

Identifying Factors Affecting the Number of Students Walking or Biking to School

A SAFE ROUTES TO SCHOOL (SRTS) SURVEY WAS CONDUCTED FOR 14 ELEMENTARY AND MIDDLE SCHOOLS IN HILLSBOROUGH COUNTY, FLORIDA, USA. THE STANDARD SURVEY FORMS AND INPUTTING TOOLS DESIGNED BY THE NATIONAL CENTER FOR SRTS WERE USED FOR BOTH STUDENT AND PARENT SURVEYS IN AN EFFORT TO IDENTIFY FACTORS THAT INFLUENCE WHETHER CHILDREN WALK OR BIKE TO SCHOOL.

BY HUAGUO ZHOU, P.E., JIGUANG ZHAO, PETER HSU, P.E., AND JEANETTE ROUSE, ATM

INTRODUCTION

Obesity and other health concerns among children are becoming increasingly relevant topics among health experts, urban planners and public policy makers in the United States. Currently, the majority of parents choose automobiles as their children's travel mode to school. Only a very small portion of parents allow their children to walk or bike to school. The Safe Routes to School (SRTS) program is aimed at encouraging elementary and middle school students to walk or bike to school by providing safer and more comfortable routes for students through education, encouragement, engineering and enforcement measures.

Traffic congestion and delays continue to be a problem for both large and small cities. Studies have shown that as much as 25 percent of morning rush hour traffic can be school related, as the majority of students or their parents choose automobiles as their primary mode of travel to school.^{1,2} This could be one factor that leads to children becoming less active and more overweight. The percentage of children who are considered severely overweight has tripled in the last 30 years.³

Since the establishment of the first national SRTS program in Denmark in 1976, transportation professionals have been deeply involved in the process, and many SRTS programs have been implemented in the United States. The National Center for Safe Routes to School (SRTS Clearinghouse) has designed a standard survey form and inputting tool for SRTS program evaluation. But so far, there has been little feedback regarding its effectiveness.

As part of the Florida SRTS program, a pilot survey was conducted for both students and parents in Hillsborough County, Florida, USA, before the SRTS education, encouragement, engineering and enforcement program started.

Hillsborough County is the fourth most populous county in Florida. As of the census of 2000, there were 998,948 people, 391,357 households, and 255,164 families residing in the county. The population density was 951 people per square mile, and the average housing density was 405 per square mile.⁴

The main objective of this study was to investigate the characteristics of student travel behaviors before the implementation of SRTS program and to identify the influential factors that affect the number of children who walk or bike to school. However, the real effects of an SRTS program can be evaluated after implementing all the engineering and education programs, which were not addressed in this paper.

LITERATURE REVIEW

Students' travel behavior to school is a complicated socioeconomic activity. Previous research indicated that many factors affect students' travel mode to school. The characteristics of the children, parents, the household and its location were considered as factors that affect children's travel mode to and from school.⁵ A study at Texas A&M University indicated that travel time, travel cost, income, expense, household type, number of hours in school, gender and ethnicity were important factors in the students' travel-mode choice.⁶ It was also found that students with shorter walking or biking times to school were significantly more likely to walk or bike.⁷

While urban form is important, it is not the sole factor influencing school travel-mode choice. Other factors such as perceptions of neighborhood safety and traffic safety, household transportation options and social and cultural norms may be equally important.⁸ The barriers that prevent students from walking to school are distance, traffic, weather, crime and policy; through the SRTS program, there has been an observable shift in stu-

dents' travel mode to school from driving to walking or biking.⁹

The SRTS program is widely deployed in the United States and around the world. Besides the health and physical activity benefits associated with the SRTS program, its safety effects are also worthy of examination. However, little research has been done on the effects that the SRTS program may have on the pedestrian and bicyclist travel safety vis-à-vis children. The effect of 10 countermeasures most relevant to SRTS on children pedestrian safety were examined, and it was found that most of those benefits are largely presumed rather than known.¹⁰

METHODOLOGY

Two types of surveys were conducted for this study. One survey was used for students and another for parents. The student survey was conducted in the classroom by teachers. Teachers asked students how they would arrive and depart from the school over a five-consecutive-day period (Monday through Friday). The parent survey was distributed by teachers to each student as a homework assignment. Parents were asked to select their children's travel mode to school and identify factors that affect their decisions.

