Canopy					
Tree Trunks					

APPENDIX 4

Reference Photo From Site Inventory Of Neighborhood Walking Environments Around Schools.

Figure 3. Glade south bound, 3:45 PM, weekday, Fall 2003.