SafeRoutes
National Center for Safe Routes to School

Trends in Walking and Bicycling to School from 2007 to 2014

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The National Center for Safe Routes to School

U.S. Department of Transportation
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Acknowledgements

The National Center for Safe Routes to School would like to thank the Federal Highway Administration for supporting the development and continuance of the data collection and reporting system. We also wish to thank the State SRTS Coordinators who championed the creation of a standardized Data System and promoted its use, thereby making the system useful to countless organizations and communities nationwide. Finally, the National Center thanks the multiple regional and local users of the Data System for devoting their time and energy in providing quality data, which help advance the Federal SRTS program.

Contents

Executive Summary

This report is the third in a series entitled *Trends in Walking and Bicycling to School* (the first two *Trends* report include: National Center for Safe Routes to School, 2013 & National Center for Safe Routes to School, 2015). This report includes 720,000 parent surveys collected by nearly 6,500 schools throughout the United States starting in 2007 and extending through 2014.

Within a year of its establishment in early 2007, the National Center for Safe Routes to School (National Center) developed and disseminated a centralized data collection and reporting system (Data System) using support from the Federal Highway Administration (FHWA). Creation of the Data System involved designing standardized data collection instruments and providing data processing services to all schools that collected school travel data using the instruments. Though the Data System was not mandated in the transportation legislation that created the Federal Safe Routes to School (SRTS) program—the *Safe, Accountable, Flexible Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU)—the National Center recognized an opportunity to make possible a nationally standardized means of benchmarking and evaluating SRTS practice before States developed their own evaluation-based systems.

Each year, more schools make use of the Data System. Most of these schools collected parent survey information, which captures the usual travel mode of students and parents' perceptions about walking and bicycling between home and school. Data gleaned from these parent surveys provide an opportunity to analyze school travel patterns and to discover ways school and household-level factors might influence families' school travel mode choices.

To examine student travel patterns and parental perceptions of active school travel over time, the research team estimated multinomial logit models which clustered parents' survey responses by school. These models estimated the probability of choosing school travel modes after accounting for school-level and household-level predictor variables. School-level variables include data maintained by the National Center for Education Statistics (NCES), such as school income and the Census-defined locale in which schools were located (i.e., cities, suburbs, towns, and rural areas). Household-level variables included: students' sex and grade in school; distance students lived from school; parents' level of education; the month and year parents completed surveys; whether students asked their parents for permission to walk or bicycle between home and school; how much fun parents perceived walking and bicycling to be for their children; how healthy walking and bicycling was for their children; and how much their children's school supported walking and bicycling to/from school.

Key Trends in School Travel from 2007 through 2014

- Walking to and from school increased significantly between 2007-08 and 2014, from 11.9% to 15.2% in the morning; and from 15.2% to 18.4% in the afternoon.
- Across all years, walking increased especially among students who attended low-income schools—defined as enrolling 75% of students who were eligible to receive free or reduced price meals.
- Also across all years, boys were equally as likely as girls to walk to and from school.

- The percentage of elementary and middle school aged students who bicycled between home and school appeared to have rebounded starting in 2012. Bicycle participation started at 2.3% bicycling in 2007-08, dipped below 2% from 2009 through 2011, and increased to 2% in 2012, stabilizing thereafter.
- Boys were twice as likely to ride a bicycle to and from school as were girls across all study years.
- Within one mile of school, the largest shift among travel modes occurred between busing and walking, with busing decreasing significantly (from 16.2 to 12.8% in the morning, and from 21.9 to 15% in the afternoon) and walking increasing significantly (from 24.6 to 29% in the morning, and from 28.3 to 35.9% in the afternoon).
- The percentage of students who traveled to and from school in cars increased significantly, from 49.1 to 51.5% in the morning, and from 40 to 45.9% in the afternoon.
- The percentage of parents who stated that their child's school supported walking and bicycling between home and school increased from 26.3 to 40.8%, with an especially pronounced increase in perceived school support in 2014.

Additional Demographic and Locale-Based Trends in School Travel from 2007 through 2014

- Riding a bus to and from school was most prevalent at schools located outside of cities.
- Students who rode in cars between home and school were most likely to attend low- and medium-income city schools.
- Younger girls were most likely to be driven to school than any other student group.
- Among all students, boys and girls attending low-income city schools were most likely to walk between home and school, whereas boys attending high-income schools were most likely to bicycle between home and school.
- Although schools located in suburbs, towns, and rural areas witnessed higher rates of walking over time, walking increased especially at city schools.

Implications for Practice

Findings from this Trends report suggest several promising ways to promote safe walking and bicycling between home and school. The following list offers some study-informed implications for practice.

1. **Bolster walking with more walking**
   Study findings indicate that more students walked to school in 2014 than did in 2007-08. And as more students walk between home and school, opportunities to establish walking school buses, "walking buddy" programs, and similar initiatives grow. These opportunities are likely to produce a virtuous cycle, whereby walking to school becomes an accepted, normal daily activity, which inspires growing numbers of students to walk (Murtagh, Rowe, Elliott, McMinn, & Nelson, 2012).
2. **Leverage schools' support for walking and bicycling**
   In this study, parents' perceived school encouragement of walking and bicycling to school increased especially in 2014. Such encouragement was strongly associated with walking to and from school. Schools can communicate about walking and bicycling to school in positive ways (a process known as policy feedback; see: Soss & Schram, 2007)

to change or reinforce parents' perceptions of 'what is possible, desirable and normal' related to school transportation.

3. **Site schools near students' households**
   This study and other longitudinal studies show that distance from school is the strongest predictor of walking and bicycling between home and school (Murtagh, Dempster, & Murphy, 2016; McDonald, Brown, Marchetti, & Pedroso, 2011). Therefore, to make walking and bicycling to school viable options for more families, decision makers can site schools nearer students' homes.

4. **Support walking and bicycling to school during winter months**
   In this report, we saw that over time, walking to school did not increase during winter months. Yet promoting walking and bicycling to school in the winter can be a great way to maintain school communities' participation in active school travel. For example, each February, Canada promotes "Winter Walk Day." The main goal of this promotional day is to support students in walking to or at school for "daily physical activity, a healthier environment, safer streets, making friends and having fun!" (Active & Safe Routes to School, n.d.). Similar initiaves have been underway in places like Arlington, VA; Sheboygan County, WI; Toledo, OH; Indiana; Montana; and Vermont.

Study Context and Background

History of Trends in Walking and Bicycling Reports

The primary goal of this report is to explore trends in travel patterns among students enrolled in grades K through 8 and their parents' perceptions about walking and bicycling to school from the years 2007 through 2014. This report is the third in a three-part series entitled *Trends in Walking and Bicycling to School.* The first two reports in the series include: National Center for Safe Routes to School, 2013; and National Center for Safe Routes to School, 2015. The initial *Trends Report* included 525,493 parent surveys from 4,691 schools that collected data in 2007 through 2012. The next report included 605,000 parent surveys collected by 5,300 schools through 2013. This report includes 719,861 parent surveys from 6,479 schools throughout the U.S. and incorporates 2014 data.

History of National Center for Safe Routes to School Data System

Starting in early 2007, the National Center for Safe Routes to School (National Center) developed and disseminated a centralized data collection and reporting system (Data System) drawing upon support from the Federal Highway Administration (FHWA). The Data System involved designing two standardized data collection instruments—(1) the student travel tally, a show-of-hands accounting of students' travel modes to and from school; and (2) the parent survey, a questionnaire that gathers information on students' typical school travel modes and parents' perceptions about walking and bicycling to school—and provided data processing services to all schools that collected school travel data using the instruments. Though the Data System was not mandated in the transportation legislation that created the Federal Safe Routes to School (SRTS) program—the *Safe, Accountable, Flexible Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU)—The National Center and FHWA recognized an opportunity to make possible nationally standardized means of benchmarking and evaluating SRTS practice before States developed their own evaluation-based systems.

This study and the preceding *Trends Reports* (National Center, 2013; National Center, 2015) continue a tradition of National Center-conducted assessments of the state of SRTS programming:

- In 2010, the National Center produced its first school travel data-oriented report. Called *Safe Routes to School Travel Data: A Look at Baseline Results* (National Center, 2010), the report described school travel patterns among data-submitting schools' first data submission, or the schools' "baseline results." Findings included the strong influence of distance from school on whether students walk or bicycle to school; the fact that family vehicles and schools buses were the most frequently used travel modes; and that though most students arrived at school in a family vehicle, many of these students shifted to riding the school bus or walking when traveling home from school.
- Two years later, the National Center conducted a multiple case study entitled, *Shifting Modes: A Comparative Analysis of SRTS Program Elements and Travel Mode Outcomes* (National Center, 2012). In the *Shifting Modes* report, National Center researchers drew upon travel tally results and interviews with local program coordinators to uncover ways in which schools' approaches to planning and implementing SRTS programs related to their students' participation in walking and bicycling between home and school. Study results revealed that successful SRTS programs were likely to possess four key program elements: (1) they identified an in-school leader to champion SRTS; (2) they conducted activities that reinforced walking and bicycling (e.g., frequent walker/bicyclist programs);

(3) they generated parent support for SRTS; and (4) they established policies that facilitated walking and bicycling to and from school (e.g., earlier dismissal for students who walk or bicycle home from school).

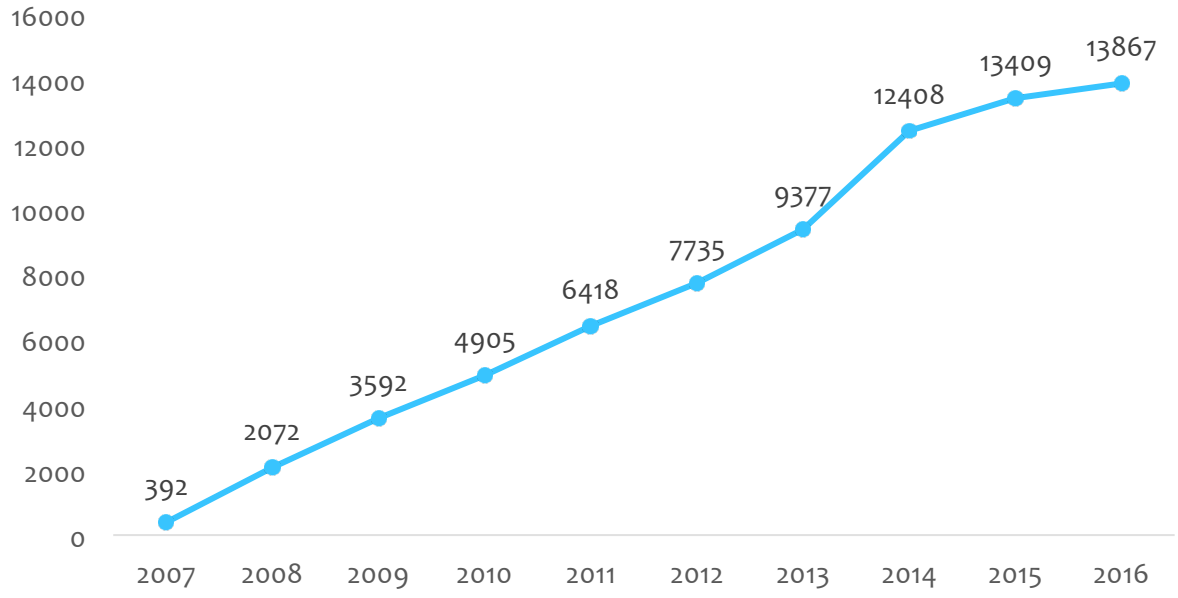
- That same year, the National Center's three-part *Getting Results* series showcased dozens of local programs that have reduced car traffic, speeding and distracted driving in proximity of schools, as well as those that have documented measurable increasing in walking and bicycling using the parent survey and travel tally instruments (National Center 2012b).
- Starting in 2013, the National Center decided to explore school travel patterns through a series of *Trends* report, of which this report is the third.

Use of the Data System

Since the Data System's inception, the number of schools that submit parent survey data continues to grow. As of May 2016, a total of 13,867 schools from all 50 states and D.C. had used the Data System (Figure 1).

Schools used the National Center's Data System for a variety of reasons. Some schools collected parent survey data to satisfy state requirements to apply for SRTS funding. Others collected data to assess the impact of interventions, like the influence of sidewalks on students' participation in walking and bicycling to school. Therefore, it is reasonable to assume that on average, data-submitting schools have greater interest in facilitating safe walking and bicycling to school compared with U.S. schools in general.

Figure 1. Number of Schools with Data in the National Center for Safe Routes to School Data System (March 2007-May 2016).



Research Approach

To examine student travel patterns and parental perceptions of active school travel over time, the research team estimated multinomial logit models which clustered responses by school. These models estimate the probability of choosing school travel modes as a function of school-level and household-level predictor variables. School-level variables include data maintained by the National Center for Education Statistics (NCES), such as school income and the Census-defined locale in which schools were located (i.e., cities, suburbs, towns, and rural areas). Household-level variables included: students' sex and grade in school; the distance students lived from school; parents' level of education; the month and year parents completed the surveys; whether students asked their parents for permission to walk or bicycle between home and school; how much fun parents perceived walking and bicycling to be for their children; how healthy walking and bicycling was for their children; and how much their children's school supported walking and bicycling to/from school.

