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MINETA TRANSPORTATION INSTITUTE

Measuring Success for Safe Routes to School Programs

Carole Turley Voulgaris, PhD
Serena Alexander, PhD
Reyhane Hosseinzade, MUP
James Jimenez
Katherine Lee
Anurag Pande, PhD

MINETA TRANSPORTATION INSTITUTE
LEAD UNIVERSITY OF
Mineta Consortium for Transportation Mobility

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REPORT 20-39

MEASURING SUCCESS FOR SAFE ROUTES TO SCHOOL PROGRAMS

Carole Turley Voulgaris, PhD
Serena Alexander, PhD
Reyahne Hosseinzade, MUP
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Katherine Lee
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16. Abstract

Safe Routes to School (SRTS) programs aim to increase the share of students who commute to school by active modes (e.g., walking and cycling). The goal of this work was to assess the effectiveness of SRTS programs. Towards that end, we analyzed the California Household Travel Survey (CHTS) data from the four counties in the San Francisco Bay area. We estimated logistic regression model(s) to predict the likelihood that a child commutes to school by active modes based on the presence of an SRTS program and controlling for individual, household, and tract characteristics. Findings indicate that longer trip distance and race (relative to White students) are associated with reduced rates of active travel to school. The presence of SRTS programs mitigates these differences. We conclude that the effect of SRTS programs might best be described as reducing barriers to active school travel, rather than simply increasing the likelihood of using active modes. We also interviewed parents and school administrators about the SRTS programs. The interviewees noted the importance of social connections among students and their families as an advantage of SRTS programs in addition to the health, economic, and environmental benefits. The barriers to more active travel to school cited by the interviewees included the challenge of implementing SRTS programs consistently over a sustained period and the lack of physical infrastructure that feels safe to the students and their parents.

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Mineta Transportation Institute
College of Business
San José State University
San José, CA 95192-0219

Tel: (408) 924-7560
Fax: (408) 924-7565
Email: mineta-institute@sjsu.edu

transweb.sjsu.edu

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EXECUTIVE SUMMARY

Increasing the share of students who commute to school has the potential to improve children's health by increasing physical activity. Safe Routes to School (SRTS) programs aim to accomplish this goal through engineering, education, enforcement, encouragement, equity, and evaluation. The latter three are the approaches SRTS programs have begun emphasizing more recently. The purpose of this study is to determine the relationship between Safe Routes to School programs and the likelihood that children will travel to school by active modes. The researchers identified children from households who were included in the 2012 California Household Travel Survey and classified them based on whether they commuted to school by active modes. The researchers identified census tracts with SRTS programs based on the presence of data in the National Center for Safe Routes to School Data Collection System. The researchers estimated a logistic regression model to predict the likelihood that a child commutes to school by active modes, based on the presence of a Safe Routes to School program and controlling for individual, household, and tract characteristics. The researchers find that longer trip distance and race (relative to white students) are associated with reduced rates of active travel to school, but that these differences are mitigated by the presence of Safe Routes to School programs. The researchers also conducted focused group interviews with five individuals who are school administrators or PTA volunteers. The researchers learned that SRTS programs may have the greatest impact on physical activity when they target students with commute lengths approaching the threshold defining a reasonable walking distance to school and who belong to populations with particularly low rates of active travel to school. The qualitative analysis based on interviewing parents and school administrators indicated several advantages of students taking active modes to school perceived by this group. The advantages cited by the interviewees include physical activity leading to better focus in the classroom, economic and environmental benefits, as well as social connections students and their families make when walking together to schools with other students and families. The challenges include implementing these programs such as the Safe Routes to School consistently over a sustained period of time at school locations and the lack of physical infrastructure that feels safe to the students and their parents. With safer infrastructure, the parents and caregivers would feel comfortable letting at least the older children use active modes. One of the structural factors that may be hard to address in the elementary school context due to the younger age of the children is the time available for working parents or caregivers in the morning to drop off the children using active modes.

I. INTRODUCTION

MOTIVATION

Between 1969 and 2001, the nationwide share of children commuting to school by active modes decreased from 41 percent to 13 percent (McDonald, 2007), and by 2009, the year of the most recent National Household Travel Survey, the share of children commuting to school or church by private automobile was over 70 percent (Santos et al., 2011). These national averages mask wide geographic variation in modal split for the journey to school. For example, the research needs statement circulated by the Mineta Transportation Institute indicated that the walking and bicycling rates of school children in Palo Alto are 45–50 percent, while in San José just 15 miles south, these rates are only 2 percent.

Safe Routes to School (SRTS) programs represent an attempt to slow or reverse the trend towards increasing reliance on automobiles among school children by facilitating and encouraging travel by active modes. The nationwide SRTS initiative promotes students walking or biking to school by addressing barriers through the “six Es” (evaluation, engineering, education, encouragement, enforcement, and equity) (Safe Routes to School National Partnership, 2015). Safe Routes to School programs can include a combination of policy and outreach interventions as well as changes to the built environment. Such programs have the potential to impact travel behavior beyond the school years. Smart and Klein (2018) have shown that early exposure to non-motorized transportation modes increases the likelihood of using those modes later in life. Moreover, active travel modes for the commute to school are associated with increases in overall physical activity (Cooper et al., 2005; Faulkner et al., 2009), which is associated in turn with better cardiovascular health (Janz et al., 2002), reduced risk for obesity (McCambridge et al., 2006), and even improved academic performance (Dwyer et al., 2001).

However, for Safe Routes to School programs to achieve these myriad benefits, a better understanding of factors contributing to the success (or failure) of these programs in a regional context is required. In the absence of available research on the types of programs and institutional structures that are effective at creating lasting behavior change, the stated goal of causing children (and their parents) to replace car trips with active travel for the commute to school may not be consistently realized.

PROJECT GOALS AND RESEARCH APPROACH

This research on Safe Routes to School programs examines quantitative and qualitative data to learn about the factors affecting the effectiveness of the programs. The research methods adopted based on extensive literature review and discussions with the stakeholders Santa Clara Valley Transportation Authority (VTA) and Silicon Valley Bicycle Coalition (SVBC) include two approaches: (i) quantitative analysis of endogenous and exogenous factors affecting the success of the SRTS programs and (ii) qualitative analysis involving in-depth interviews with individuals involved in planning and implementing the SRTS programs.

REPORT ORGANIZATION

The following chapters provide a detailed background of the existing research on Safe Routes to School program and active transportation to school (Chapter 2), a quantitative analysis based on California Household Travel Survey Data (Chapter 3), a qualitative analysis based on insights gained from detailed interviews (Chapter 4), and conclusions and recommendations (Chapter 5).

II. ACTIVE TRAVEL TO SCHOOLS AND SRTS PROGRAMS

According to (Stewart, 2011), the SRTS programs in their current form originated in Denmark during the 1970s, with the first US programs appearing in 1997 in Florida and New York. The federal legislation Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) (in 2005) established the SRTS program within Federal Highway Administration (FHWA). The act also established the National Center for Safe Routes to School (NCSRTS) to act as a clearinghouse for SRTS resources (Stewart, 2011).

The background information provided in this chapter is organized as follows: First, the literature on active travel to school is described to learn about its benefits, its prevalence in the US context, and the factors influencing the mode choice to school. Next, literature specific to the SRTS programs in the US is described with a focus on effectiveness.

ACTIVE TRAVEL TO SCHOOL

Benefits of Travel to School by Active Modes

Through a detailed review of the literature, Faulkner et al. (2009) demonstrated that active school commuters tend to be more physically active overall than passive commuters, but they did not find significant evidence of active commuters having a healthier weight range as defined by categorization of Body Mass Index (BMI) (Body Mass Index - an Overview | ScienceDirect Topics, n.d.). The increase in overall physical activity in children is associated with several health benefits including better cardiovascular health (Janz et al., 2002) and reduced risk for obesity (McCambridge et al., 2006). Physical activity through active commuting to school has even been noted to be correlated with improved academic performance ((Dwyer et al., 2001) (Committee on School Transportation Safety, 2002) (Cooper et al., 2005). There is also evidence in the literature documenting that sustainable commuting habits acquired at childhood tend to have an impact on commuting choices made by the same person in adulthood (Smart & Klein, 2018). Thus, promoting active commuting to school may have the long-term benefit of reducing automobile dependence.