The standard survey form and data input tool for SRTS designed by the National Center for Safe Routes to School were adopted for this survey. The survey was designed as multiple-choice questions.

The parents' survey asked two types of questions. The first focused on demographic characteristics of their children, such as age, gender, number of children in the family and distance from home to the school. The second focused mainly on the subjective feelings or opinions parents had of their children walking or biking to school.

The Pearson's chi-square test was employed to explore those factors significantly associated with students' travel mode to school.¹¹ The Pearson's chi-square test is used to assess whether paired observations on two variables expressed in a contingency table are independent of one another. Chi-square is calculated by finding the difference between each observed and theoretical frequency for each possible outcome, squaring them,

THERE ARE BASICALLY FIVE MODES FOR CHILDREN TRAVELING TO SCHOOL: WALKING, BIKING, CARPOOLING AND ARRIVING VIA EITHER FAMILY VEHICLE OR SCHOOL BUS.

dividing each by the theoretical frequency and taking the sum of the results. The following equation was used to do the Pearson's chi-square test:

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i}$$

where O_i is an observed frequency and E_i is an expected frequency.

GENERAL SURVEY RESULTS

A total of 489 classrooms were surveyed, with 416 tally sheets returned and a student participation rate of 84 percent for the student survey. For the parent survey, a total of 12,318 survey forms were

handed out with 3,213 returned, leading to a response rate of 26.1 percent.

There are basically five modes for children traveling to school: walking, biking, carpooling and arriving via either family vehicle or school bus. Two additional modes listed in the students' survey form were "transit" and "other." Currently, the percentage of students walking or biking to school is relatively low in the selected 14 schools: 10.9 percent for walking and 2.3 percent for biking. For the rest, 9.5 percent chose carpool, 39.6 percent chose family vehicle and 37.7 percent chose school bus.

Table 1 lists the matrix of students' travel modes to and from school obtained from the survey. Results in Table 1 show that for some students there was a difference between their travel modes to and from school, but for most students their travel modes were the same for the round trip.

The distribution of students' travel modes to and from school from kindergarten to eighth grade were examined, as shown in Table 2. Results indicated that as students increased in grade level, more of them selected (or were allowed by their parents) to walk or bike to school, while fewer students traveled to and from school by family vehicle or carpool. This indicated that students' grade or age is an important factor when parents consider their child's travel mode to and from school.

The student's gender is also another important factor on deciding the travel mode. The Hillsborough County survey indicated that all the students biking to school were male students. More male students traveled to and from school by school bus, while more female students traveled to school by walking, carpooling, or family vehicle.

Table 1. Matrix of students' modes for traveling to/from school.

		Travel mode from school				
		Bike	Carpool	Family vehicle	School bus	Walk
Traffic mode to school	Bike	73				
	Carpool		138	47	35	
	Family vehicle		10	887	92	
	School bus		136	251	1080	31
	Walk		20	48		320
	Transit other			20		
			17			

Table 2. Distribution of student travel modes for different grade and gender.