It is important to note that data stored in the Data System is dynamic. Users of the system can add and remove data at their discretion, which means that the parent surveys included in the preceding *Trends Reports* (National Center, 2013; National Center, 2015) are not identical to those included in this report and not simply because it includes another year of data. Instead, these *Trends Reports* depict yearly school travel patterns and perceptions among shifting data-submitting school populations.

This follow-up study replicates the methods used in the first two *Trends Reports.* Unique to this report is analysis and discussion of how the season in which parent survey data were collected—i.e., Winter, Spring, Summer, Fall—influenced school travel patterns.

Methods

The National Center research team incorporated household- and school-level data into the model estimates of school travel patterns over time. These data analyses come from the parent survey instrument and information maintained by the US Department of Education's National Center for Education Statistics (NCES). Using unique school identifiers, the National Center linked parent survey data stored in the Data System with school-level information maintained by NCES. School-level data gathered from the NCES included U.S. Census-defined "locale"—which refers to a school's proximity to an urbanized area, or region with a densely settled core with densely settled surrounding area—(NCES, n.d.), school enrollment figures, and the proportion of students who were eligible to receive free or reduced price lunch—an indicator of "school-level income."

The National Center successfully matched 8,240 or 82 percent of all schools that maintained parent survey data in the database collected through 2014. Of these 8,240 schools, 6,479 schools satisfied two selection criteria: (1) they enrolled students in Kindergarten through eighth grade—the focus of the Federal Safe Routes to School program—and (2) they entered more than 10 completed parent surveys each year the schools collected survey data. Schools submitted an average of 112 survey responses per time period. The analyses that follow pertain to surveys and NCES information related to these 6,479 schools.

Data Preparation

After matching parent survey data collected at the 6,479 study schools with school-level information maintained by the NCES, the National Center prepared the data for analysis in four steps:

1. We placed schools into three categories according to the percentage of their students who were eligible to receive free and reduced priced meals (FRPM) in 2014: low-income; medium-income; and high-income schools. In keeping with work conducted by California's Safe Routes to School Technical Assistance Resource Center (TARC, 2010), low-income schools were defined as those schools where 75 percent or more of their students were eligible to receive FRPM; medium-income schools as those where between 75 and 40 percent of their students were eligible to receive FRPM; and high income schools as those where 40 percent or fewer of their students were eligible to receive FRPM.
2. National Center reserachers then collapsed three variables into binary "agree" and "do not agree" categories: (1) parents' perceptions about the degree to which their child's school supported walking and bicycling to and from school; (2) the degree to which parents thought walking and bicycling were healthy for their child; and (3) the degree to which parents thought walking and bicycling to school were fun for their child. We collapsed these variables to enhance interpretability of non-committal responses (i.e., "neutral" or "neither" responses).
3. We also collapsed four travel mode categories into two more inclusive categories. We collapsed the "family vehicle" and "carpool" travel mode options in a "car" category, and collapsed the "transit" and "bus" response options into a "bus" category. The National Center combined these travel mode choices to improve the statistical power of estimation.
4. Finally, we collapsed the month in which parents completed the surveys into seasonal categories: (1) "Winter" = December, January, and February; (2) "Spring" = March, April, May; (3) "Summer" = June, July, August; and (4) "Fall." = September, October, and November.

Data Analysis and Model Estimation

Data analysis proceeded in three steps:

1. We described the schools in this study using descriptive statistics, which included study schools' locale and their percentage of students eligible to receive FRPM. The descriptive analysis also captured household-level information including how far the students lived from school, students' sex and grade in school, the season parents completed surveys, and parents' level of education.
2. National Center researchers assessed the representativeness of the study schools on the basis of where the schools were located, the schools' FRPM-based income, and the distribution of students' distances from school. To assess the representativeness of our sample, we compared data-submitting schools to school information maintained by NCES (i.e., schools' locales and income levels) and to survey results from the 2009 National Household Travel Survey (i.e., students' distance from school) **(**McDonald, Brown, Marchetti, & Pedroso, 2011**)**, the latter of which included a nationally representative sample of U.S. households.
3. After the descriptive and representative analyses, we explored school travel patterns and parental perceptions of walking and bicycling to school over time. Using multinomial logit models which clustered responses by individual schools, we estimated school travel

mode choices. Multinomial logit is an efficient statistical method to study the selection of mode choices (Ashalatha, Manju, & Zacharia, 2013). However, these models rely on an assumption known as the independence of irrelevant alternatives (IIA), which theorizes that the odds of choosing one mode is not affected by the availability or characteristics of another mode. A Hausman test detected no violation of the IIA assumption (χ^2 (93) = 14.32, p = 0.916).

The models were estimated using Stata MP v. 14 program software (StataCorp, 2014). Across all multinomial logit model estimates, we regressed the probability of selecting one of five school travel modes (i.e., walk, bicycle, bus, other, and car) onto school-level predictors and household-level predictors (Table 1).

Table 1. Variables Used in the Analyses.

Variable Type	Definition	Response Options
Outcome		
Arrival	"On most days, how does your child arrive and leave for school?"	Walk; Bike; School Bus; Family Vehicle; Carpool; Transit; Other
Departure	"On most days, how does your child arrive and leave for school?"	Walk; Bike; School Bus; Family Vehicle; Carpool; Transit; Other
Predictor		
Locale	U.S. Census defined locale in terms of how populated an area is and how far away from a population center it is located.	City; Suburb; Town; Rural
School income	The percentage of students enrolled in a school who were eligible to receive free or reduced price meals as of 2011.	N/A
Distance	"How far does your child live from school?"	Less than ¼ mile; ¼ mile up to ½ mile; ½ mile up to 1 mile; 1 mile up to 2 miles; More than 2 miles
Sex	"Is the child who brought home this survey male or female?"	Male; Female
Grade	"What is the grade of the child who brought home this survey?	Grade (K, 1, 2, 3… 8)
Education level	"What is the highest grade or year of school you completed?"	Grades 1 through 8; Grades 9 through 11; Grade 12 or GED; College 1 to 3 years; College 4 years or more; Prefer not to answer
Asked permission	"Has your child asked for permission to walk or bike to/from school in the last year?"	Yes; No
Fun	"How much fun is walking or biking to/from school for your child?"	Very Fun; Fun; Neutral; Boring; Very Boring
School support	"In your opinion, how much does your child's school encourage or discourage walking and biking to/from school?"	Strongly Encourages; Encourages; Neither; Discourages; Strongly Discourages
Healthy	"How healthy is walking or biking to/from school for your child?"	Very Healthy; Healthy; Neutral; Unhealthy; Very Unhealthy
Season	Month in which survey was completed	*Winter* (Dec, Jan, Feb); *Spring* (Mar, Apr, May); *Summer* (Jun, Jul, Aug); *Fall* (Sep, Oct, Nov)
Year	Year in which survey was completed	2007 - 2014

Results

Descriptive Analysis

The following analyses derive from 719,861 parent survey responses involving 6,479 schools located in all states and D.C. As seen in Table 2, the majority of students attended schools in city, suburb, and town locations, rather than in rural areas. And most students in the sample attended high- and medium-income schools. About one-third of students lived beyond two miles from school, and nearly a fifth of them lived within ¼ mile from school. In terms of age, students were concentrated in grades K through 5, making up nearly 80 percent of the sample. Slightly more than half of the surveys related to female students, and more than 70 percent of responding parents attended college at some point.

Table 2. School-Level and Household-Level Sample Characteristics.

	Percent	n
Locale		
City	31.9%	229791
Suburb	32.0%	230344
Town	20.6%	148371
Rural	15.5%	111354
School-level income		
Low	19.2%	138329
Medium	37.3%	268846
High	43.4%	312686
Female	52.1%	374881
Male	47.9%	344980
Distance		
< 1/4 mi	19.9%	143062
1/4 - 1/2 mi	13.3%	95618
1/2 - 1 mi	17.4%	125235
1 - 2 mi	19.1%	137668
> 2 mi	30.3%	218278
Grade in school		
K	12.3%	88342
1	13.2%	94877
2	13.1%	94129
3	13.7%	98951
4	13.4%	96480
5	12.7%	91089
6	9.3%	67075
7	6.8%	48761
8	5.6%	40158

Parent level of education		
Grades 1 through 8	6.5%	46878
Grades 9 through 11	5.6%	40666
Grade 12 or GED	18.7%	134441
College 1 to 3 years	29.7%	213693
College 4 years or more	39.5%	284182

Representative Analysis

As seen in Table 2, a significantly higher percentage of parents attended college—i.e., 70 percent—compared to the estimated 58 percent of adults with college experience in the general population (United States Census Bureau, 2014). Moreover, as reported in Figures 2 through 4, compared with a nationally representative sample of schools, students attending data-submitting schools were more likely to attend schools located in cities, suburbs, and towns, rather than in rural areas. They were also slightly more likely to attend wealthier schools, and to live closer to school than average. These findings suggest that this study's results may not readily apply to schools located in rural areas, and with students who live greater than two miles from school.

Figure 2. U.S. Census-Defined Locale.

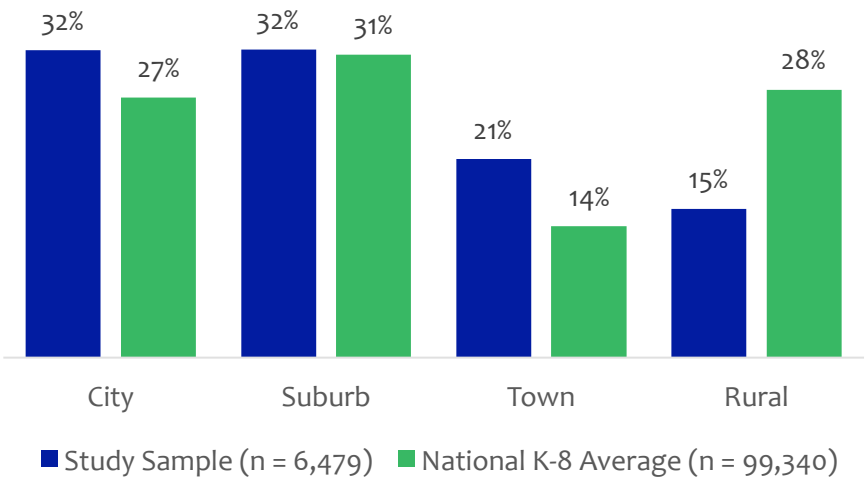


Figure 3. School-Level Income.

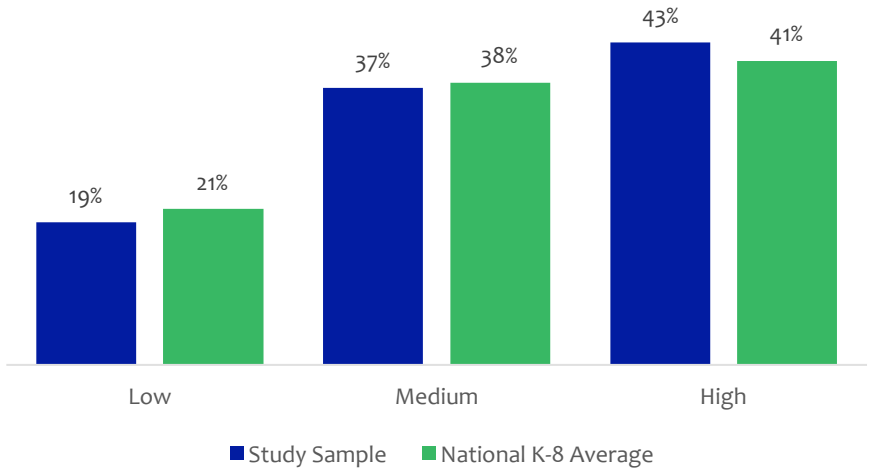
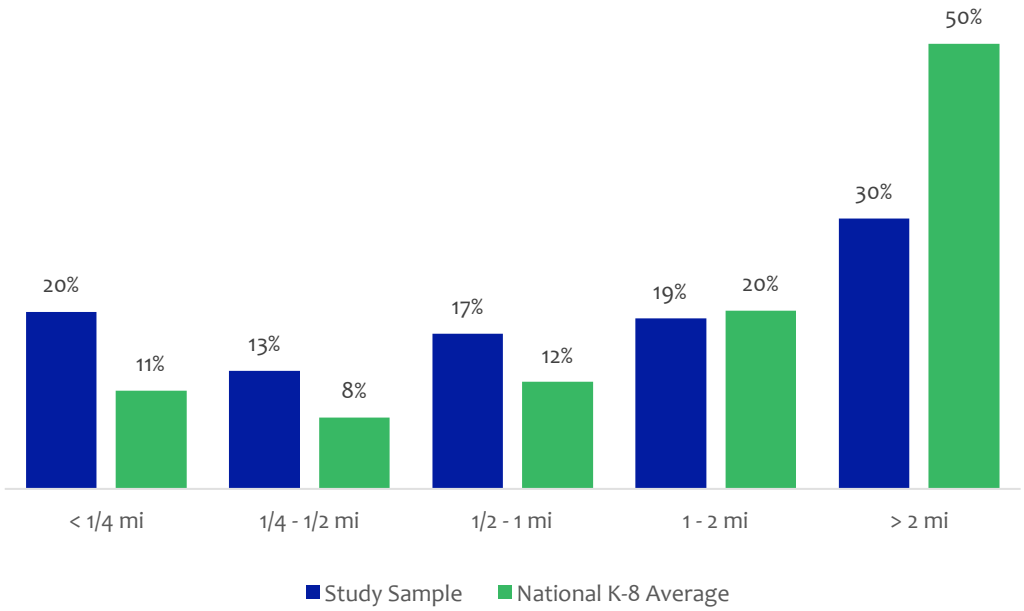


Figure 4. Distance from School.