Prevalence of Active Travel to School

McDonald (2008) analyzed the National Personal Transportation Survey conducted by the US Department of Transportation (for years 1969, 1977, 1983, 1990, 1995, and 2001) to estimate the proportion of students actively commuting to school. The percentage of active trips to school went from 40.7% (95% confidence interval [CI]=37.9–43.5) in 1969 to 12.9% (95% CI=11.8–13.9) by 2001. The study found this decline of active transportation among school children to be worrisome and recommended continued support of programs such as Safe Routes to School and the Centers for Disease Control and Prevention's KidsWalk. More recently, Omura et al. (Omura et al., 2019) estimated the proportion of children walking or biking to school and contrasted their findings with a similar study that used data from 2004 (Martin & Carlson, 2005). The overall estimate from both the studies was close to 17%.

Explanations for Children's Mode Choice for the Journey to School

The federal legislation Intermodal Surface Transportation Efficiency Act (ISTEA), passed in 1991, is widely recognized to be the federal legislation that inspired the significant shift towards policies promoting multimodal and active transportation (Anderson et al., 1995). These attempts in turn led to significant research in the mode choice behavior, interventions aiming at the modal shift, and evaluations of those interventions. Traditionally, the research into mode choice had focused on time, monetary costs, and socioeconomic factors. Since the mid-1990s, mode choice research has been informed by the field of psychology, and researchers have been able to learn about how perceptions of the local context and attitudes towards specific modes affect the decision-making process used to select a travel mode, including intentions and habits (Schneider, 2013).

The psychological need to have a basic level of safety from traffic collisions and crime ((Handy, 1996)(Saelens et al., 2003), habitual driving (Loukopoulos & Gärling, 2005), and lack of awareness of other travel modes (Rose & Marfurt, 2007) all contribute to a giant mode choice for the personal automobile. Similar psychological factors on the part of parents affect the mode choice of school commuters. Based on these factors, Schneider (2013) discussed the operational theory of routine model choice. According to the theory, effective modal shift interventions need to address the following steps:

- Awareness and availability,
- Basic safety and security,
- Convenience and cost,
- Enjoyment, and
- Habit.

Bradshaw (1995), McDonald & Aalborg (2009), and more recently (Omura et al., 2019) explored the factors affecting parents' choice between active modes and driving children to school. The prevalence of active modes in the United States differed significantly by parental race/ethnicity, marital status, region, and distance from school. (McDonald, 2007) also noted that distance to school has increased over time and may account for half of the decline in active transportation to school. According to Omura et al. (2019), too, the most common barrier to active mode was living too far away (51.3%), followed by traffic-related danger (46.2%), weather (16.6%), crime (11.3%), and school policy (4.7%). This mix of factors points to the potential effectiveness of Schneider's operational theory of routine mode choice (Schneider, 2013).

The success of SRTS programs in achieving wider and long-lasting mode shifts towards active modes requires a comprehensive understanding of the barriers to choosing walking and bicycling for different people in different communities; these barriers must then be addressed. The focus of the SRTS programs on the six Es (evaluation, engineering, education, encouragement, enforcement, and equity) is consistent with this need for a comprehensive set of strategies to influence travel behavior towards the use of active modes.

BACKGROUND ON SAFE ROUTES TO SCHOOLS PROGRAM BACKGROUND ON SAFE ROUTES TO SCHOOLS PROGRAMS

As mentioned previously, federal funding for SRTS programs was first instituted under the federal legislation, Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Under subsequent federal legislation of 2012 and 2015 (Moving Ahead for Progress (MAP-21) and Fixing America's Surface Transportation Act (FAST) Act, respectively), the federal SRTS program was combined with other bicycling and walking programs into a new program called the Transportation Alternatives Program (TAP). State Departments of Transportation and Metropolitan Planning Organizations (MPOs) receive funding that may be directed towards SRTS projects (FAST Act Background and Resources | Safe Routes Partnership, n.d.).

McDonald et al. (2013) analyzed all SRTS projects awarded between 2005 and 2012 under SAFETEA-LU (5,532 projects, excluding projects from the states of NV and NM due to lack of complete data). The study compared demographic and neighborhood characteristics of schools with and without funded SRTS program projects. McDonald et al. (2013) found that schools benefiting from SRTS program funding were more urban and had higher Latinx populations but were otherwise comparable to US public schools. McDonald et al. (2013) also reported that a statewide analysis of California SRTS projects found that low-income schools were over-represented among supported schools.

EFFECTIVENESS OF SAFE ROUTES TO SCHOOL PROGRAMS

In the literature review on the use of active modes to school, two studies are cited here: one that examined the prevailing trends in mode choice using data from 1969 through 2001 (McDonald, 2007) and the other using data from 2017 (Omura et al., 2019). The percentage of active school commuters from these two studies was 12.4% in 2001 (down from more than 40% in 1969) compared to 16.5% in 2017. Comparing the two proportions indicates that the federal SRTS program established in 2005 may have had an impact on arresting the downward trend. However, since the two studies used different methodologies, and the choice of active modes and the nature of SRTS-funded programs vary significantly based on the community context, it is necessary to review studies that have examined specific programs in detail.

The literature offers mixed results for the effectiveness of individual programs. For example, one study of SRTS programs found that improved pedestrian infrastructure effectively increased the likelihood of children starting to walk or bike to school (Boarnet et al., 2005). Also, a 2007 study of SRTS programs in California found that, overall, such programs were successful in improving pedestrian safety and increasing the share of active travel mode choices (Caltrans, 2007). However, McDonald and Aalborg (2009) have found that most parents cite convenience and time constraints as primary reasons for choosing to drive their children to school, and they suggest that few SRTS programs (especially those focused primarily on built environment improvements) adequately address those needs. McDonald (2008a) also argued that projects funded through the SRTS programs alone are insufficient unless coupled with changes in the spatial distribution of schools and residences. A 2015 evaluation of the Regional Safe Routes to School Program in the Bay Area completed by the Metropolitan Transportation Commission (MTC) suggests that these programs are generally effective in increasing the share of active travel mode choices , but that gathering consistent, reliable data from a large number of programs remains a challenge in the empirical analysis of program success (Metropolitan Transportation Commission, 2015).

(Boarnet et al., 2005) conducted a cross-sectional evaluation to examine the relationship between changes to the urban form through SRTS projects and walking and bicycle travel to school. The study created case and control groups from third- through fifth-grade children at ten schools having a completed SRTS project in their vicinity. Placement of the case and control sample depended on whether the parents stated via a survey that their children would pass the SRTS project on the way to school. Based on the analysis, children who passed a recently completed SRTS project were more likely to show increases in walking or bicycle travel than the children who would not pass by said projects (15% vs. 4%). The study focused specifically on infrastructure projects and not on the educational or awareness-focused projects.

CONCLUSIONS FROM THE LITERATURE REVIEW

While the studies described above are encouraging in their findings concerning the overall effectiveness of Safe Routes to School programs, there is a need for research that can help to identify where SRTS programs are likely to be the most effective in achieving program goals. To achieve this goal, the researchers relied on large-scale regional travel survey data (McDonald, 2007) and analyzed it with schools without SRTS funding as controls. Also, the researchers collected qualitative data from detailed interviews to identify whether the perceptions of program coordinators and school staff at SRTS program schools are consistent with the findings from the literature review and quantitative analysis.

III. QUANTITATIVE ANALYSIS: ACTIVE TRAVEL AND SAFE ROUTES TO SCHOOL PROGRAMS

This chapter presents an analysis of the effects of Safe Routes to School programs within a neighborhood on the likelihood that children attending school in that neighborhood will travel to school by an active mode, based on data from the 2012 California Household Travel Survey. The researchers find that two factors in particular influence whether children are likely to travel to school by an active mode: the distance of the commute to school and student race/ethnicity. Based on the analysis, for students with commutes shorter than about three-quarters of a mile, SRTS programs mitigate the effects of both race/ethnicity and distance on the likelihood that a child will travel to school by an active mode.