Demographics	Travel Mode					Total
	Walk	Bike	Carpool	Family Vehicle	School Bus	
Grade						
Kindergarten	28 (8.2%)		90 (26.2%)	158 (46.1%)	67 (19.5%)	343
Grade 1	56 (14.8%)			180 (47.5%)	143 (37.7%)	379
Grade 2	3 (1.1%)			158 (59.0%)	107 (39.9%)	268
Grade 3			79 (32.1%)	82 (33.3%)	85 (34.6%)	246
Grade 4	22 (3.9%)	20 (3.6%)		344 (61.2%)	176 (31.3%)	562
Grade 5	79 (17.0%)		2 (0.4%)	130 (28.0%)	254 (54.6%)	465
Grade 6	48 (13.0%)	25 (6.8%)	76 (20.6%)	59 (16.0%)	161 (43.6%)	369
Grade 7	105 (35.1%)	28 (9.4%)	40 (13.4%)	37 (12.4%)	89 (29.8%)	299
Grade 8	10 (3.7%)		17 (6.3%)	125 (46.1%)	119 (43.9%)	271
Gender						
Male	131 (8.3%)	73 (4.6%)	94 (5.9%)	579 (36.6%)	704 (44.5%)	1,581
Female	220 (13.5%)		210 (12.9%)	694 (42.6%)	505 (31.2%)	1,629

FACTORS THAT PREVENT CHILDREN WALKING OR BIKING TO SCHOOL

To attract more students to walk or bike to school, it is necessary to discover what factors prevent them from doing so. Proper measures can then be designed and implemented to improve students' travel environments to school.

Factors that prevented parents from allowing their children to walk or bike to school include distance, convenience, time, extracurricular activities, speed and amount of traffic along route, the presence of an adult cowalker, sidewalks or pathways, safety of intersections and crossings, the presence of crossing guards, violence and weather.

Parents were asked two types of questions regarding these factors. The first was whether such factors affect their decisions to allow or not allow children to walk or bike to school. The second was whether they would allow their children to walk or bike to school if the identified conditions improved. In total, 3,213 parents were surveyed on this issue. Table 3 lists the number of parents, subdivided by specific factors, who would allow the examined factor to affect their decisions.

Ranking on Importance of Factors

When asked which factors affect their decision to allow children to walk or bike to school, the parents' responses are as follows: distance (67.0 percent), speed of traffic along route (53.7 percent), amount of traffic along route (51.3 per-

Table 3. Factors affecting children's walking or biking.		
Factor	Number of parents considering as changeable factor*	Number of parents considering as affecting factor**
Distance	819(25.5%)	2153(67.0%)
Intersection safety	707(22.0%)	1226(38.2%)
Weather or climate	705(21.9%)	1129(35.1%)
Adults to walk/bike with	563(17.5%)	511(15.9%)
Convenience of driving	483(15.0%)	400(12.4%)
Sidewalks or pathways	402(12.5%)	920(28.6%)
Extracurricular activity	389(12.1%)	181(5.6%)
Crossing guards	386(12.0%)	485(15.1%)
Time	313(9.7%)	971(30.2%)
Traffic amount along route	305(9.5%)	1650(51.3%)
Violence or crime	155(4.8%)	1354(42.1%)
Traffic speed along route	113(3.5%)	1725(53.7%)

Note: * denotes number of parents that will let child walk or bike to school if condition is improved; **denotes number of parents considering the factor affective on their decision on whether allowing child to walk or bike to school.

cent), violence or crime (42.1 percent), safety of intersections and crossings (38.2 percent), weather or climate (35.1 percent), time (30.2 percent), sidewalks or pathways (28.6 percent), presence of an adult cowalker (15.9 percent), presence of crossing guards (15.1 percent), convenience of driving (12.4 percent) and extracurricular activities (5.6 percent), as shown in Figure 1. This ranking can reflect the relative importance of these factors. When parents determine whether to let children walk or bike to school,

factors with higher rankings will be more likely to prevent students from walking or biking to school.