Model Estimates

Using multinomial logistic models which clustered responses at the level of each school, we estimated the probability of students walking, bicycling, riding a school bus, being driven in a car, or using some other travel mode to get between home and school. We regressed these school travel modes onto the year the surveys were completed and various school-level and household-level factors (see Table 1 for details) to see how these factors impacted families' choice of school travel mode. We combined data collected in 2007 and 2008 for the analysis to account for the limited amount of data collected during those years. The following results refer to the average marginal effect that survey year had on choosing one of five school travel modes after controlling for school- and household-level variables displayed in Table 1. Detailed multinomial logit model results are displayed in Appendix G and H.

As seen in Figures 5 and 6, the percentage of students walking to and from school increased significantly between 2007-08 to 2014, from 11.5 to 15.2 percent in the morning, and from 14.6 to 18.1 percent in the afternoon. These trends represent increases in walking to and from school of 32 and 24 percent from 2007-08, respectively. At the same time, the percentage of students riding a bus between home and school decreased substantially, from 36.8 to 29.8 percent in the morning, and from 42.5 to 34.6 percent in the afternoon. Finally, riding to school in a car increased significantly, from 49.1 to 51.5 percent in the morning, and from 40 to 45.9 percent in the afternoon (see Figures 5 and 6, as well as Appendix G and H for model results).

By a large margin, distance was the strong predictor of walking and bicycling between home and school. Students living beyond one-half mile from school were less than a fifth as likely to walk to school as students living within one-half mile from school (RRR = 0.183; 95% C.I. = 0.172 – 0.195). Students living beyond one mile from school were only half as likely to bicycle to school as those living within one mile of school (RRR = 0.535; 95% C.I.: 0.498 – 0.575).

When all other predictor variables were held constant, older students (i.e., those in grades 6 through 8) were significantly more likely to walk and bicycle to school than younger students (i.e., students in grades K through 5). Moreover, across age groups, boys were more than twice as likely to bicycle to school as were girls. Parent-perceived school support for walking and bicycling was most strongly associated with walking, whereas perceived fun of walking and bicycling was most predictive of bicycling.

Students who rode the bus to and from school were most likely to attend schools in rural areas or to otherwise live farther than average from school. Older students were slightly more likely than younger students to ride a bus to school. Students attending low-income and medium-income schools were equally likely to ride a bus to and from school, and students attending high-income schools were the most likely to ride buses. Girls whose parents had higher levels of education and who attended high-income city schools were most likely to ride in a car to school.

To better understand how factors interacted with one another to influence choice of school travel mode, we conducted a seris of sub-analyses. These analyses included interactions among school travel mode trends and: (1) distance to school; (2) students' sex; (3) their grade level in school; (4) school-level income; and (5) the season (i.e., Winter, Spring, Summer, Fall) parents completed surveys. Results from each of these sub-analyses are presented in the following sections. Within these analyses, the research team estimated interactions that looked at the simultaneous influence of two variables on the families' mode choices. For example, one

interaction look at the influence of students' sex and grade in school, and their combined impact on mode choice. Other interactions included those between schools' locale and income level, and these variables' combined influence on mode choice. These sub-models were not included in this report for the sake of brevity; however, their results are described in the following sections, as well as in Appendices B through F.

Figure 5. Arrival at School: 2007-08 to 2014.

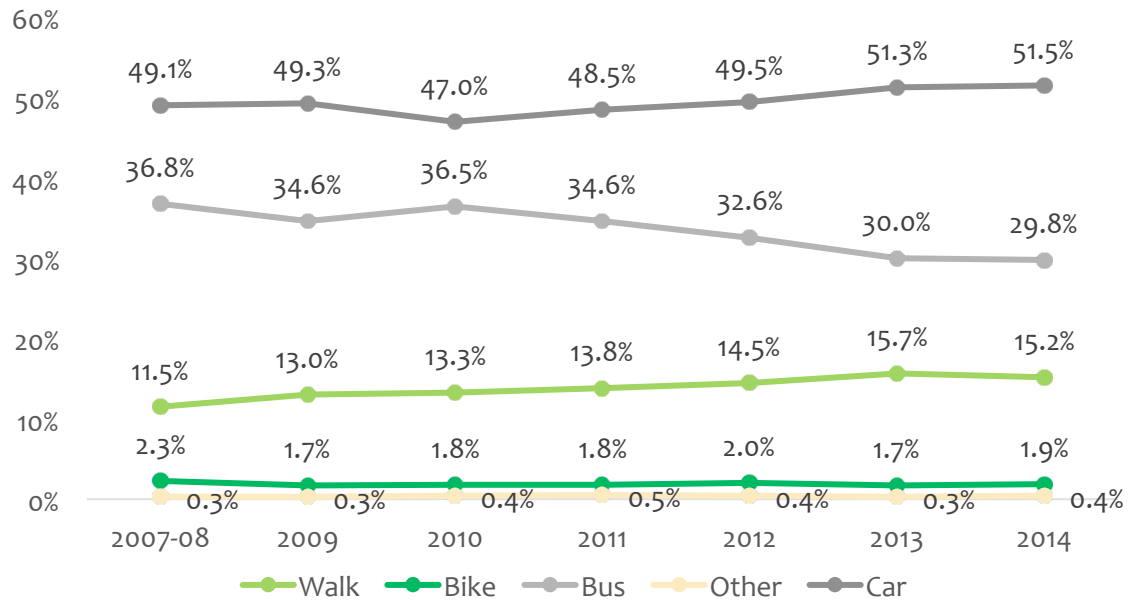
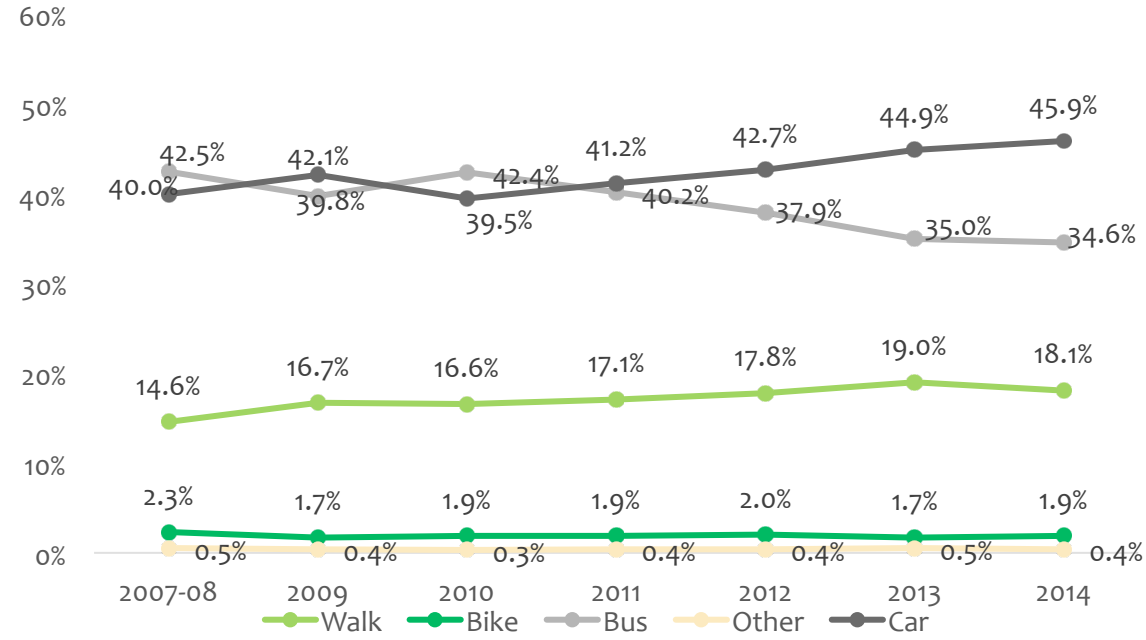


Figure 6. Departure from School: 2007-08 to 2014.



Distance from School

The table below shows two results for each travel mode by the distance students lived from school. The two results include (1) whether use of the mode increased (indicated by an "" sign), decreased (indicated by a "" sign) or neither increased or decreased (as shown by a ""sign) from 2007-08 through 2014; and (2) which subgroups of students were most likely to use each travel mode, as well as where they were most likely to use them. For example, as seen in the table below, among students living within one mile of school, walking increased (from 24.6 to 29% in the morning, and from 28.3 to 35.9% in the afternoon), especially among boys who attended low income city schools.

Distance from School	Walk	Bike	Bus	Car
Within one mile	↑ 24.6% to 29% / 28.3% to 35.9%	↓ 4% to 3.4% / 3.3 to 3%	↓ 16.2% to 12.8% / 21.9% to 15%	↔ 54.5% to 53.9% / 45% to 44.8%
Most Likely Among	• Low income city schools • Boys	• High income city schools • Boys	• Town-based and rural schools • Older girls	• Medium and high income suburban schools • Younger girls
Between 1 and 2 miles	↑ 3.3% to 4.5% / 6% to 7.5%	↑ 2.1% to 2.5% / 2.2 to 2.6%	↓ 37% to 30.2% / 45.8% to 35.2%	↑ 56.9% to 62.1% / 44.7% to 53.6%
Most Likely Among	• Low income city and suburban schools • Girls and boys equally likely to walk	• High income city schools • Boys	• Low income suburban., town-based and rural schools • Older girls	• Medium income suburban schools • Younger girls
Beyond 2 miles	↔ 1.2% to 0.9% / 3% to 2.8%	↔ 0.3% to 0.5% / 0.5 to 0.7%	↓ 48.7% to 36.9% / 53.4% to 41.5%	↑ 49.2% to 61.3% / 42.2% to 54.1%
Most Likely Among	• Low income city, suburban, and town-based schools • Girls and boys equally likely to walk	• High and medium income city schools • Older boys	• Low income suburban., town-based and rural schools • Younger boys	• Medium income suburban schools • Younger girls

Note. "Younger" = elementary-aged girls/boys; "Older" = middle school-aged girls/boys.

Travel Patterns among Male and Female Students

The table below shows two results for each travel mode by students' sex. The two results include (1) whether use of the mode increased from 2007-08 through 2014 (indicated by an "↑" sign), decreased (indicated by a "↓" sign) or neither increased or decreased (as shown by a "↔"sign) from 2007-08 through 2014; and (2) which subgroups of students were most likely to use each travel mode, as well as where they were most likely to use them.

Students' Sex	Walk	Bike	Bus	Car
Male students	↑ 11.6% to 15.2% / 15.3% to 18.1%	↔ 3.3% to 2.8% / 3.3% to 2.9%	↓ 34.1% to 23.9% / 39.5% to 29.2%	↑ 49.8% to 57.1% / 40.5% to 48.6%
Most Likely Among	• Low income city schools • Older boys whose parents report that their child's school encouraged walking and bicycling	• High income city schools • Older boys whose parents believed walking and bicycling were fun for their child	• High income suburban schools • Younger boys	• Medium income suburban schools • Younger boys
Female students	↑ 11.4% to 15.2% / 15.1% to 18%	↔ 1.7% to 1.6% / 1.6 to 1.6%	↓ 34% to 24% / 39.4% to 28.2%	↑ 51.8% to 58.5% / 42.8% to 51%
Most Likely Among	• Low income city schools • Older girls	• High income city schools • Girls who asked for permission and whose parents believed walking and biking were fun for their child	• Low income suburban., town-based and rural schools • Older girls	• Medium and low income city schools • Younger girls

Note. "Younger" = elementary-aged girls/boys; "Older" = middle school-aged girls/boys.

Grade in School

The table below shows two results for each travel mode by students' grade in school. The two results include (1) whether use of the mode increased from 2007-08 through 2014 (indicated by an "" sign), decreased (indicated by a "" sign) or neither increased or decreased (as shown by a ""sign) from 2007-08 through 2014; and (2) which subgroups of students were most likely to use each travel mode, as well as where they were most likely to use them.

Grade in School	Walk	Bike	Bus	Car
K - 2nd grade	↑ 12% to 15.1% / 13.4% to 16.7%	↔ 1.5% to 1.2% / 1.4% to 1.2%	↓ 30.8% to 25.8% / 35.8% to 28.7%	↔ 55.1% to 57.1% / 48.2% to 52.4%
Most Likely Among	• Low income city schools • Boys and girls whose parents reported positive perceptions of walking and bicycling	• High income city and rural schools • Boys whose parents believed walking and bicycling were fun for their child	• High income town-based and rural schools • Boys	• Medium income suburban schools • Girls
3rd - 5th grade	↑ 13.1% to 16.1% / 17.1% to 19.1%	↓ 3.1% to 2.4% / 3.2% to 2.4%	↓ 33.5% to 23.9% / 39.4% to 28%	↑ 49.6% to 57% / 39.2% to 49.6%
Most Likely Among	• Low income city schools • Boys and girls whose parents reported positive perceptions of walking and bicycling	• High income city and rural schools • Boys whose parents believed walking and bicycling were fun for their child	• High income suburban, town-based and rural schools • Boys	• Medium income suburban schools • Girls
6th - 8th grade	↑ 9.3% to 12.1% / 15% to 18.5%	↑ 3.2% to 3.8% / 3.2% to 4%	↓ 42.2% to 27.5% / 47.5% to 32.4%	↑ 44.3% to 56% / 33.1% to 44.3%
Most Likely Among	• Low income city schools • Boys and girls whose parents reported positive perceptions of walking and bicycling	• City schools across income levels • Boys whose parents believed walking and bicycling were fun for their child	• Suburban, town-based and rural schools across income levels • Boys	• High and medium income suburban schools • Girls

Note. "Younger" = elementary-aged girls/boys; "Older" = middle school-aged girls/boys.