DEFINITION OF STUDY AREA, STUDY SAMPLE AND VARIABLES OF INTEREST

The study area for this research comprises four counties in the San Francisco Bay Area: Alameda, Contra Costa, San Mateo, and Santa Clara County. Census tracts within these four counties were categorized into one of two categories: those containing schools for which the National Center for Safe Routes to School (NCSRTS) Data Collection System included student travel data from 2012 (hereafter referred to as SRTS tracts) and those which did not contain schools with available student travel data (hereafter referred to as non-SRTS tracts). For the most part, the former category includes any schools that received funding from federal SRTS funds under SAFETEA-LU, since those schools were required to submit student travel data to the NCSRTS Data Collection System. Participation in the NCSRTS Data Collection System was optional for schools that did not rely on federal SRTS funding (and it is currently optional for all schools, since the federal SRTS program was discontinued with the passage of MAP-21).

Since some schools with private, state, or locally funded SRTS programs may have opted not to submit data to the NCSRTS Data Collection System, some tracts with SRTS programs are likely to have been categorized as non-SRTS tracts. This problem is especially acute in the City of Palo Alto, which has had very active SRTS programs since 2005 (City of Palo Alto, 2019) but has not relied on federal funds for its programs, nor has it participated in the NCSRTS Data Collection System. The City of Palo Alto has a very active SRTS program that predates the development of the National Safe Routes to School National Consensus Agreement. Local funding for the program—through General Funds, and partially sourced from the Gas Tax—has been instrumental to its success. Although the City periodically receives federal funds for particular projects and has used the required National Center for Safe Routes to School Parent Survey in the past, Palo Alto discovered that the national survey questions tended to focus on communities where little to no walking/biking was occurring. A local survey instrument was developed to better reflect the needs of a community where walking and biking are more dominant forms of transportation. To address the problem of misclassifying Palo Alto census tracts since National Center for Safe Routes to School survey data are not available, the 20 census tracts within the City of Palo Alto were excluded from the study area. Although other census tracts with SRTS programs may also have been classified as non-SRTS tracts, the full set of SRTS tracts can be considered to be more likely to contain schools with SRTS programs than the set of non-SRTS tracts. Figure 1 shows the boundaries of the study area and the locations of SRTS tracts.

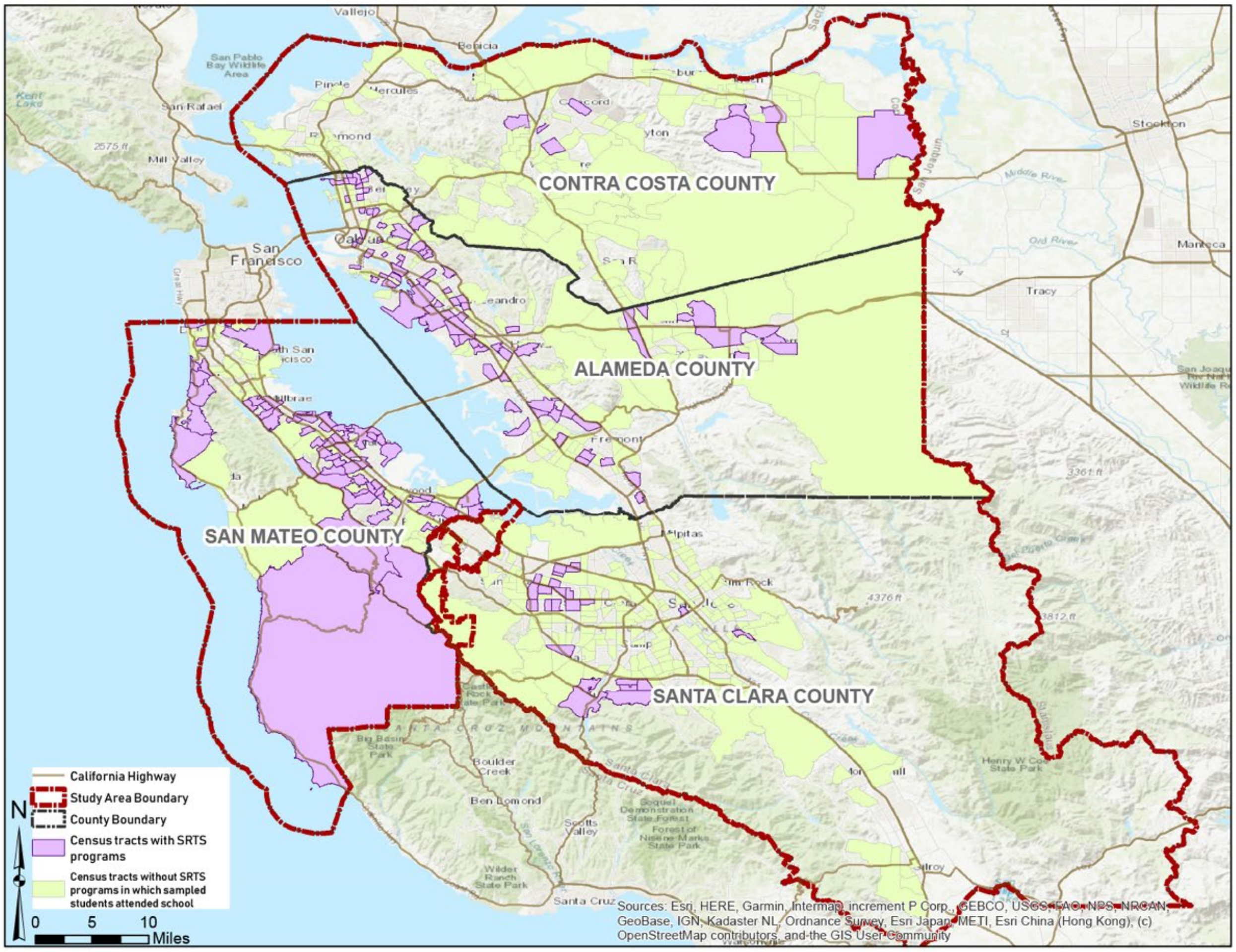

Figure 1. Map of Study Area Showing Census Tracts Categorized as With and Without Safe Routes to School Programs

Although the presence of student travel data in the NCSRTS Data Collection System was used to identify tracts in which at least one school had an SRTS program, the student travel data itself could not be used in this study comparing travel to SRTS tracts to travel to non-SRTS tracts, since it only includes data on travel in and to SRTS tracts. To obtain comparable data on student travel for both SRTS tracts and non-SRTS tracts, the researchers drew on the most recent California Household Travel Survey (CHTS), which was administered in 2012. To the researchers' knowledge, the CHTS is the only large-sample travel survey with an adequate sample size during the study period that includes the travel behavior of children throughout the region, irrespective of which school they attend.

Conducted by the California Department of Transportation (Caltrans) through a contract with NuStats Research Solutions, the CHTS collects travel data on an approximate ten-year cycle from households throughout California. Members of participating households complete travel diaries with detailed information about all trips and activities during a pre-assigned 24-hour period, where dates are assigned to ensure that data are collected every day for a full year.

Upon completing the travel diary, survey participants report their travel through a computer-assisted telephone interview or by returning the travel diaries by mail.

The public CHTS data were downloaded from the Transportation Secure Data Center of the National Renewable Energy Laboratory (National Renewable Energy Laboratory, 2017). Caltrans created the CHTS sample using an address-based sampling frame approach to distribute the invitation to participate in the survey to a random sample of households across all 58 counties in California (NuStats Research Solutions, 2013). To account for differences in response rates across population groups, NuStats developed a set of analytic weights to enable the production of unbiased estimates of population parameters. The Transportation Secure Data Center provides these weights together with the public CHTS data, and the researchers applied those weights to the raw survey data to generate all averages and associated confidence intervals reported in this report, using the “survey” package in the R statistical programming software (Lumley, 2004, 2019).

109,113 individuals from 42,454 households participated in the 2012 CHTS. Analysis was limited to households living in the study area, with children in kindergarten through eighth grade (K–8) who attend school in the study area. As shown in Table 1, this resulted in a total sample of 1,674 children, 28 percent of whom attend school in an SRTS tract. Based on weighted survey responses, the 95-percent confidence interval for the share of K–8 students in the study area attending school in an SRTS tract in 2012 was 24 to 30 percent.

Table 1. Study Area and Sample Populations

	Tracts with identified SRTS programs	Tracts without identified SRTS programs	Total study area
Total number of census tracts	175	790	965
Total population of children (ages 5–14)[a]	110,017	533,353	643,370
Number of census tracts in which CHTS surveyed children attended school	128	401	529
Total sample of CHTS surveyed children (grades K–8)[b]	471	1203	1,674

[a]Children categorized into SRTS/non-SRTS tracts based on where they live.
[b]Children categorized into SRTS/non-SRTS tracts based on where they attend school.