Ranking on Effectiveness of Factor Improvement

When parents were asked which factors would change their decisions and let them allow their children to walk or bike to school if conditions were improved, the responses are as follows: distance (25.5 percent), safety of intersections and crossings (22.0 percent),

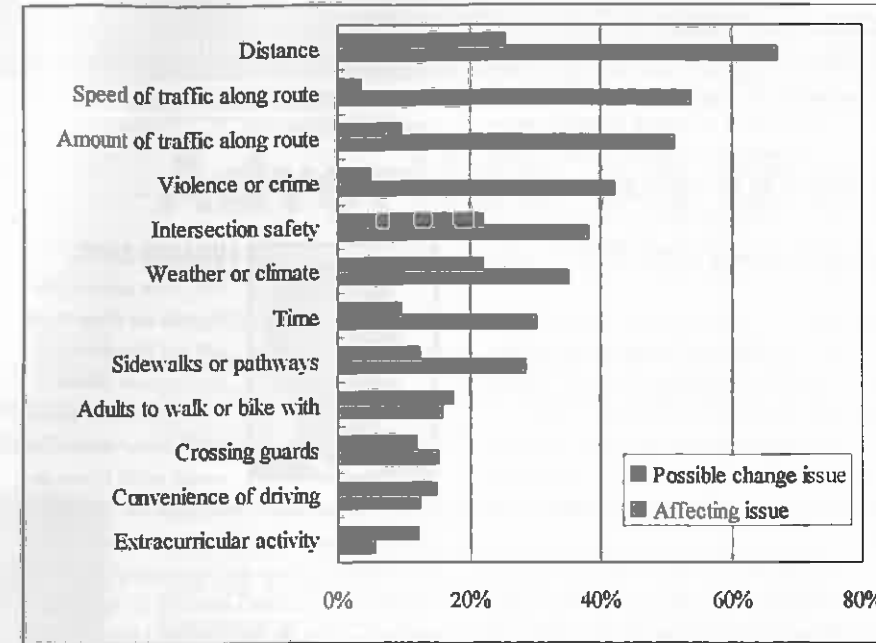


Figure 1. Ranking of factors.

weather or climate (21.9 percent), presence of an adult cowalker (17.5 percent), convenience of driving (15.0 percent), sidewalks or pathways (12.5 percent), extracurricular activities (12.1 percent), presence of crossing guards (12.0 percent), time (9.7 percent), amount of traffic along route (9.5 percent), violence or crime (4.8 percent) and speed of traffic along route (3.5 percent), as shown in Figure 1. This ranking can reflect the relative effectiveness of improvements on these factors. Those factors that received higher rankings will allow more parents to let their children walk or bike to school and will therefore be more effective in an SRTS program.

Differences existed between these two rankings. For example, the safety of intersections and crossings ranked fifth in the first ranking but second in the second ranking. This reveals variance between people's perceptions and their reactions.

Distance ranked first in both rankings, indicating that distance is a decisive factor in determining students' travel mode to school. When the distance is too long, most students will not walk or bike to school. In order to encourage more students to walk or bike to school, school authorities should take this factor into consideration when locating new schools.

The situation is quite different for each individual factor. Figure 1 shows

that for some factors, such as traffic volume and speed along route, only a small percentage of parents would allow their children to walk or bike to school after improvements. A large percentage of parents reported that improvements in other factors, such as the presence of crossing guards and the presence of an adult cowalker, would increase their likelihood of allowing their children to walk or bike to school. For some factors, parents appear to think children's safety conditions while walking or biking to school will be ensured after improvements; for other factors, the condition may be difficult to change even with improvements. Special consideration should be given to this when designing an SRTS program.

Those factors that influence children's safety as they walk or bike to school can be eliminated or improved by "4E" improvements through SRTS program; that is, engineering, education, enforcement and encouragement. For such factors as distance, intersection safety, sidewalks or pathways, convenience of driving, traffic volume and traffic speed along route, conditions can be improved by engineering methods such as pathway connection, traffic sign/signal installation and so forth. For the presence of an adult cowalker, crossing guard, violence, or crime, the conditions can be improved by education and enforcement methods. Although

there are some factors such as weather or climate, time and extracurricular activities that cannot be improved through an SRTS program, SRTS programs are expected to greatly improve the safety condition of students' travel to school, thus allowing more students to walk or bike to school.