School-Level Income

The table below shows two results for each travel mode by school-level income. The two results include (1) whether use of the mode increased from 2007-08 through 2014 (indicated by an "↑" sign), decreased (indicated by a "↓" sign) or neither increased or decreased (as shown by a "↔"sign) from 2007-08 through 2014; and (2) which subgroups of students were most likely to use each travel mode, as well as where they were most likely to use them.

School-level Income	Walk	Bike	Bus	Car
Low Income Schools	↑ 21.1% to 25% / 24.1% to 29%	↔ 0.8% to 1% / 0.8% to 1.1%	↓ 23.4% to 17.4% / 26.4% to 22.3%	↔ 53.8% to 55.8% / 47.1% to 46.5%
Most Likely Among	• City schools • Older boys whose parents reported positive perceptions of walking and bicycling	• City schools • Older boys	• Rural schools • Younger boys	• Suburban schools • Girls
Medium Income Schools	↑ 10.2% to 13.9% / 13.5% to 16.1%	↔ 1.9% to 1.9% / 1.9% to 1.9%	↓ 33.9% to 24.9% / 40% to 29%	↑ 53.4% to 58.8% / 43.6% to 52%
Most Likely Among	• City schools • Older boys and girls whose parents believed their child's school encouraged walking and bicycling to school	• City and rural schools • Older boys whose parents believed walking and bicycling were fun for their child	• Town-based and rural schools • Boys	• Suburban schools • Younger girls
High Income Schools	↑ 11.1% to 13.7% / 14.4% to 16.7%	↔ 3.3% to 2.9% / 3.3% to 2.9%	↓ 36.6% to 26.8% / 42.2% to 30.8%	↑ 48.2% to 56% / 39% to 48.7%
Most Likely Among	• City and suburban schools • Older boys and girls whose parents believed their child's school encouraged walking and bicycling to school	• City schools • Older boys whose parents believed walking and bicycling were fun for their child	• Suburban, town-based and rural schools	• Suburban schools • Younger girls

Note. "Younger" = elementary-aged girls/boys; "Older" = middle school-aged girls/boys.

Season of Survey Completion

The table below shows two results for each travel mode by the season parents completed surveys. The two results include (1) whether use of the mode increased from 2007-08 through 2014 (indicated by an "↑" sign), decreased (indicated by a "↓" sign) or neither increased or decreased (as shown by a "↔"sign) from 2007-08 through 2014; and (2) which subgroups of students were most likely to use each travel mode, as well as where they were most likely to use them.

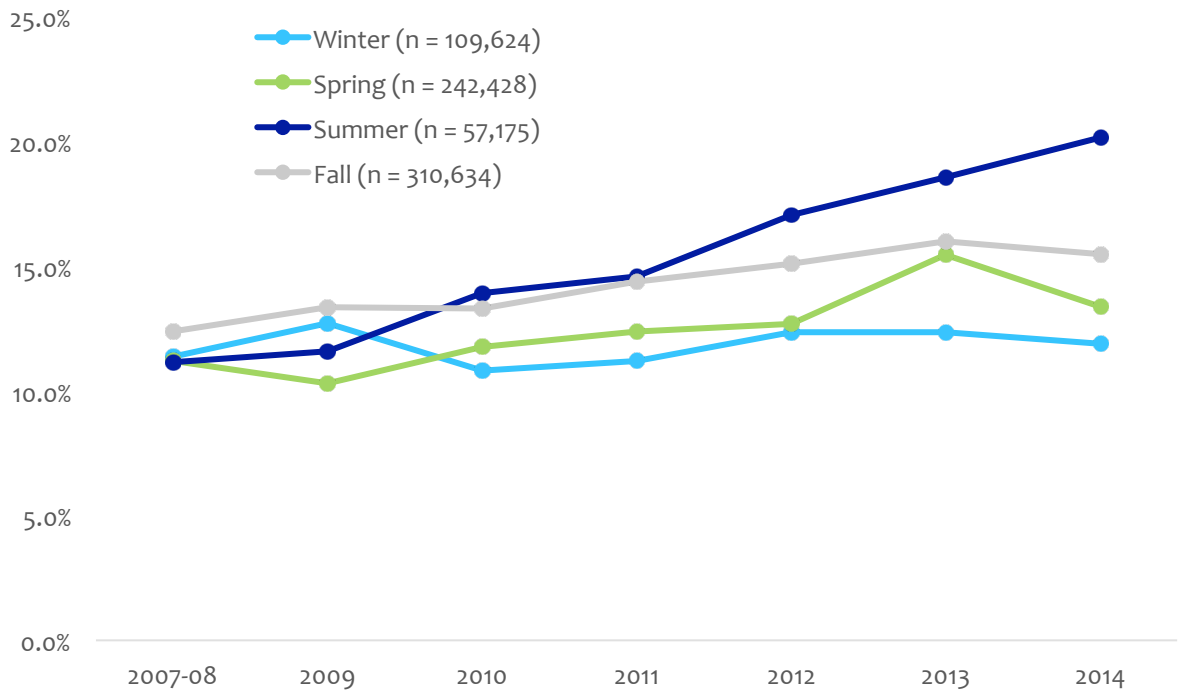
Season	Walk	Bike	Bus	Car
Winter (Dec, Jan, Feb)	↔ 11.1% to 12.1% / 14.3% to 15.1%	↓ 2.3% to 1.7% / 2.3% to 1.7%	↓ 33.6% to 27% / 38.7% to 31.5%	↑ 52.4% to 58.5% / 43.8% to 50.6%
Most Likely Among	• Low income city schools • Older boys and girls whose parents believed their child's school encouraged walking and bicycling to school	• High income city schools • Older boys whose parents believed walking and bicycling were fun for their child	• Low income rural schools • Older boys	• Medium income city, suburban, and town-based schools • Younger girls
Spring (Mar, Apr, May)	↑ 11.3% to 15.8% / 15.2% to 16.6%	↔ 2.5% to 2.3% / 2.5% to 2.4%	↓ 32.3% to 25% / 39.7% to 31.3%	↑ 52.8% to 56.9% / 41.5% to 48.8%
Most Likely Among	• Low income city schools • Older boys and girls	• High income city schools • Older boys whose parents believed walking and bicycling were fun for their child	• High income rural schools • Older boys and girls	• Medium income city schools • Younger girls
Summer (Jun, Jul, Aug)	↑ 12.2% to 20.8% / 15.6% to 24%	↔ 2.9% to 2.5% / 3.1% to 2.4%	↓ 35.1% to 19.6% / 41.4% to 25%	↑ 49.2% to 55.2% / 39% to 47.8%
Most Likely Among	• Low income city schools • Older boys and girls	• High income city and rural schools • Older boys	• Low income rural schools • Older boys	• Medium income city and town-based schools • Younger girls
Fall (Sep, Oct, Nov)	↑ 11.5% to 16.2% / 15.7% to 17.8%	↔ 2.5% to 2.1% / 2.5% to 2.1%	↓ 32% to 23.4% / 36.2% to 27.3%	↑ 52.9% to 57.5% / 44.9% to 51.8%
Most Likely Among	• Low income city schools • Older boys and girls	• High income city and rural schools • Older boys	• High income rural schools • Older boys and girls	• Medium income city and town-based schools • Younger girls

Note. "Younger" = elementary-aged girls/boys; "Older" = middle school-aged girls/boys.

Walking to School by Season

As noted earlier, unique to this report is the inclusion of seasonal influences on school travel patterns. We have seen how walking to and from school increased significantly from 2007-08 through 2014. However, this trend did not hold across all times of year.Given these apparent seasonal variations in school travel, National Center researchers wanted to take a closer look at how the season in which schools administerered parent surveys may have impacted trends in walking between home and school. As seen in Figure 7, during spring (i.e., March, April, May) and fall (i.e., September, October, November) months, walking to school increased at a slow, but steady pace. Yet during summer months (i.e., June, July, August), walking to school increased rapidly, especially from 2011 through 2014. In contrast with other seasons, walking to school during winter months (i.e., December, January, February) hovered between 11 and 12 percent across time. It is worth noting that students made 33 percent of "summer trips" in June and another 64 percent in August, and that only three percent of summer walking trips to school occurred in July. This suggests that the majority of summer trips captured using the parent survey occurred during the beginning (August) and end (June) of the school years.

Figure 7. Proportion of Students Walking to School by Season over Time.

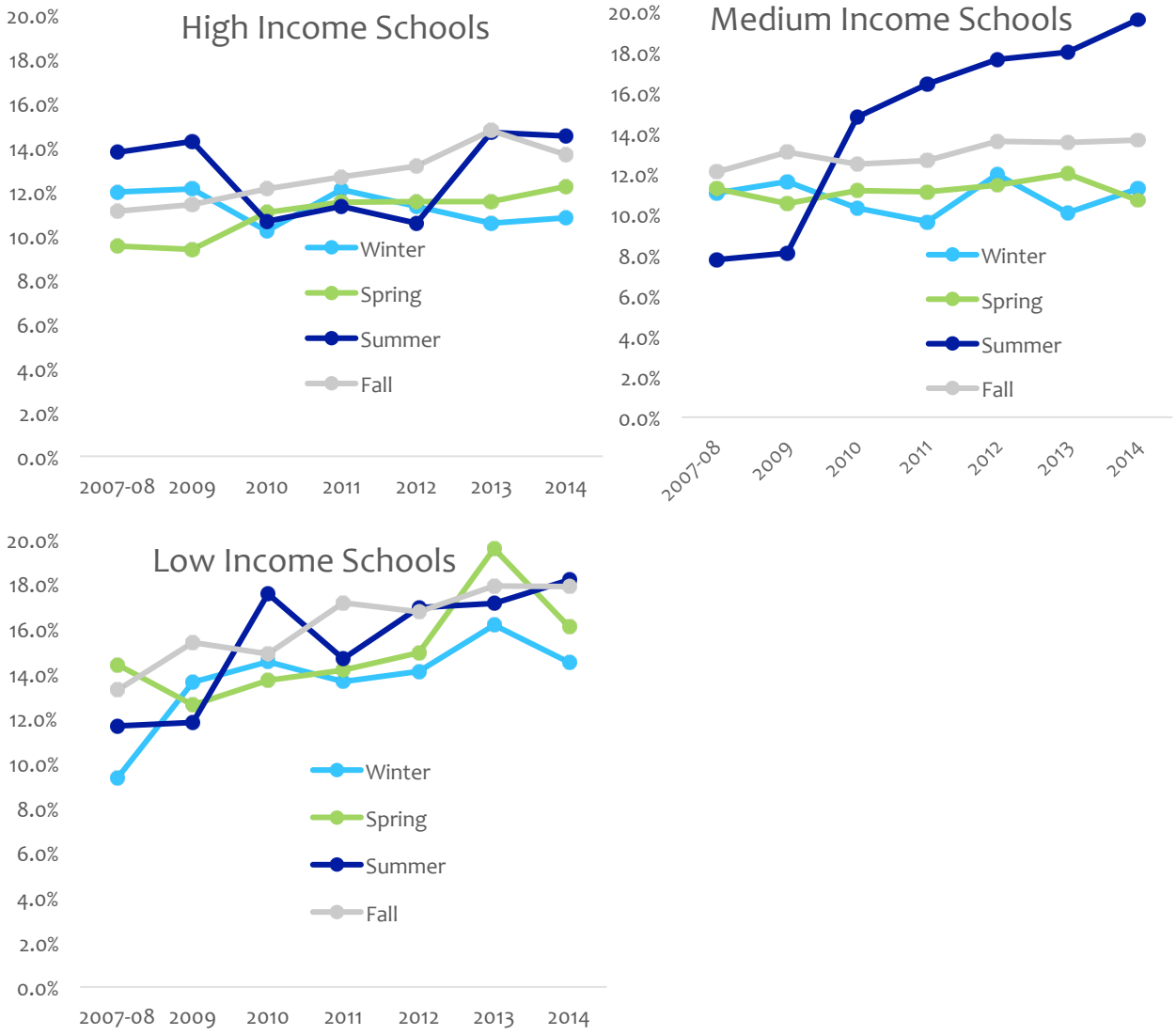


To further explore the relationship between walking to school during different seasons, National Center researchers examined interactions among walking to school by season and school level income. As such, Figure 8 shows students' probability of walking to school by season per school income group. Regardless of income, spring and winter consistently had lower participation rates than summer and fall. One possible explanation for this is that parents are concerned with cold and or wet weather and do not allow their child to walk in such conditions. Heat seems to pose less of an issue, especially among parents of students attending medium- and low-income schools. In Ahlport, Linnan, Vaughn, Evenson & Ward's (2008) study on barriers of walking and

biking to school, focus groups revealed that parents viewed inclement weather as a barrier to getting to school. However, children expressed few concerns about getting cold or wet and only expressed distaste for walking and biking in the heat.