Individual and Household Characteristics Included in the Analysis

The public CHTS data include the census tract in which survey respondents attend school (but not the census tract in which they live), as well as several other individual and household characteristics to describe typical travel habits—or factors that, based on the literature presented in Chapter 2, the research team hypothesized could influence children’s mode of travel to school. These are described below.

Typical Mode of Travel to School

Survey respondents who identified as students (as the children included in the sample did) indicated the mode they typically use to travel to school. The researchers used their responses to generate a binary variable indicating whether students typically travel to school by an active mode (either walking or cycling) or by a motorized mode (all other modes). Based on weighted survey responses, the 95-percent confidence interval for the share of K–8 students in the study area who usually traveled to school by an active mode in 2012 was 27 to 33 percent.

Household Income

Prior research has found that students from higher-income households are less likely to walk to school than students from lower-income households (McDonald, 2008a, 2008b) and that students living in higher-income neighborhoods are less likely to walk to school than those living in lower-income neighborhoods (Larsen et al., 2009).

Households participating in the CHTS indicated whether their annual household income was in one of ten income categories: less than $10,000; $10,000 to $24,999; $25,000 to $34,999; $35,000 to $49,999; $50,000 to $74,999; $75,000 to $99,999; $100,000 to $149,999; $150,000 to $199,999; $200,000 to $249,999; and $250,000 or more. In the study area, the estimated shares of K–8 students in each of these income categories, based on weighted survey responses, are shown in Figure 2. The researchers converted these categories to a continuous income variable by assigning each household an income at the midpoint of their income range. Incomes greater than or equal to $250,000 per year were interpreted as $275,000 per year. Based on these assumptions, the researchers calculated the 95-percent confidence interval for the average household income of K–8 students in the study area to be $113,886 to $127,733 per year.

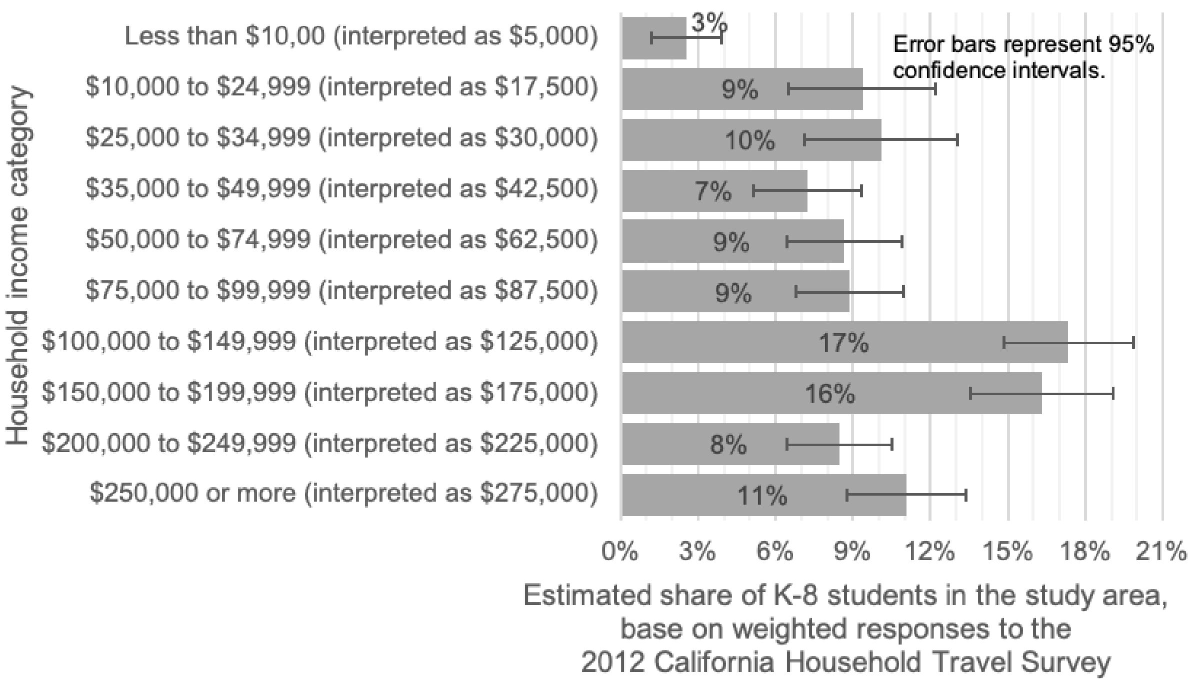

Figure 2. Estimated Shares of Study Area K–8 Students By Income Category

Race/Ethnicity

Prior studies have found differences in the likelihood of walking to school according to racial/ethnic categories. Chillón et al. (2014) have found that schools with higher percentages of Hispanic students had higher shares of students traveling to school by active modes and schools with higher percentages of African–American students had lower shares of commuting by active modes. McDonald (2008a) finds that there are large differences in the likelihood of active travel to school across racial/ethnic categories, but that much of the difference can be attributed to differences in income, density, and neighborhood composition. With controls for income and neighborhood characteristics, McDonald (2008a) found that Asian students are less likely than other students to travel to school by active modes, as are students from multi-racial households.

Each CHTS survey respondent identified as belonging in one of five primary racial/ethnic categories: White; Black or African–American; American Indian or Alaska Native; Native Hawaiian or Pacific Islander; or other. Ambiguities in the definitions of these categories are left to be interpreted by survey respondents, since race is self-reported, and multi-racial respondents may choose to identify with a single primary racial category, or to identify as "other." In a separate question, respondents indicated whether they identified as Hispanic/Latino. The researchers combined the responses from these two questions to categorize survey respondents into one of five racial/ethnic categories: non-Hispanic white, non-Hispanic Black, Asian or Pacific Islander, Hispanic, and other. Figure 3 shows the estimated shares of study area K–8 students in each of these race/ethnicity categories, based on weighted survey responses.

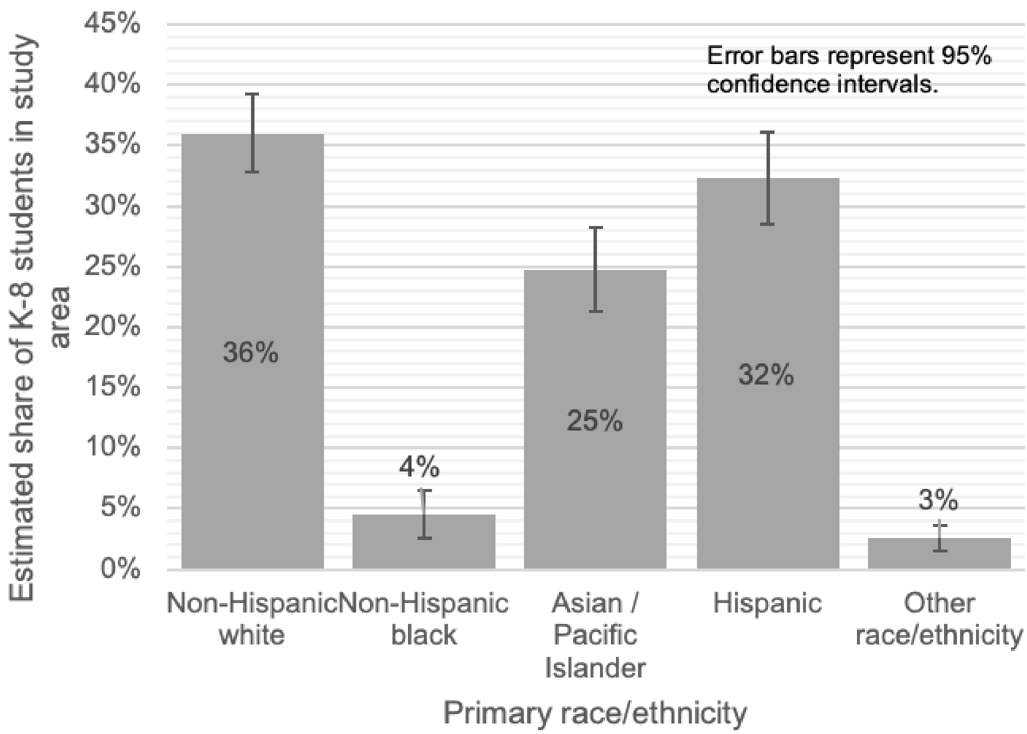

Figure 3. Estimated Shares of Study Area K–8 Students By Race/Ethnicity

Sex

Prior studies have consistently found that girls are less likely than boys to travel to school by active modes (Babey et al., 2009; Evenson et al., 2003; McDonald, 2007, 2012; McMillan et al., 2006; O'Brien et al., 2000). Based on weighted responses to the 2012 CHTS, the estimated share of K–8 students in the study area who are female is between 45 and 51 percent.