For the Hillsborough County SRTS program, engineering improvements such as bike racks for 39 elementary schools and sidewalks for three elementary schools have been planned, and powered school flashers and speed-feedback signs have been implemented for most of schools in the county. The Florida Department of Transportation (FDOT) has already received some positive feedback for the speed-feedback sign from local agencies. The effectiveness of the SRTS improvements and education programs can be measured by comparing the students' travel mode behavior after all the engineering improvements have been implemented.

CONCLUSIONS

Student survey results showed that student demographic characteristics such as grade, gender, the number of children in the family and distance from home to school affected their travel mode to school.

- With an increase in grade level, students' travel mode to school shifted from carpool and family vehicle to walking, biking and family vehicle. Thirty-five percent of seventh graders walk to school, and 9.4 percent of them bike to school, which are both the highest among all grades.
- When distance from home to school is short, walking is still the prevailing travel mode to school for students. Close to 52 percent of students who live less than a quarter-mile from school walk to school. As distance from home to school increases, there is a shift in students' travel mode from walking and biking to family vehicle and carpool, and then to school bus.
- As the number of children in the family increases, more students travel by school bus. Most students from families with more than three children will choose school bus as their travel mode to school.
- No significant difference was found among the weekdays (from Mon-

day to Friday) from this survey. The newly updated standard form was changed from a five-day (Monday through Friday) survey to a two-day (Tuesday and Thursday) survey.

Peoples' subjective opinions were also considered as effective in deciding students' travel mode to school. Most students and parents held positive attitudes toward students walking or biking to school.

- Forty percent of students consider walking or biking to school "fun" or "very fun," and less than 10 percent of students consider it "boring" or "very boring."
- 57.2 percent of students consider it "healthy" or "very healthy" to walk or bike to school.
- 78.8 percent of students have asked for permission to walk or bike to school.
- Only 4.1 percent of students believed their schools discourage or strongly discourage students to walk or bike to school.
- 32.9 percent of parents will allow their child to walk or bike alone at different grades.

Chi-square test results revealed that student demographic characteristics and parents' subjective opinions are significantly associated with students' travel mode to school.

The study also ranked factors that prevent parents from letting their children walk or bike to school. Survey results show that when conditions improve, parents will allow children to walk or bike to school, and 25.5 percent of parents will allow their children to walk or bike to school when the distance from home to school becomes acceptable for walking or biking. The same is true for other issues such as intersection safety and weather.

The study results suggest that education and encouragement should focus on the students who live less than two miles from the school. School attitudes have a great impact on the number of students walking and biking. Engineering improvements, such as speed reduction, sidewalks and intersection safety improvements, will very likely affect parents' decisions on their children's travel modes to school.

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HUAGUO ZHOU, P.E., is an assistant professor at the Department of Civil Engineering at the Southern Illinois University Edwardsville and a senior research associate at the Center for Urban Transportation Research at the University of South Florida. He holds a Ph.D. in transportation engineering from the University of South Florida and a bachelor's and a Ph.D. in railway engineering from Beijing Jiaotong University. He is a member of ITE.



JIGUANG ZHAO is a graduate research assistant at the Center for Urban Transportation Research at the University of South Florida (USF). His research interest focuses on traffic operations and safety. He is a member of ITE.



PETER HSU, P.E., is the district safety and special projects Engineer with the Florida Department of Transportation (FDOT), District 7 (Tampa, FL, USA)

office. He received a master's degree in transportation engineering from the University of Florida. He is the recipient of two prestigious 2007 National Roadway Safety awards and numerous Davis Productivity awards.



JEANETTE ROUSE, ATM, is the community traffic safety team program manager with the FDOT, District 7. She is also responsible for the non-infrastructure side of the Safe Routes to School Program, with a focus on education and encouragement projects.