Figure 8 suggests that many students at low income schools did not walking by choice but by necessity. This is demonstrated by the small seasonal differences in walking to low income schools versus the sizable seasonal difference in walking to school participation at medium income schools, especially during summer months. The idea that walking for middle income students is a choice made by the parents relates to the idea that parents—not necessarily their children—often dislike walking in the rain and cold, which could contribute to a decline in walking activity in cold conditions (de Montigny, Ling & Zacharias, 2012).

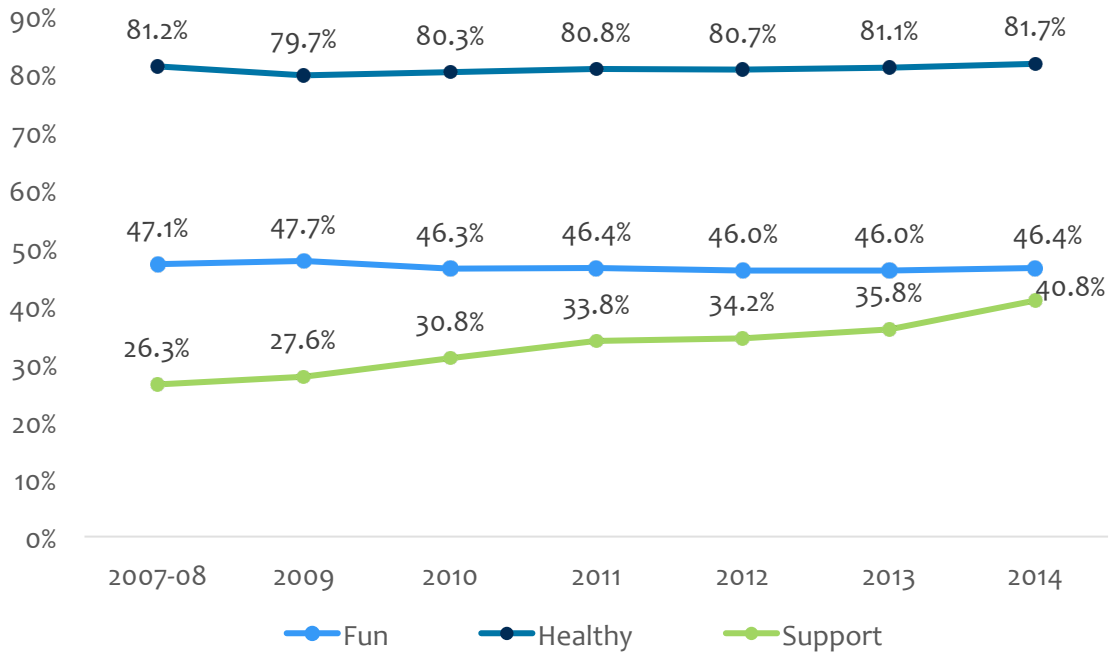
Figure 8. Proportion of Students Walking to School by School-Level Income and Season over Time.



Parental Perceptions of Walking and Bicycling

In 2014, parents' perceptions about walking and bicycling to school shifted substantially in one respect: how much they perceived their children's school encouraged walking and bicycling to school. In our initial report on school travel trends (National Center, 2013), we noted a steady, significant increase in perceived school support for active school travel. Yet in 2014, perceived school support for walking and bicycling rose sharply to 40.8 percent, an increase of 55 percent since 2007-08 (Figure 8). Otherwise, parents' beliefs about how healthy walking and bicycling was for their child remained stable at more than 80 percent, and between 46 and 47 percent of them thought that walking and bicycling were fun for their child. Binary logit models revealed that parents whose children were younger girls who walked or bicycled to city schools school were most likely to perceived strong school support for walking and biking to school (see Appendix I for model results).

Figure 9. Parental Perceptions of Walking and Bicycling to/from School.



Discussion

This study explored school travel trends at 6,479 schools located in all 50 states and D.C. using responses from 719,816 completed parent surveys and school-level data maintained by the National Center for Education Statistics. This study's results indicate that walking to and from school increased until 2013 and then stabilized in 2014. Results also highlight noteworthy patterns among walking, bicycling, riding a bus, and being driven the school, as well as parents' perceptions of active school travel between 2007 and 2014.

Walking to and from school increased significantly between 2007 and 2014, from 11.5% to 15.2% in the morning, and from 15.2% to 18.1% in the afternoon. Students attending low-income city schools were especially likely to walk and girls were as likely as boys to walk to and from school over the study period. Within one mile of school, the largest shift between travel modes occurred between busing and walking, with busing decreasing significantly and walking increasing significantly. As reported elsewhere (e.g., National Center, 2010; McDonald, et al., 2011; Murtagh, Dempster, & Murphy, 2016), distance from school was the strongest predictor of walking and bicycling, with significantly less walking and bicycling occurring the farther students lived from school.

SRTS programs have matured over the years with many communities taking advantage of opportunities to install infrastructure that supports safe walking and bicycling and to conduct walking and bicycling educational and promotional activities. Communities' efforts have paid off. In a study examining school travel patterns at 801 schools across the U.S., McDonald and colleagues (2014) found that after five years, the average SRTS program produced a 31 percent increase walking and bicycling to and from school.

Not only have schools sustained interest in promoting safe walking and bicycling to school, but it is likely that within the past few years, greater numbers of schools learned about and benefited from SRTS. From 2007 through 2014, the number of schools participating in the Federal Safe Routes to School program grew from 1,833 to 15,643 (National Center, 2007 & 2014b). Also during this time, First Lady Michelle Obama's "Let's Move" campaign (Let's Move, 2013), which focuses on healthy eating and active living began, and participation in International Walk to School Day increased from 2,760 to 4,447 schools (National Center 2007b & 2014c).

In the initial *Trends Report* (National Center, 2013), we documented a significant decline in bicycling to school from 2007 through 2012. However, starting in 2013, bicycling approached 2007 levels of participation, with significance tests indicating no significant difference between 2007-08 and 2013, as well as between 2007-08 and 2014. Older boys attending high-income city schools were the most likely to bicycle to and from school. Boys were twice as likely to ride a bicycle to/from school as were girls, a finding that is consistent with prior work (e.g., McDonald, 2012).

Also in our first *Trends Report* (National Center 2013), we hypothesized that the 2007 to 2012 decline in bicycling was at least partially attributable to the fact that early data-submitting schools may have been "primed" to take up and advance SRTS programs more quickly than other schools, for they voluntarily adopted SRTS earlier. Nonetheless, SRTS programs are likely to have matured within the past few years and the longer schools support safe walking and bicycling to school, the more likely students are to use these modes (McDonald, et al, 2014). Plus, despite stabilized sales figures for new bicycle purchases in the U.S. (National Bicycle

Dealers Association, 2015), there are signs of a resurgence in bicycling to school. For example, the first-ever National Bike to School Day event was held in May of 2012 with participation from 950 schools in 49 states and D.C. The following year, participation grew 80 percent to 1,705 schools, in 2014, participation expanded to 2,222 schools in all 50 states and D.C (National Center, 2014).

As walking increased, busing to and from school decreased significantly between 2007 and 2014, from 36.8 to 29.8 percent in the morning and from 42.5 to 34.6 percent in the afternoon. Within one mile of school, the largest shift between travel modes occurred between busing and walking, with busing decreasing significantly and walking increasing significantly. Busing was most prevalent among boys who attended high-income schools located outside of cities. Though national statistics are not readily available, one possible explanation for the decline in busing may have involved cuts to school bus service that occurred during the study period (American Association of School Administrators, 2012). The price of automotive diesel fuel—the fuel most often used by school buses—also rose sharply during the study period, from an average of $2.97 per gallon in 2007 to an average of $3.85 per gallon in 2014, a 30 percent increase in price (Bureau of Labor Statistics, 2014).

Across all distances from school, the percentage of students riding to and from school in cars increased significantly between 2007 and 2014, from 49.1 to 51.5 percent in the morning and from 40 to 45.9 percent in the afternoon. Younger girls attending low- and medium-income city schools were the most likely to ride in cars between home and school. Beyond two miles of school, the largest shift between travel modes occurred between riding a bus and riding in a car, with busing decreasing significantly and being driven increasing significantly. Media coverage of bullying grew starting in 2009 (Winburn, Winburn, & Niemeyer, 2014) and with it plausible increases in parents' concern about bullying on school buses. Thus, it is possible this contributed to less riding on school buses. Together with concerns about bullying, it seems the loss of bus service is likely to have precipitated students' traveling to school in cars.

During the study period parents' beliefs about walking and bicycling between home and school altered significantly in one respect: the percentage of parents who stated that their child's school encouraged walking and bicycling as a school travel mode increased from 26.3 to 40.8 percent from 2007 through 2014, with an especially pronounced increase in 2014. Walking and perceived school support increased in tandem throughout the study period, which is promising, for a process-impact evaluation of more than a dozen schools in Victoria, Australia, revealed that school community support for walking and bicycling strongly predicted success in advancing use of these modes (Crawford & Garrard, 2013).

Parent perceived health and fun associated with walking and bicycling between home and school strongly predicted whether their children walked or biked to school. From 2007 through 2014, parent perceived health of these behaviors stabilized at between 80 and 82 percent; and their thoughts about the fun of walking and bicycling school hovered between 46 and 48 percent. Parents whose younger boys attended high income city schools and who biked to school thought walking and bicycling to school was especially fun for their children. Though positive parental attitudes were associated with both walking and bicycling to and from school, walking was most closely associated with *perceived school encouragement* of walking and bicycling to school, whereas bicycling was most closely associated with *perceived fun.* Regarding fun, Romero (2015) argues that a central way to encourage children to walk to school is to highlight the fun

aspects of their experiences. He found that on the walk to school, children encountered rich sensory experiences, play opportunities, and chances to be independent, which contributed to their enjoyment of walking to school and likely inspired them to continue walking.

A more recent discovery made from examining school travel trends involves the impact of season on students' school travel choices. From 2007-08 through 2014, walking to school in winter months (i.e., December, January, and February) stabilized at between 11 and 11.5 percent of all trips to school. Yet those same years, walking to school in the summer months (i.e., June, July, and August) rose significantly, from 11 to 20 percent of all trips between 2007-08 and 2014. Walking to school in spring (i.e., March, April, and May) and fall (i.e., September, October, November) months increased, but not as significantly as it did in summer months. That is, walking between home and school increased over time, yet only during more temperate times of year.

This is not surprising given that a great deal of focus on walking and bicycling occurs around the same time as Walk to School Day and Bike to School Day. Walk to School Day takes place each October and Bike to School Day takes place each May. October and May are during fall and spring, respectively, which are also times when walking to school steadily increased between 2007-08 and 2014 (see Figure 7). This makes sense, as research suggests that promotional events can increase the number of students who walk or bicycle to school weeks after the day of the events (Buckley, Lowry, Brown, & Barton, 2013). Otherwise, schools may be reluctant to promote walking and bicycling to school during colder times of year, which may contribute to the lack of change in walking participation during winter months among students attending medium and high income schools (see Figure 8). It seems that among students attending low income schools, walking between home and school may have been less of a choice than it would have been for relatively wealthier students.

The research and practical implications of this "season-school income" relationship are two-fold. First, transportation professionals and other SRTS stakeholders could assess walking conditions in low income communities and practitioners could work to ensure that such conditions are safe and secure for walking to school. And second, SRTS practitioners could work together to design interventions that enhance the appeal and comfort of walking to and from school during colder times of year.

Although this study illustrates seven-year school travel trends at 6,500 schools, it is limited in a few ways. First, survey-collecting schools do not necessarily reflect patterns at schools that did not collect such data, thereby limiting this study's external validity. That is, school travel patterns depicted here do not necessarily reflect average school travel patterns in the United States. The schools that submitted and entered parent survey data into the National Center's Data System ranged from those schools that collected data to satisfy funding requirements, to those that want to monitor their progress toward achieving walking and bicycling mode share goals. Second, this study focuses on trends and provides educated guesses as to which factors may have contributed to the documented shifts in school travel modes over time. That is, this study does not address such important questions as: how have SRTS programs and more general active living initiatives impacted school travel mode choices among schools in this study?; and which, if any, community-scale built environment features can be credited with the increases in walking reported in this study? Nonetheless, recent research suggests that central elements of SRTS

programs, such as infrastructure and educational and promotional activities, can significantly increase walking and bicycling to school (McDonald, et al, 2014).

As we stated in previous *Trends* reports, we encourage researchers to build upon the existing body of evaluation work by developing crash modification factors (CMFs) and walking- and bicycle-related elasticies associated with various SRTS interventions. For example, a CMF could be developed for reducing the turning radii at intersections in school zones, which would indicate the reduction in crashes stakeholders should expect when implementing this treatment (FHWA, n.d.). Similarly, elasticities related to carrying out encouragement activites such as walking school bus programs could help determine how often and for how long these programs should last to maintain increases in safe walking and bicycling to school. Together, SRTS-related CMFs and intervention elasticities can help improve program planning and decision-making.

In addition to CMFs and intervention elasticities, results point toward other research questions than can advance understanding of active school travel trends. For example, what are some recommended ways to support and promote safe walking and bicycling to school during colder times of year? Another research question might explore why boys have consistently been two to three times as likely as girls to bicycle to school. Given significant increases in driving children to and from school, how can SRTS programs encourage more walking, bicycling, bus riding, as well as "park and walk" and "park and roll" campaigns to reduce the safety-related and environmental costs associated with driving for the sake of entire school communities? Moreover, how can practitioners adapt SRTS to address issues commonly experienced in rural areas? The school travel trends reported here can provide a foundation upon which researchers and practitioners can explore more specific and community-relevant issues related to safe walking and bicycling.