Presence of a Non-Working Adult in the Home

McDonald and Aalborg (2009) note that driving children to school is particularly convenient for parents who commute to work by car since they can coordinate the school drop-off trip with the work commute, rather than walking a child to school and returning home before commuting to work. In a study of primary school children in London, DiGiuseppi et al. (1998) found that the presence of a working mother in the household is associated with a lower likelihood that students will walk to school, although the presence of a working father in the home is not. The presence of a non-working adult in a child's household could make it more convenient for students to walk to school, particularly if parents do not allow their children to travel to school unaccompanied. Based on weighted responses to the 2012 CHTS, the estimated share of K–8 students in the study area who live in a home with at least one non-working adult is between 43 and 51 percent.

School Neighborhood Characteristics included in Analysis

In addition to the individual and household variables described above, the researchers gathered other data on the census tracts within the study area from the 2012 five-year sample of the United States Census Bureau American Community Survey. The variables anticipated to have a relationship with children's mode of travel to school area described below.

Housing Density

In a study of fifth-grade students at schools holding Walk to School Day events, Braza, Shoemaker, and Seeley (2004) found that higher population densities were associated with a greater likelihood that students would walk to school in the week before a Walk to School Day event. Higher-density neighborhoods have shorter average distances for within-neighborhood trips, which may lead to more walking for all neighborhood trips. More walking within these neighborhoods may have the effect of normalizing walking for children commuting to school.

Share of Population between the Ages of Five and Fourteen Years Old

McDonald and Aalborg (2009) found that, among children in the Bay Area who walk to school, only about half walked to school unaccompanied. The remainder traveled with parents, siblings, or friends. In places where school-aged children represent a higher share of the population, children are more likely to live near or with other children who can walk to school with them, which may influence their likelihood of traveling to school by active modes.

Average Block Length

Shorter block lengths generally increase the directness of walking trips, so that the network walking distance between an origin and destination is closer to the straight-line (or “as-the-crow-flies”) distance. In a review of the literature on the relationship between travel and the built environment, Ewing and Cervero (2010)update earlier work, include additional outcome measures, and address the methodological issue of self-selection. Methods: We computed elasticities for individual studies and pooled them to produce weighted averages. Results and conclusions: Travel variables are generally inelastic with respect to change in measures of the built environment. Of the environmental variables considered here, none has a weighted average travel elasticity of absolute magnitude greater than 0.39, and most are much less. Still, the combined effect of several such variables on travel could be quite large. Consistent with prior work, we find that vehicle miles traveled (VMT found some evidence of a relationship between block length and the share of the walking mode choice. As a result of that research, block length is an important input to a widely-used walkability metric marketed as WalkScore™ (Koschinsky et al., 2017)

Percent of Workers who Walk to Work

The researchers used the percentage of workers who walk to work as a proxy for qualitative aspects of neighborhood walkability that extend beyond density and route directness. In neighborhoods in which larger shares of workers commute to work by walking, there is likely to be a better overall pedestrian environment, which might also make it more likely that children attending school in those places would commute by active modes.

Trip Distance

Prior research has established trip distance as the most important factor influencing the decision to travel by active modes, both for adults (Ewing & Cervero, 2010) and children (McDonald, 2008a). The CHTS only includes data on the distance of the journey to school for survey respondents who attended school on the survey day. The CHTS assigned respondents to survey days across a 365-day period, so many respondents completed their travel diaries on weekends, holidays, or during the summer months when K–8 schools are not in session. Of the 1,674 children included in the study sample, 950 attended school on the survey day and have journey-to-school distances available.

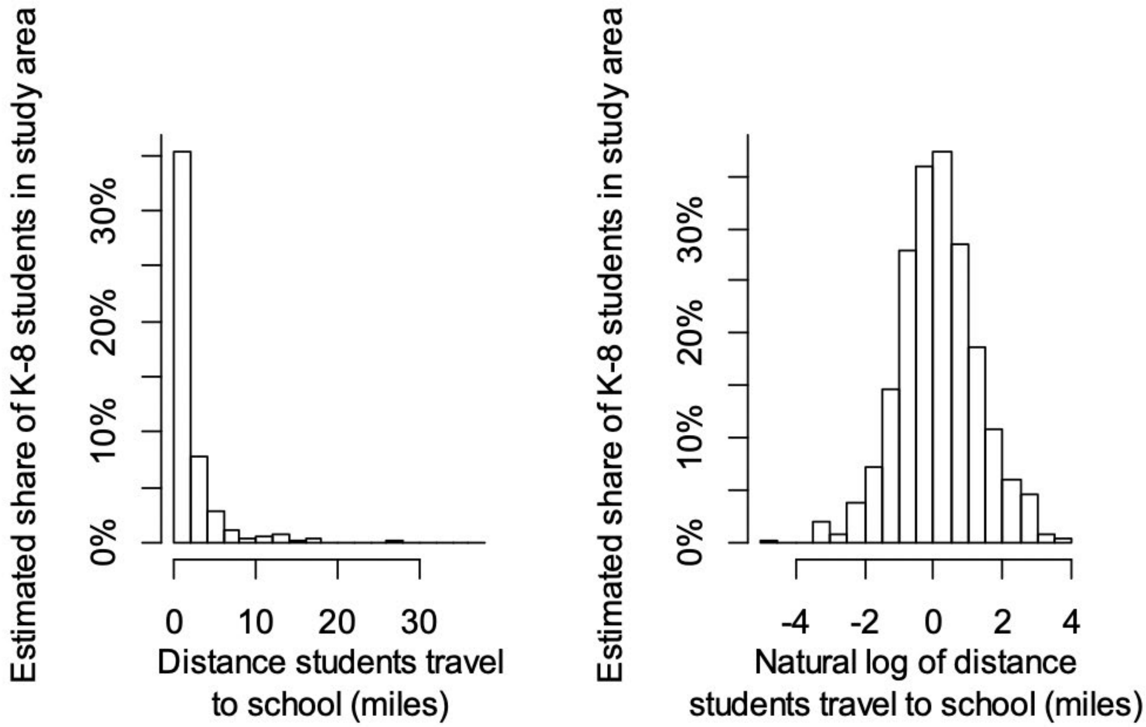

Figure 4. Distribution of Commute Distance Within Study Sample, With and Without Log Transformation

As shown in Figure 3, the distribution of commute distance for students in the study area is left-skewed, with many students traveling short distances to school, and a smaller share of students traveling a long distance. The log of commute distance is more normally distributed, so commute distance was log-transformed for the logistic regression models described below.

ANALYSIS METHODOLOGY

The purpose of this analysis is to determine how the likelihood of traveling to school by an active mode relates to the presence of a Safe Routes to School program in the census tract where a student attends school. To this end, the researchers conducted a set of difference in means tests to determine naïve differences associated with the presence of an SRTS program. The researchers also estimated a set of logistic regression models to determine whether these differences persist when controlling for individual, household, and neighborhood characteristics.

The Difference in Means Tests

The researchers estimated the share of K–8 students in the study area who commuted to school by active modes in 2012 for three different groups: the full population of K–8 students in the study area, the subpopulation of students attending school in SRTS tracts, and the subpopulation of students in non-SRTS tracts. The researchers used a two-sample t-test to determine the magnitude and statistical significance of the difference in active mode shares between the latter two groups. Note that the term “mode shares” in this report refers to the percentage or proportion of trips allotted to each mode by the commuters and not to parts of a single trip split between multiple modes. The researchers likewise calculated averages and differences in means (using a two-sample t-test) to determine how students in SRTS tracts and non-SRTS tracts differed in terms of the individual, household, and school neighborhood characteristics described above.