Implications for Practice

Findings from this Trends report suggest several promising ways to promote safe walking and bicycling between home and school. The following list offers some study-informed implications for practice.

1. **Bolster walking with more walking**
   Study findings indicate that more students walked to school in 2014 than did in 2007-08. And as more students walk between home and school, opportunities to establish walking school buses, "walking buddy" programs, and similar initiatives grow. These opportunities are likely to produce a virtuous cycle, whereby walking to school becomes an accepted, normal daily activity, which inspires growing numbers of students to walk (Murtagh, Rowe, Elliott, McMinn, & Nelson, 2012).
2. **Leverage schools' support for walking and bicycling**
   In this study, parents' perceived school encouragement of walking and bicycling to school increased especially in 2014. Such encouragement was strongly associated with walking to and from school. Schools can communicate about walking and bicycling to school in positive ways (a process known as policy feedback; see: Soss & Schram, 2007) to change or reinforce parents' perceptions of 'what is possible, desirable and normal' related to school transportation.
3. **Site schools near students' households**

This study and other longitudinal studies show that distance from school is the strongest predictor of walking and bicycling between home and school (Murtagh, Dempster, & Murphy, 2016; McDonald, Brown, Marchetti, & Pedroso, 2011). Therefore, to make walking and bicycling to school viable options for more families, decision makers can site schools nearer students' homes.

4. **Support walking and bicycling to school during winter months**
   In this report, we saw that over time, walking to school did not increase during winter months. Yet promoting walking and bicycling to school in the winter can be a great way to maintain school communities' participation in active school travel. For example, each February, Canada promotes "Winter Walk Day." The main goal of this promotional day is to support students in walking to or at school for "daily physical activity, a healthier environment, safer streets, making friends and having fun!" (Active & Safe Routes to School, n.d.). Similar initiaves have been underway in places like Arlington, VA; Sheboygan County, WI; Toledo, OH; Indiana; Montana; and Vermont.

Conclusion

This study depicts school travel trends at nearly 6,500 schools around the country. From 2007 through 2014, greater percentages of students attending data-submitting schools walked to and from school and more parents believed that their child's school supported walking and bicycling as viable school commute options. Further, starting in 2012, bicycling appears to have rebounded after declining for several years. Within a reasonable walking distance from school (i.e., one mile), busing decreased significantly at the same time walking increased significantly. However, during winter months walking did not increase, at least not among students attending medium- and high-income schools. Thus, it seems important to support and promote walking and bicycling to school during less temperate times of year. This report provides another piece of evidence of the positive impact of SRTS on student participation in walking and bicycling between home and school. With new schools expressing interest in safe walking and bicycling as viable school commuting options each year, SRTS and similar programs are poised to enhance the health and well-being of students and their communities for years to come.

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Appendix

Appendix A. Description and Explanation of Multinomial Logit Modeling Approach

The National Center used multinomial logit regression to predict the probability of students' use of one among five school travel modes categories (i.e., walking, bicycling, riding a school bus, being driven in a car, or using some "other" travel mode) in a given year. We estimated these probabilities by regressing school travel mode categories onto multiple predictor variables, such as a school's locale, a student's grade in school, how far away from school each student lived, among others. Multinomial logit regression uses maximum likelihood estimation to examine the probability of choosing a particular travel mode.

Results from the multinomial logit models used in this study are displayed in Appendix F and G. For each model, the research team chose the 'car' travel mode option as the reference mode to which all other travel mode options were compared. The selection of the 'car' as the reference mode was arbitrary – any of the other modes instead of the car could have been chosen as the reference mode, and that would not have changed the probability of choosing a particular mode. The following equations explain the structure of the multinomial logit models used in this study. See Greene (2012) for more information on maximum likelihood estimation, multinomial logit analyses, among similar topics.

Based on the multinomial logit model, the probability of arriving at the school using mode 1 (walking) can be written as follows:

$$\Pr(Arrival = 1) = \frac{\exp(\beta_1 X)}{1 + \exp(\beta_1 X) + \exp(\beta_2 X) + \exp(\beta_3 X) + \exp(\beta_4 X)}$$

Similarly, the probability of arriving at the school using the other modes can be written as follows:

$$\Pr(Arrival = 2) = \frac{\exp(\beta_2 X)}{1 + \exp(\beta_1 X) + \exp(\beta_2 X) + \exp(\beta_3 X) + \exp(\beta_4 X)}$$

$$\Pr(Arrival = 3) = \frac{\exp(\beta_3 X)}{1 + \exp(\beta_1 X) + \exp(\beta_2 X) + \exp(\beta_3 X) + \exp(\beta_4 X)}$$

$$\Pr(Arrival = 4) = \frac{\exp(\beta_4 X)}{1 + \exp(\beta_1 X) + \exp(\beta_2 X) + \exp(\beta_3 X) + \exp(\beta_4 X)}$$

$$\Pr(Arrival = 5) = \frac{1}{1 + \exp(\beta_1 X) + \exp(\beta_2 X) + \exp(\beta_3 X) + \exp(\beta_4 X)}$$

Where β_1 through β_4 refer to vectors of coefficients that correspond to each of the modes (i.e., walk(1), bike(2), bus(3), other(4), [not car(5), given that it is the reference mode]); and

X refers to a vector of predictor variables (e.g., locale, school income, etc.).

To estimate the unique impact that the variable **Year** had on the probability of walking, bicycling, riding the bus, riding in a car, or using some "other" school travel mode, **average marginal effects** were calculated using Stata's *margins* command. An average marginal effect is an estimate of a population-averaged marginal effect

on an outcome. In this case, the population is the total number of students included in a given survey year (e.g., 2012), and the outcome is the probability of selecting specific school travel modes in a given year. Once calculated, the average marginal effect is added to the proportion of students who used the five travel modes during the baseline year, which in this case is 2007-08. As seen in Appendix B, the percentage of students who lived within one mile of school and walked to school in the morning increased from 24.6 percent in 2007-08 to 28.4 percent in 2014. This means that the (population-averaged) marginal effect of the year 2014 on walking to school was 6.1 percent (28.4% - 24.6% = 3.8%).

Appendix B. Multinomial Average Marginal Effects of School Arrival and Departure Patterns by Distance and Time.

Within 1 mile (n = 363,915)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	24.6%	24.6%	25.6%	27.3%	28.1%	29.2%	29.0%	28.3%	29.2%	32.0%	33.5%	35.3%	36.2%	35.9%
Bike	4.0%	3.1%	3.1%	3.2%	3.4%	3.3%	3.4%	3.3%	2.8%	2.9%	2.9%	2.9%	2.9%	3.0%
Bus	16.2%	17.3%	17.3%	15.6%	13.7%	12.9%	12.8%	21.9%	22.6%	19.8%	18.5%	17.0%	15.1%	15.0%
Other	0.8%	0.8%	0.8%	0.8%	0.6%	0.7%	0.9%	1.4%	1.1%	1.1%	1.2%	1.0%	1.1%	1.3%
Car	54.5%	54.1%	53.1%	53.2%	54.2%	53.9%	53.9%	45.0%	44.3%	44.2%	43.9%	43.8%	44.7%	44.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Between 1 and 2 miles (n = 137,668)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	3.3%	3.3%	3.5%	4.0%	4.1%	5.3%	4.5%	6.0%	6.7%	6.6%	6.9%	7.7%	8.5%	7.5%
Bike	2.1%	1.3%	1.6%	2.2%	2.2%	2.6%	2.5%	2.2%	1.5%	1.7%	2.3%	2.3%	2.3%	2.6%
Bus	37.0%	40.2%	41.6%	36.5%	33.6%	30.1%	30.2%	45.8%	46.9%	47.9%	42.5%	39.1%	35.8%	35.2%
Other	0.8%	0.5%	0.7%	0.7%	0.9%	0.7%	0.7%	1.3%	1.1%	1.0%	1.1%	1.0%	1.1%	1.1%
Car	56.9%	54.7%	52.7%	56.6%	59.2%	61.3%	62.1%	44.7%	43.7%	42.8%	47.2%	49.9%	52.3%	53.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

More than 2 miles (n=218,278)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	1.2%	0.9%	0.8%	0.9%	1.0%	1.6%	0.9%	3.0%	2.7%	2.4%	2.6%	2.9%	3.3%	2.8%
Bike	0.3%	0.3%	0.3%	0.7%	0.4%	0.5%	0.5%	0.5%	0.3%	0.5%	0.7%	0.6%	0.7%	0.7%
Bus	48.7%	48.1%	46.3%	42.9%	41.6%	37.6%	36.9%	53.4%	53.0%	51.9%	48.4%	46.2%	43.0%	41.5%
Other	0.6%	0.3%	0.3%	0.5%	0.4%	0.4%	0.3%	0.9%	0.8%	0.8%	1.2%	1.0%	1.1%	0.9%
Car	49.2%	50.4%	52.3%	55.0%	56.5%	59.9%	61.3%	42.2%	43.2%	44.4%	47.1%	49.3%	51.9%	54.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix C. Multinomial Average Marginal Effects of School Arrival and Departure by Students' Sex and Time.

Male (n = 344,980)														
	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.6%	13.7%	13.9%	14.1%	14.7%	15.6%	15.2%	15.3%	17.3%	17.3%	17.7%	18.0%	19.0%	18.1%
Bike	3.3%	2.5%	2.6%	2.6%	2.7%	3.0%	2.8%	3.3%	2.5%	2.6%	2.7%	2.8%	3.0%	2.9%
Bus	34.1%	30.2%	31.8%	30.1%	28.2%	27.6%	23.9%	39.5%	35.2%	37.1%	35.3%	33.1%	31.9%	29.2%
Other	0.8%	0.6%	0.6%	0.6%	0.6%	0.8%	1.0%	1.3%	1.0%	1.1%	1.0%	1.0%	1.2%	1.1%
Car	49.8%	53.1%	51.2%	52.6%	53.7%	53.1%	57.1%	40.5%	44.0%	41.9%	43.3%	45.2%	44.9%	48.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Female (n = 374,881)														
	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.4%	13.1%	13.4%	13.9%	14.4%	14.9%	15.2%	15.1%	16.6%	16.5%	17.0%	17.7%	18.5%	18.0%
Bike	1.7%	1.0%	1.1%	1.3%	1.4%	1.5%	1.6%	1.6%	1.0%	1.2%	1.3%	1.4%	1.5%	1.6%
Bus	34.0%	30.0%	31.6%	29.6%	28.1%	27.2%	24.0%	39.4%	34.8%	37.1%	34.9%	33.0%	31.2%	28.2%
Other	0.7%	0.4%	0.5%	0.5%	0.4%	0.5%	0.7%	1.1%	0.9%	0.8%	1.1%	0.8%	0.8%	1.1%
Car	51.8%	55.5%	53.5%	54.7%	55.6%	56.0%	58.5%	42.8%	46.6%	44.4%	45.8%	47.1%	48.0%	51.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix D. Multinomial Average Marginal Effects of School Arrival and Departure by Students' Grade and Time.

Kindergarten through 2nd grade (n = 277,347)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	12.0%	13.4%	13.5%	14.2%	15.1%	16.0%	15.1%	13.4%	14.9%	15.0%	15.8%	16.5%	17.2%	16.7%
Bike	1.5%	0.9%	1.0%	1.2%	1.2%	1.2%	1.2%	1.4%	0.9%	1.0%	1.2%	1.2%	1.2%	1.2%
Bus	30.8%	27.5%	29.7%	27.6%	26.0%	26.4%	25.8%	35.8%	32.3%	34.5%	32.2%	30.5%	30.2%	28.7%
Other	0.6%	0.5%	0.6%	0.6%	0.7%	0.6%	0.7%	1.2%	1.1%	1.2%	1.1%	1.1%	1.0%	1.0%
Car	55.1%	57.7%	55.3%	56.4%	56.9%	55.8%	57.1%	48.2%	50.9%	48.3%	49.7%	50.7%	50.4%	52.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

3rd through 5th grade (n = 286,519)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	13.1%	14.3%	15.0%	15.0%	15.4%	16.6%	16.1%	17.1%	18.7%	18.7%	18.9%	19.1%	20.3%	19.1%
Bike	3.1%	2.2%	2.2%	2.3%	2.6%	2.7%	2.4%	3.2%	2.3%	2.2%	2.4%	2.6%	2.8%	2.4%
Bus	33.5%	29.1%	30.8%	29.0%	27.2%	26.0%	23.9%	39.4%	34.2%	36.3%	34.3%	32.3%	30.5%	28.0%
Other	0.7%	0.5%	0.5%	0.5%	0.4%	0.6%	0.6%	1.1%	1.0%	0.9%	1.0%	0.8%	1.0%	0.9%
Car	49.6%	53.8%	51.6%	53.2%	54.4%	54.1%	57.0%	39.2%	43.8%	41.9%	43.4%	45.2%	45.4%	49.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

6th through 8th grade (n = 155,955)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	9.3%	12.2%	11.9%	12.2%	12.4%	12.5%	12.1%	15.0%	18.5%	18.0%	18.4%	19.4%	19.4%	18.5%
Bike	3.2%	2.6%	3.0%	2.8%	2.9%	3.5%	3.8%	3.2%	2.7%	3.1%	2.9%	3.0%	3.5%	4.0%
Bus	42.2%	34.3%	35.0%	34.0%	31.8%	29.5%	27.5%	47.5%	39.0%	41.3%	40.0%	36.8%	34.2%	32.4%
Other	1.0%	0.4%	0.3%	0.4%	0.4%	0.6%	0.6%	1.1%	0.8%	0.5%	0.8%	0.6%	0.9%	0.8%
Car	44.3%	50.6%	49.8%	50.7%	52.5%	53.9%	56.0%	33.1%	39.1%	37.1%	38.0%	40.1%	41.9%	44.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix E. Multinomial Average Marginal Effects of School Arrival and Departure by School-Level Income and Time.

Low-income Schools (n = 138,329)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	21.1%	26.7%	25.4%	26.1%	26.1%	29.2%	25.0%	24.1%	31.4%	29.8%	31.1%	31.4%	33.1%	29.0%
Bike	0.8%	0.6%	0.7%	0.6%	0.6%	0.4%	1.0%	0.8%	0.6%	0.8%	0.7%	0.7%	0.5%	1.1%
Bus	23.4%	17.0%	22.0%	18.6%	17.6%	15.8%	17.4%	26.4%	19.7%	25.1%	21.3%	20.5%	17.5%	22.3%
Other	0.9%	0.6%	0.8%	0.7%	0.8%	0.6%	0.7%	1.6%	1.3%	1.5%	1.3%	1.2%	1.0%	1.1%
Car	53.8%	55.1%	51.0%	54.1%	54.9%	53.9%	55.8%	47.1%	47.0%	42.9%	45.6%	46.2%	47.9%	46.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Medium-income Schools (n = 312,686)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	10.2%	11.1%	12.1%	12.1%	12.8%	13.4%	13.9%	13.5%	15.0%	15.6%	15.4%	16.2%	16.8%	16.1%
Bike	1.9%	1.2%	1.3%	1.4%	1.5%	1.7%	1.9%	1.9%	1.3%	1.3%	1.4%	1.5%	1.7%	1.9%
Bus	33.9%	32.3%	30.4%	30.2%	25.8%	25.7%	24.9%	40.0%	38.5%	36.8%	36.6%	31.4%	30.4%	29.0%
Other	0.6%	0.5%	0.6%	0.4%	0.5%	0.7%	0.6%	1.0%	0.9%	1.1%	1.0%	0.9%	1.2%	1.0%
Car	53.4%	54.9%	55.6%	55.9%	59.4%	58.6%	58.8%	43.6%	44.3%	45.2%	45.5%	50.0%	49.8%	52.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

High-income Schools (n = 288,918)

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.1%	12.2%	12.5%	13.1%	13.7%	13.6%	13.7%	14.4%	15.4%	15.6%	16.2%	16.6%	16.7%	16.7%
Bike	3.3%	2.3%	2.5%	2.6%	2.8%	3.2%	2.9%	3.3%	2.3%	2.5%	2.6%	2.8%	3.2%	2.9%
Bus	36.6%	30.1%	32.9%	30.4%	30.9%	29.2%	26.8%	42.2%	34.6%	38.2%	35.3%	35.5%	33.9%	30.8%
Other	0.8%	0.5%	0.3%	0.5%	0.3%	0.5%	0.5%	1.2%	0.9%	0.7%	1.0%	0.8%	0.9%	0.9%
Car	48.2%	54.9%	51.8%	53.3%	52.3%	53.4%	56.0%	39.0%	46.7%	43.0%	44.9%	44.3%	45.3%	48.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix F. Multinomial Average Marginal Effects of School Arrival and Departure by Season and Year.

Winter (n = 109,624)														
	Arrival							**Departure**						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.1%	11.8%	11.7%	14.3%	11.1%	11.0%	11.5%	14.3%	14.9%	14.9%	15.2%	15.8%	15.7%	15.1%
Bike	2.3%	2.4%	2.2%	1.9%	2.2%	1.8%	1.7%	2.3%	2.4%	2.2%	1.9%	2.2%	1.8%	1.7%
Bus	33.6%	35.4%	33.3%	29.8%	23.8%	25.1%	27.0%	38.7%	40.2%	39.7%	37.8%	31.9%	31.2%	31.5%
Other	0.5%	0.3%	0.8%	0.9%	0.4%	0.2%	0.4%	0.9%	1.0%	1.1%	0.8%	0.8%	0.9%	1.1%
Car	52.4%	46.1%	49.9%	53.0%	59.5%	58.9%	58.5%	43.8%	41.5%	42.0%	44.3%	49.4%	50.4%	50.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Spring (n = 242,428)														
	Arrival							**Departure**						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.3%	12.5%	13.7%	14.2%	14.5%	15.8%	14.8%	15.2%	15.0%	16.5%	16.7%	17.2%	18.8%	16.6%
Bike	2.5%	1.7%	1.7%	1.7%	2.1%	1.4%	2.3%	2.5%	1.7%	1.7%	1.8%	2.1%	1.5%	2.4%
Bus	32.3%	33.5%	31.2%	29.0%	28.6%	26.8%	25.0%	39.7%	40.1%	38.4%	36.9%	35.2%	33.3%	31.3%
Other	1.0%	1.0%	0.6%	0.8%	0.9%	1.1%	0.9%	1.1%	1.0%	0.9%	0.9%	1.0%	0.8%	0.9%
Car	52.8%	51.3%	52.8%	54.3%	54.0%	54.9%	56.9%	41.5%	42.2%	42.5%	43.7%	44.6%	45.6%	48.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Summer (n = 57,175)														
	Arrival							**Departure**						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	12.2%	12.6%	14.8%	15.6%	18.1%	19.5%	21.8%	15.6%	15.8%	17.4%	20.4%	19.5%	21.9%	24.0%
Bike	2.9%	1.5%	1.8%	3.2%	2.7%	3.1%	2.5%	3.1%	1.6%	1.9%	3.1%	2.8%	3.1%	2.4%
Bus	35.1%	33.2%	29.4%	30.9%	27.7%	20.0%	19.6%	41.4%	39.2%	35.9%	34.6%	31.6%	23.7%	25.0%
Other	0.6%	0.6%	0.6%	0.7%	0.7%	0.6%	0.9%	1.0%	0.7%	0.9%	0.7%	1.1%	0.8%	0.9%
Car	49.2%	52.2%	53.3%	49.6%	50.8%	56.7%	55.2%	39.0%	42.7%	44.0%	41.2%	45.0%	50.5%	47.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Fall (n = 310,634)														
	Arrival							**Departure**						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.5%	14.0%	14.3%	15.2%	15.7%	16.5%	16.2%	15.7%	17.0%	16.1%	17.6%	17.6%	18.2%	17.8%

	Fall (n = 310,634)													
	Arrival								Departure					
Bike	2.5%	2.2%	2.4%	2.6%	2.4%	2.5%	2.1%	2.5%	2.2%	2.4%	2.6%	2.5%	2.5%	2.1%
Bus	32.0%	29.5%	30.9%	27.8%	26.5%	23.7%	23.4%	36.2%	35.9%	37.5%	32.9%	32.1%	27.9%	27.3%
Other	1.0%	0.8%	0.6%	0.8%	0.7%	0.8%	0.8%	0.8%	1.0%	3.9%	1.0%	0.9%	1.0%	1.1%
Car	52.9%	53.5%	51.8%	53.6%	54.7%	56.6%	57.5%	44.9%	43.9%	40.2%	46.0%	46.9%	50.4%	51.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix G. Multinomial Model: School Arrival Results.

	Walk			Bike			Bus			Other		
	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*
Locale												
City	---	---	---	---	---	---	---	---	---	---	---	---
Town	-0.277	0.045	0.000	-0.532	0.074	0.000	0.489	0.065	0.000	-0.329	0.093	0.000
Suburb	-0.478	0.047	0.000	-0.380	0.076	0.000	0.500	0.061	0.000	-0.627	0.115	0.000
Rural	-0.554	0.058	0.000	-0.203	0.105	0.052	0.759	0.067	0.000	-0.532	0.153	0.001
School Income												
Low	---	---	---	---	---	---	---	---	---	---	---	---
Medium	0.007	0.041	0.861	-0.384	0.069	0.000	-0.287	0.053	0.000	-0.140	0.095	0.140
High	0.378	0.047	0.000	-1.205	0.095	0.000	-0.387	0.066	0.000	-0.704	0.123	0.000
Distance												
< 1/4 mi	---	---	---	---	---	---	---	---	---	---	---	---
1/4 to 1/2 mi	-1.075	0.016	0.000	0.460	0.033	0.000	0.864	0.024	0.000	0.053	0.072	0.466
1/2 to 1 mi	-1.855	0.022	0.000	0.347	0.036	0.000	1.411	0.028	0.000	-0.176	0.078	0.024
1 to 2 mi	-3.038	0.037	0.000	-0.053	0.053	0.317	2.054	0.033	0.000	-0.652	0.093	0.000
> 2 mi	-4.400	0.057	0.000	-1.410	0.084	0.000	2.280	0.037	0.000	-0.995	0.112	0.000
Don't know	-1.693	0.034	0.000	-0.526	0.078	0.000	2.175	0.035	0.000	-0.168	0.130	0.196
Female	-0.009	0.010	0.341	-0.686	0.028	0.000	-0.063	0.008	0.000	-0.577	0.061	0.000
Grade												
K	---	---	---	---	---	---	---	---	---	---	---	---
1	-0.119	0.019	0.000	-0.028	0.054	0.607	0.053	0.020	0.008	0.081	0.096	0.397
2	-0.156	0.020	0.000	0.075	0.055	0.172	0.096	0.022	0.000	0.000	0.096	0.999
3	-0.139	0.022	0.000	0.251	0.059	0.000	0.108	0.025	0.000	-0.010	0.103	0.923
4	-0.104	0.024	0.000	0.569	0.064	0.000	0.110	0.029	0.000	0.212	0.108	0.051
5	-0.011	0.025	0.673	0.726	0.064	0.000	0.139	0.032	0.000	0.091	0.105	0.384
6	0.117	0.038	0.002	0.998	0.084	0.000	0.187	0.049	0.000	-0.081	0.128	0.526
7	0.253	0.059	0.000	1.211	0.092	0.000	0.175	0.064	0.006	0.152	0.161	0.347
8	0.354	0.070	0.000	1.145	0.094	0.000	0.102	0.069	0.139	0.390	0.182	0.032

	Walk			Bike			Bus			Other		
	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*
Education												
Grade 8 or less	---	---	---	---	---	---	---	---	---	---	---	---
Grades 9 - 11	-0.074	0.031	0.016	-0.285	0.085	0.001	0.224	0.028	0.000	-0.460	0.180	0.011
Grade 12 or GED	-0.552	0.032	0.000	-0.064	0.057	0.261	0.101	0.028	0.000	-0.264	0.129	0.040
College 1 - 3 years	-0.748	0.034	0.000	0.039	0.056	0.488	-0.176	0.029	0.000	-0.045	0.112	0.688
College 4 + years	-0.541	0.038	0.000	0.317	0.061	0.000	-0.429	0.032	0.000	0.114	0.111	0.305
Prefer not answer	-0.279	0.036	0.000	0.200	0.072	0.005	-0.013	0.029	0.646	0.197	0.151	0.193
Asked Permission	0.504	0.018	0.000	-1.283	0.034	0.000	0.554	0.017	0.000	-0.431	0.057	0.000
Fun	0.281	0.013	0.000	0.852	0.029	0.000	-0.032	0.011	0.003	0.494	0.064	0.000
School Support	0.605	0.017	0.000	0.471	0.038	0.000	-0.470	0.026	0.000	0.282	0.061	0.000
Healthy	0.360	0.018	0.000	0.473	0.050	0.000	-0.143	0.011	0.000	-0.127	0.091	0.166
Season												
Winter	---	---	---	---	---	---	---	---	---	---	---	---
Spring	0.123	0.046	0.007	-0.070	0.089	0.429	0.047	0.051	0.362	-0.027	0.113	0.807
Summer	0.465	0.086	0.000	0.294	0.119	0.013	-0.129	0.094	0.169	0.471	0.155	0.002
Fall	0.296	0.045	0.000	0.215	0.084	0.010	-0.061	0.053	0.253	-0.078	0.109	0.470
Year												
2007-08	---	---	---	---	---	---	---	---	---	---	---	---
2009	0.012	0.078	0.879	-0.282	0.111	0.011	0.068	0.095	0.472	0.053	0.226	0.816
2010	0.075	0.060	0.211	-0.222	0.092	0.016	0.052	0.075	0.490	-0.174	0.172	0.314
2011	0.158	0.058	0.006	-0.132	0.082	0.109	-0.137	0.074	0.066	-0.078	0.167	0.640
2012	0.223	0.057	0.000	-0.098	0.090	0.276	-0.247	0.076	0.001	0.015	0.166	0.930
2013	0.340	0.064	0.000	-0.218	0.093	0.019	-0.422	0.079	0.000	0.071	0.176	0.686
2014	0.272	0.063	0.000	-0.119	0.097	0.221	-0.434	0.087	0.000	0.190	0.177	0.285
Constant	-0.323	0.077	0.000	-4.304	0.138	0.000	-2.619	0.100	0.000	-4.888	0.248	0.000
N = 719,861; Log pseudolikelihood = -183677.59; Wald chi2(185) = 102405.65; Prob > chi2 = 0.000												

Note. Robust SE = Robust standard error; *p* significant at < 0.05. Base outcome = Car.