Logistic Regression Models

To better estimate the effect of SRTS programs on children’s use of active modes for the journey to school, it is necessary to control for other factors that might also influence active travel to school. To do this, the researchers estimated a set of binomial logistic regression models predicting the log-odds (also called the logit) that a student will travel to school by an active mode, selecting the best-fitting model from four alternative model forms. These are described below.

Model 1: Non-Threshold Model without Interaction Terms

The simplest model form evaluated included a binary variable indicating the presence of an SRTS school program in the census tract where a student attends school as the independent variable of interest, controlling for trip length and each of the individual, household, and school neighborhood characteristics described above.

Model 2: Non-Threshold Model with Interaction Terms

Model 1 can estimate the average difference in the probability of taking an active mode to school that can be predicted by the presence of an SRTS program, but it cannot evaluate the question of whether SRTS programs might exacerbate or mitigate the effects of other individual, household, and neighborhood characteristics on the propensity to use active modes. To do this, the researchers estimated an alternative model that included interaction terms between the presence of an SRTS program and each of the control variables, in addition to all of the terms included in Model 1.

Model 3: Threshold Model without Interaction Terms

Prior research has established that trip distance has an outsized effect on the decision to travel by an active mode. Some of the promise of SRTS programs may lie in encouraging or enabling students to consider walking longer distances to their school than they otherwise would. In other words, successful SRTS programs may reduce the amount by which a child’s likelihood of active travel to school decreases with each incremental increase in the distance to school. If this is the case, it would be expected to see a positive and statistically significant coefficient for the interaction term between log-transformed trip distance and the presence of an SRTS program in Model 2. However, even if this is the case for relatively short-distance journeys to school, there may be a threshold distance beyond which students will not travel to school by active modes, regardless of the presence or absence of an SRTS program. To account for this possibility, Model 3 replaces the indicator variable for the presence of an

SRTS program with an indicator for whether the student attends school in an SRTS tract *and* has a commute distance of less than a threshold value (the identification of this value is described hereafter). In all other respects, Model 3 is identical to Model 1.

Model 4: Threshold Model with Interaction Terms

As Model 3 does, Model 4 also replaces the indicator variable for the presence of an SRTS program with an indicator for whether the student attends school in an SRTS tract *and* has a commute distance below a threshold value. In all other respects, Model 3 is identical to Model 1.

Identification of the Threshold Value

For Models 3 and 4, the researchers identified the commute distance threshold value by calculating the Akaike Information Criterion (AIC) for versions of both models with threshold values varying from 0.5 miles to 2 miles. AIC is a measure of model fit which can be applied to many different types of regression models, in contrast to R-squared, which can only apply to ordinary-least-squares (OLS) regression. The team selected the commute distance threshold value that maximized average model fit (i.e., minimized the AIC score) across Models 3 and 4.

RESULTS

Figure 3 shows that, in 2012, students commuting to schools in SRTS tracts were significantly more likely to commute to school by active modes than students commuting to school in non-SRTS tracts.

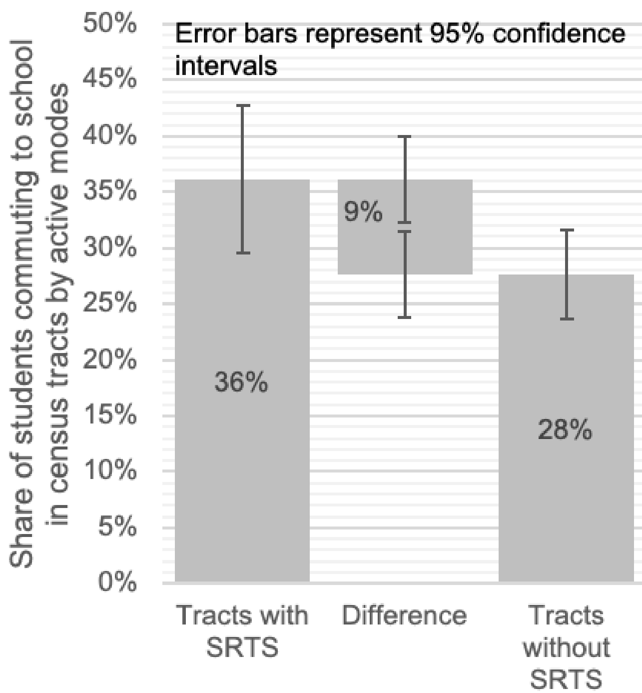

Figure 5. Difference in Active Mode Shares By Presence of a Safe Routes to Schools Program In or Near Students' School

Individual, Household, Neighborhood, and Trip Characteristics Related to the Presence of Safe Routes to School Programs

While the difference in active commuting associated with SRTS tracts is encouraging, it cannot indicate the effectiveness of SRTS programs, since SRTS tracts may differ from non-SRTS tracts in ways that extend beyond the presence or absence of SRTS programs. Moreover, students commuting to school in SRTS tracts might differ from their peers who commute to non-SRTS tracts in other important ways that might explain this difference between commute mode shares.

School Neighborhood Characteristics

Table 2 shows the results of four two-sample t-tests for the differences in housing density, the children and worker walking mode shares, and average block length between SRTS tracts and non-SRTS tracts. Statistically significant results were found for three of these variables.

Table 2. Characteristics of Neighborhoods Where Students Attend School, by SRTS Program Presence

		Students who attend school…		
95-percent confidence interval for…	Full Sample (n = 1,674)	… in a tract with a SRTS program (n = 471)	… in a tract without a SRTS program (n = 1,203)	Difference
Housing density in the census tract where students attend school (housing units per acre)	4.2 to 4.7	4.7 to 5.6	3.8 to 4.4	0.5 to 1.5
Percent of the population between the ages of 5 and 14 years old living in the census tract where students attend school	13% to 14%	13% to 13%	13% to 14%	Not significant
Percent of the population that walks to work living in the census tract where students attend school	2% to 3%	2% to 3%	2% to 2%	0% to 2%
Average block length in the census tract where students attend school (miles)	0.8 to 0.8	0.6 to 0.7	0.8 to 0.9	-0.2 to -0.1

The difference in housing unit density experienced by students attending school in SRTS tracts, compared to those in non-SRTS tracts, is shown in Table 2 and illustrated in Figure 4. Students attending school in SRTS tracts experience a housing density around their schools that is almost 25 percent higher than those attending school in non-SRTS tracts.

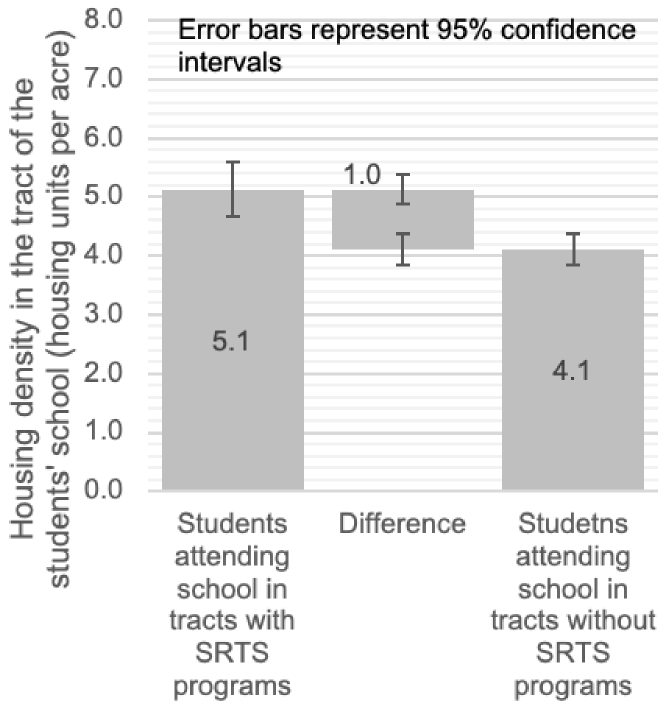

Figure 6. Difference in Housing Density By Presence of SRTS Program

Students attending school in SRTS tracts also experience shorter block lengths near their school compared to those attending school in non-SRTS tracts, as shown in Table 2 and illustrated in Figure 5.

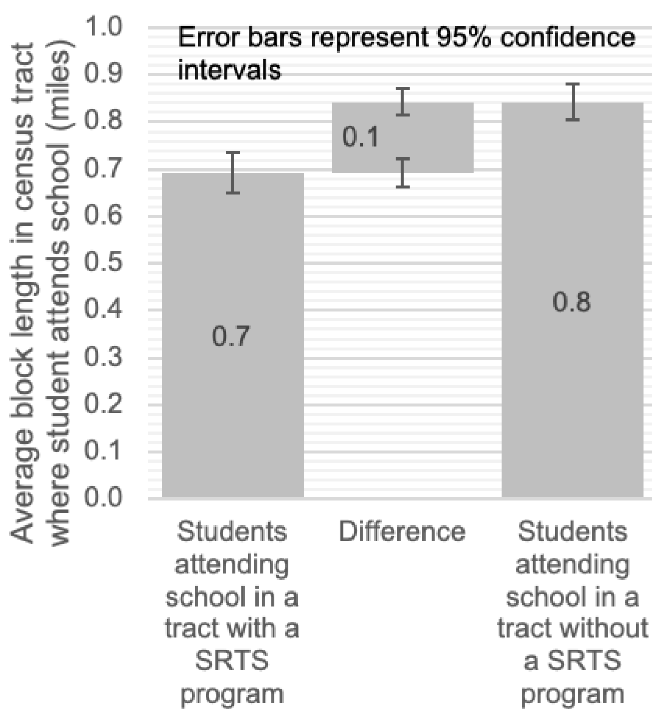

Figure 7. Difference in Average Block Length By Presence of SRTS Program

The difference in housing density and block length shown in Figure 4 and Figure 5 might partly explain the difference in the share of adult workers living in SRTS tracts who walk to work, relative to those who live in non-SRTS tracts, as shown in Table 2 and illustrated in Figure 6. The difference in the share of workers who walk probably also reflects other unmeasured differences in the quality of the pedestrian environment.

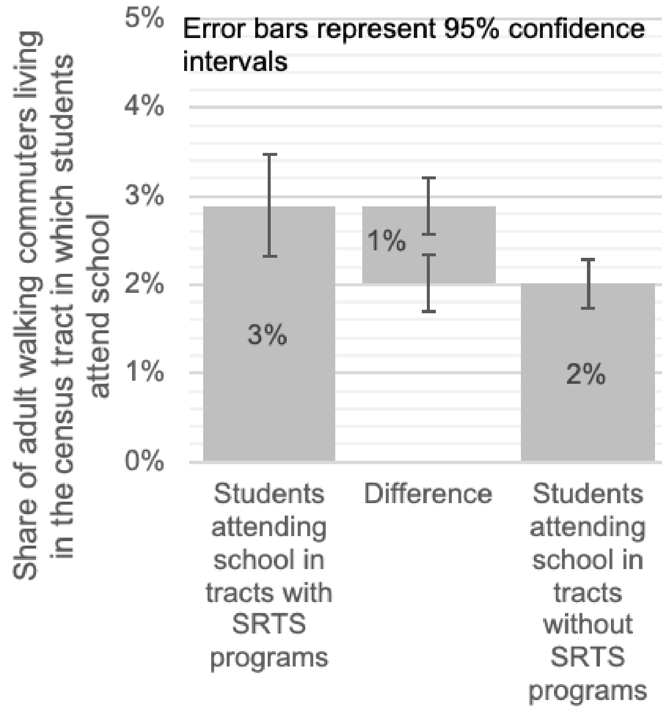

Figure 8. Difference in Adult Commute Mode Shares by Presence of SRTS Program

Individual and Household Characteristics

In addition to the differences between SRTS tracts and non-SRTS tracts, the researchers also used two-sample t-tests to measure differences between students attending school in SRTS tracts and those attending school in non-SRTS tracts. The results, shown in Table 3, indicate that, of the variables tested, only race/ethnicity is significantly associated with the presence or absence of an SRTS program in the tract where a student attends school. Students attending school in an SRTS tract are more likely to identify as non-Hispanic white than students attending school in a non-SRTS tract.

Table 3. Characteristics of Students and Their Households, by SRTS Program Presence

		Students who attend school…		
95-percent confidence interval for…	**Full Sample (n = 1,674)**	**… in a tract with a SRTS program (n = 471)**	**… in a tract without a SRTS program (n = 1,203)**	**Difference**
Share of students living in a home with at least one adult who is not in the workforce	43% to 51%	35% to 50%	44% to 53%	Not significant
Share of students who are female	45% to 51%	38% to 49%	46% to 53%	Not significant
Share of students who are non-Hispanic white	33% to 39%	35% to 48%	30% to 38%	0% to 15%
Share of students who are non-Hispanic Black	3% to 6%	1% to 8%	2% to 7%	Not significant
Share of students who are non-Hispanic Asian or Pacific Islander	21% to 28%	15% to 27%	22% to 30%	Not significant
Share of students who are Hispanic	28% to 36%	24% to 38%	28% to 37%	Not significant
Students' household income	$113,886 to $127,732	$104,136 to $128,598	$114,222 to $130,634	Not significant

The racial/ethnic difference shown in Table 3 can also be expressed in terms of the shares of students attending school in an SRTS tract for each racial/ethnic group. Figure 7 shows that non-Hispanic white students were more likely than other students to attend school in an SRTS tract in 2012.

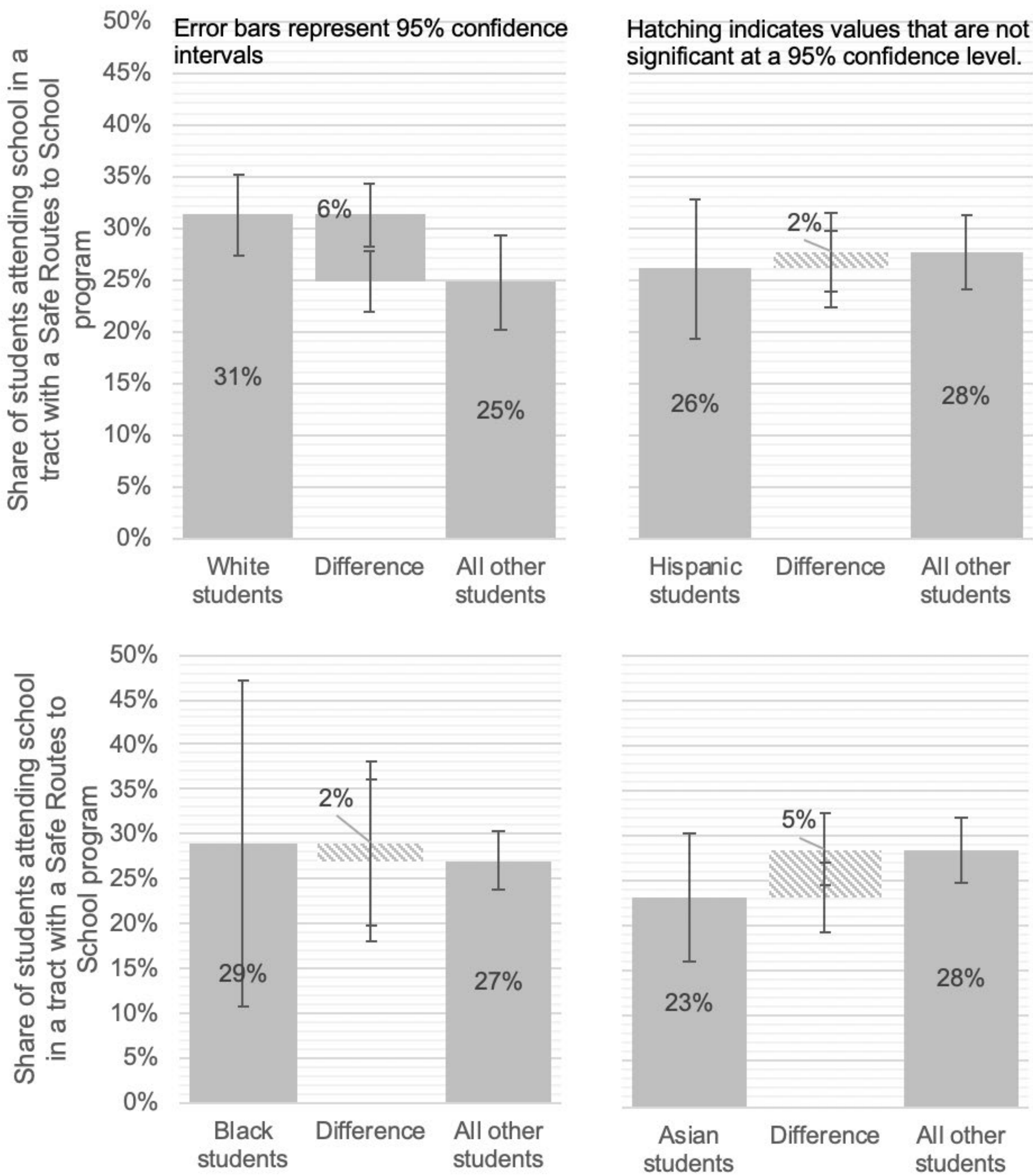

Figure 9. Difference in Presence of Safe Routes to School Program by Race and Ethnicity

Note: “White” indicates non-Hispanic white students, “Black” indicates non-Hispanic Black students, and “Asian” indicates non-Hispanic Asian and Pacific Islander students.