Appendix H. Multinomial Model: School Departure Results.

	Walk			Bike			Bus			Other		
	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*
Locale												
City	---	---	---	---	---	---	---	---	---	---	---	---
Town	-0.184	0.043	0.000	-0.491	0.074	0.000	0.498	0.065	0.000	-0.199	0.077	0.010
Suburb	-0.306	0.043	0.000	-0.343	0.077	0.000	0.649	0.062	0.000	-0.493	0.100	0.000
Rural	-0.419	0.048	0.000	-0.135	0.106	0.203	0.869	0.068	0.000	-0.575	0.123	0.000
SchIncome												
Low	---	---	---	---	---	---	---	---	---	---	---	---
Medium	0.058	0.037	0.120	-0.375	0.069	0.000	-0.258	0.053	0.000	0.036	0.081	0.652
High	0.441	0.046	0.000	-1.155	0.093	0.000	-0.377	0.065	0.000	-0.167	0.094	0.075
Distance												
< 1/4 mi	---	---	---	---	---	---	---	---	---	---	---	---
1/4 to 1/2 mi	-0.979	0.015	0.000	0.410	0.033	0.000	0.774	0.022	0.000	0.104	0.062	0.095
1/2 to 1 mi	-1.720	0.020	0.000	0.298	0.036	0.000	1.307	0.025	0.000	0.032	0.064	0.617
1 to 2 mi	-2.750	0.030	0.000	-0.071	0.052	0.172	1.938	0.030	0.000	-0.364	0.074	0.000
> 2 mi	-3.789	0.042	0.000	-1.402	0.083	0.000	2.135	0.034	0.000	-0.528	0.086	0.000
Don't know	-1.711	0.033	0.000	-0.601	0.080	0.000	1.968	0.032	0.000	-0.106	0.105	0.313
Female	-0.027	0.010	0.005	-0.692	0.028	0.000	-0.050	0.007	0.000	-0.379	0.047	0.000
Grade												
K	---	---	---	---	---	---	---	---	---	---	---	---
1	-0.060	0.019	0.002	0.027	0.057	0.631	0.076	0.018	0.000	0.065	0.071	0.357
2	-0.070	0.020	0.000	0.147	0.059	0.013	0.123	0.020	0.000	0.058	0.074	0.433
3	-0.011	0.022	0.636	0.363	0.060	0.000	0.152	0.024	0.000	-0.011	0.076	0.884
4	0.103	0.024	0.000	0.668	0.065	0.000	0.159	0.028	0.000	0.117	0.078	0.130
5	0.265	0.025	0.000	0.834	0.065	0.000	0.190	0.031	0.000	-0.079	0.085	0.352
6	0.552	0.037	0.000	1.110	0.086	0.000	0.242	0.048	0.000	-0.290	0.106	0.006
7	0.766	0.053	0.000	1.335	0.095	0.000	0.218	0.067	0.001	-0.362	0.148	0.015
8	0.944	0.060	0.000	1.273	0.094	0.000	0.129	0.071	0.069	-0.176	0.160	0.272

	Walk			Bike			Bus			Other		
	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*
Education Level												
Grade 8 or less	---	---	---	---	---	---	---	---	---	---	---	---
Grades 9 - 11	-0.044	0.027	0.108	-0.240	0.086	0.005	0.166	0.026	0.000	-0.419	0.146	0.004
Grade 12 or GED	-0.491	0.029	0.000	-0.031	0.057	0.583	0.131	0.027	0.000	-0.053	0.102	0.606
College 1 - 3 years	-0.632	0.031	0.000	0.064	0.056	0.255	-0.073	0.028	0.008	0.185	0.096	0.052
College 4 + years	-0.551	0.035	0.000	0.289	0.060	0.000	-0.292	0.032	0.000	0.257	0.096	0.007
Prefer not answer	-0.235	0.033	0.000	0.224	0.072	0.002	-0.026	0.028	0.356	0.208	0.126	0.100
Asked Permission	-0.721	0.018	0.000	-1.312	0.034	0.000	0.569	0.017	0.000	-0.234	0.044	0.000
Fun	0.173	0.013	0.000	0.805	0.029	0.000	-0.034	0.010	0.001	0.133	0.047	0.005
School Support	0.491	0.016	0.000	0.470	0.039	0.000	-0.492	0.026	0.000	0.084	0.049	0.086
Healthy	0.414	0.017	0.000	0.524	0.049	0.000	-0.137	0.012	0.000	-0.105	0.064	0.098
Season												
Winter	---	---	---	---	---	---	---	---	---	---	---	---
Spring	0.118	0.044	0.008	-0.042	0.089	0.636	0.003	0.051	0.952	-0.286	0.093	0.002
Summer	0.312	0.081	0.000	0.298	0.12	0.013	-0.201	0.097	0.039	0.183	0.131	0.164
Fall	0.145	0.044	0.001	0.222	0.084	0.008	-0.112	0.053	0.033	-0.251	0.092	0.006
Year												
2007-08	---	---	---	---	---	---	---	---	---	---	---	---
2009	0.017	0.075	0.819	-0.257	0.111	0.021	0.053	0.091	0.559	0.243	0.190	0.200
2010	0.065	0.057	0.252	-0.206	0.092	0.025	0.048	0.074	0.513	0.078	0.141	0.581
2011	0.142	0.055	0.011	-0.107	0.081	0.190	-0.168	0.073	0.021	0.194	0.143	0.173
2012	0.191	0.054	0.000	-0.084	0.089	0.350	-0.288	0.075	0.000	0.059	0.139	0.670
2013	0.255	0.062	0.000	-0.203	0.092	0.028	-0.465	0.079	0.000	0.131	0.148	0.376
2014	0.199	0.060	0.001	-0.110	0.096	0.253	-0.484	0.086	0.000	0.279	0.147	0.058
Constant	-0.132	0.072	0.067	-4.426	0.136	0.000	-2.350	0.097	0.000	-4.566	0.212	0.000
N = 719,861; Log pseudolikelihood = -183677.59; Wald chi2(185) = 102405.65; Prob > chi2 = 0.000												

Note. Robust SE = Robust standard error; *p* significant at < 0.05. Base outcome = Car.

Appendix I. Binary Logit Models Predicting Parental Perceptions of Walking and Bicycling to/from School.

	Fun			Healthy			Support		
	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*
Locale									
City	-----	-----	-----	-----	-----	-----	-----	-----	-----
Suburb	-0.052	0.017	0.002	-0.048	0.019	0.012	-0.385	0.055	0.000
Town	-0.128	0.021	0.000	-0.071	0.020	0.000	-0.593	0.064	0.000
Rural	-0.081	0.021	0.000	-0.092	0.020	0.000	-0.558	0.087	0.000
School Income									
High	-----	-----	-----	-----	-----	-----	-----	-----	-----
Medium	-0.060	0.016	0.000	-0.170	0.016	0.000	-0.188	0.052	0.000
Low	-0.105	0.019	0.000	-0.306	0.023	0.000	-0.333	0.056	0.000
Distance from School									
< 1/4 mi	-----	-----	-----	-----	-----	-----	-----	-----	-----
1/4 to 1/2 mi	-0.060	0.013	0.000	0.169	0.018	0.000	0.037	0.015	0.012
1/2 to 1 mi	-0.149	0.013	0.000	0.113	0.017	0.000	0.075	0.017	0.000
1 to 2 mi	-0.268	0.014	0.000	0.008	0.017	0.661	0.112	0.022	0.000
> 2 mi	-0.314	0.015	0.000	-0.249	0.017	0.000	0.167	0.027	0.000
Don't know	-0.194	0.020	0.000	-0.204	0.021	0.000	0.171	0.022	0.000
Female	-0.059	0.007	0.000	0.007	0.008	0.387	0.037	0.007	0.000
Grade									
K	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	-0.040	0.013	0.002	-0.003	0.015	0.830	-0.002	0.015	0.905
2	-0.057	0.013	0.000	-0.045	0.015	0.003	-0.038	0.017	0.029
3	-0.116	0.013	0.000	-0.062	0.015	0.000	-0.084	0.019	0.000
4	-0.226	0.014	0.000	-0.052	0.016	0.001	-0.091	0.022	0.000
5	-0.359	0.015	0.000	-0.030	0.017	0.082	-0.091	0.024	0.000
6	-0.604	0.020	0.000	0.001	0.022	0.977	-0.304	0.045	0.000
7	-0.828	0.025	0.000	0.017	0.024	0.483	-0.412	0.056	0.000
8	-1.040	0.027	0.000	0.011	0.023	0.631	-0.416	0.064	0.000
Education Level									
Grade 8 or less									
Grades 9 - 11	-0.155	0.022	0.000	0.049	0.025	0.052	-0.151	0.022	0.000

	Fun			Healthy			Support		
	Coef	Robust SE	*p*	Coef	Robust SE	*p*	Coef	Robust SE	*p*
Grade 12 or GED	-0.348	0.019	0.000	0.032	0.020	0.110	-0.422	0.021	0.000
College 1 - 3 years	-0.351	0.018	0.000	0.157	0.020	0.000	-0.536	0.023	0.000
College 4 + years	-0.106	0.019	0.000	0.332	0.021	0.000	-0.373	0.025	0.000
Prefer not answer	-0.378	0.025	0.000	-0.240	0.026	0.000	-0.265	0.026	0.000
Asked Permission	-1.160	0.011	0.000	-0.427	0.012	0.000	-0.380	0.014	0.000
Walk	-0.305	0.064	0.000	0.320	0.096	0.001	0.175	0.062	0.005
Bus	-0.582	0.065	0.000	-0.076	0.095	0.423	-0.778	0.066	0.000
Bike	0.274	0.072	0.000	0.490	0.107	0.000	0.128	0.065	0.049
Car	-0.590	0.064	0.000	0.046	0.095	0.626	-0.389	0.063	0.000
School Support	0.892	0.011	0.000	0.752	0.013	0.000	0.789	0.013	0.000
Healthy	2.470	0.016	0.000	2.457	0.016	0.000	0.889	0.011	0.000
Season									
Winter	-----	-----	-----	-----	-----	-----	-----	-----	-----
Spring	0.094	0.017	0.000	0.080	0.018	0.000	0.290	0.047	0.000
Summer	0.081	0.028	0.004	0.118	0.026	0.000	0.487	0.076	0.000
Fall	0.077	0.017	0.000	0.058	0.019	0.002	0.287	0.050	0.000
Year									
2007-08	-----	-----	-----	-----	-----	-----	-----	-----	-----
2009	0.031	0.037	0.397	-0.124	0.050	0.013	0.080	0.106	0.450
2010	-0.048	0.028	0.091	-0.076	0.035	0.031	0.263	0.073	0.000
2011	-0.038	0.028	0.178	-0.037	0.034	0.275	0.421	0.072	0.000
2012	-0.064	0.028	0.022	-0.047	0.033	0.152	0.444	0.074	0.000
2013	-0.063	0.030	0.035	-0.015	0.034	0.648	0.529	0.077	0.000
2014	-0.041	0.030	0.165	0.039	0.038	0.297	0.782	0.079	0.000
Constant	-0.624	0.075	0.000	0.945	0.104	0.000	-1.069	0.120	0.000

Note. Robust SE = Robust standard error; *p* significant at < 0.05.

Appendix J. Two Models' Travel Mode Average Marginal Effects Estimates Over Time.

Multinomial logit model with clustered school-level responses

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	11.9%	13.3%	13.6%	13.9%	14.5%	15.2%	15.0%	15.2%	16.9%	16.8%	17.3%	17.8%	18.4%	18.0 %
Bike	2.5%	1.7%	1.8%	1.9%	2.1%	2.2%	2.2%	2.5%	1.8%	1.9%	2.0%	2.1%	2.2%	2.2%
Bus	34.0%	30.1%	31.7%	29.9%	28.2%	27.4%	26.6%	39.5%	35.0%	37.1%	35.1%	33.1%	31.8%	29.5%
Other	0.7%	0.5%	0.5%	0.5%	0.5%	0.6%	.06%	1.2%	1.0%	0.9%	1.0%	0.9%	1.0%	0.9%
Car	50.8%	55.0%	53.0%	54.4%	55.4%	55.4%	56.4%	41.7%	45.4%	43.2%	44.6%	46.2%	46.6%	48.9%

Binary logit models using GEE framework and autoregressive correlation structure

	Arrival							Departure						
	2007-08	2009	2010	2011	2012	2013	2014	2007-08	2009	2010	2011	2012	2013	2014
Walk	12.1%	13.7%	13.8%	14.1%	14.9%	15.4%	15.0%	15.3%	17.1%	17.2%	17.6%	18.1%	18.6%	17.9%
Bike	2.4%	1.8%	1.9%	2.0%	2.2%	2.2%	2.2%	2.5%	2.0%	2.1%	2.1%	2.1%	2.2%	2.2%
Bus	33.7%	29.5%	31.3%	29.5%	27.6%	26.9%	26.6%	38.9%	34.7%	36.7%	34.5%	32.9%	31.6%	29.6%
Other	0.7%	0.7%	0.5%	0.6%	0.7%	0.5%	.06%	1.1%	1.0%	0.9%	1.0%	0.9%	0.9%	1.0%
Car	51.1%	54.3%	52.5%	53.8%	54.6%	55.0%	56.4%	42.2%	45.2%	43.1%	44.8%	46.0%	46.7%	49.2%

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