Trip Length

Some of the differences in the shares of commute modes between students who attend school in SRTS tracts and those who do not might be explained by differences in commute distance. As shown in Table 4 and illustrated in Figure 8, students attending school in SRTS tracts have trips to school that are more than one mile shorter, on average, than those attending school in non-SRTS tracts.

Table 4. Trip Length, by Presence of Safe Routes to Schools Program

95-percent confidence interval for…	Full sample of students who travelled to school on survey day (n = 950)	Students who attend school… … in a tract with a SRTS program (n = 264)	Students who attend school… … in a tract without a SRTS program (n = 686)	Difference
Distance students travel to school (miles)	1.9 to 2.6	1.2 to 1.7	2.1 to 2.9	-1.6 to -0.6

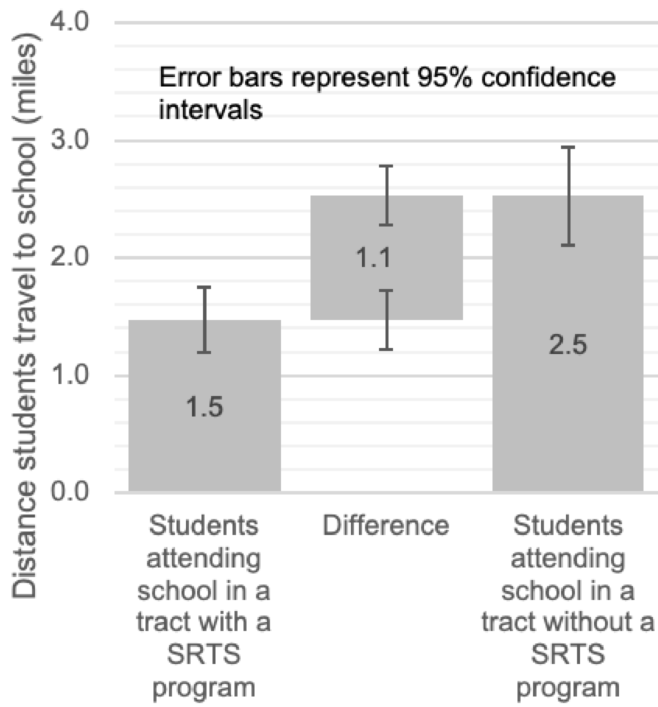

Figure 10. Difference in Distance Students Travel to School by Presence of Safe Routes to School Program

Individual, Household, Neighborhood, and Trip Characteristics Related to Active Travel to School

The differences between SRTS tracts and non-SRTS tracts, and the demographic differences between students who attend school in each, might explain differences in active mode shares if the variables for which differences are observed are also associated with differences in active mode shares.

School Neighborhood Characteristics

Table 5 shows the results of four two-sample t-tests for the differences in housing density, children and worker walking mode share, and average block length for the tract in which students attend school, according to whether they travel to school by an active mode or a motorized mode. Only the difference in average block length was statistically significant.

Table 5. Characteristics of Neighborhoods where Students Attend School, by Students' Mode of Travel to School

95-percent confidence interval for…	Full Sample (n = 1,674)	Students who travel to school… … by active modes (n = 500)	… by motorized modes (n = 1,174)	Difference
Housing density in the census tract where students attend school (housing units per acre)	4.2 to 4.7	4.3 to 5.3	4.0 to 4.5	Not significant
Percent of the population between the ages of 5 and 14 years old living in the census tract where students attend school	13% to 14%	13% to 14%	13% to 14%	Not significant
Percent of the population that walks to work living in the census tract where students attend school	2% to 3%	2% to 3%	2% to 2%	Not significant
Average block length in the census tract where students attend school (miles)	0.8 to 0.8	0.7 to 0.8	0.8 to 0.9	-0.2 to -0.1

As shown in Table 5 and illustrated in Figure 9, the average block length throughout the study area is fairly long, with the average block length experienced by students averaging about 0.8 miles. Students traveling to school by active modes attended school in tracts with an average block length about a tenth of a mile shorter than students who traveled by motorized modes.

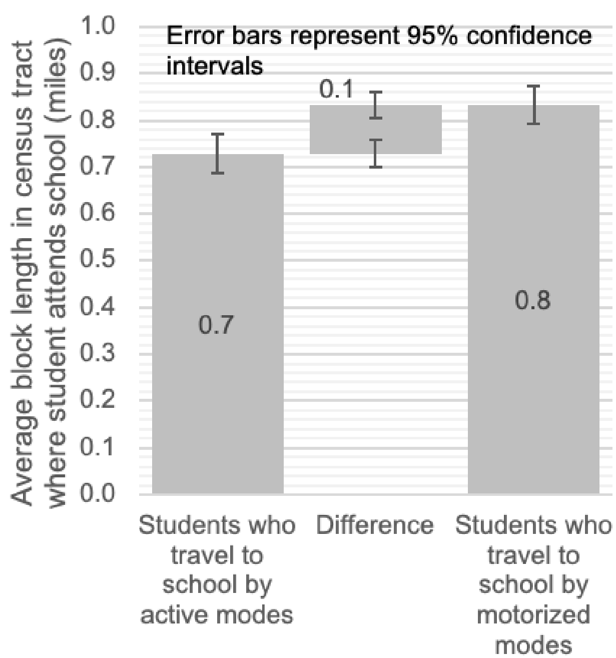

Figure 11. Difference in Average Block Length Near Students' School, by Commute Mode

Individual and Household Characteristics

In addition to the differences in characteristics of the tracts where active commuters and motorized commuters attend school, the research team also used two-sample t-tests to measure differences in the individual and household characteristics of active and motorized commuters. The results, shown in Table 6, indicate that of the variables tested, only race/ethnicity and the presence of a non-working adult in the home are significantly associated with the share of students commuting to school by active modes.

Table 6. Characteristics of Students and Their Households, by Mode of Travel to School

		Students who travel to school…		
95-percent confidence interval for…	**Full Sample (n = 1,674)**	**… by active modes (n = 500)**	**… by motorized modes (n = 1,174)**	**Difference**
Share of students living in a home with at least one adult who is not in the workforce	43% to 51%	46% to 60%	40% to 49%	1% to 17%
Share of students who are female	45% to 51%	40% to 50%	46% to 53%	Not significant
Share of students who are non-Hispanic white	33% to 39%	33% to 46%	31% to 38%	Not significant
Share of students who are non-Hispanic Black	3% to 6%	2% to 10%	2% to 6%	Not significant
Share of students who are non-Hispanic Asian or Pacific Islander	21% to 28%	14% to 26%	23% to 31%	-14% to -0.1%
Share of students who are Hispanic	28% to 36%	26% to 40%	28% to 36%	Not significant
Students' household income	\$113,886 to \$127,732	\$104,898 to \$130,599	\$114,091 to \$130,061	Not significant

As shown in Table 6, the share of students living in a home with at least one non-working adult was greater among students who commuted by active modes in 2012 than among those who commuted by motorized modes. This difference can also be expressed in terms of the difference in active commute mode shares between students who live with a non-working adult and those who do not. As shown in Figure 11, a greater share of students living with a non-working adult commuted to school by active modes than other students.

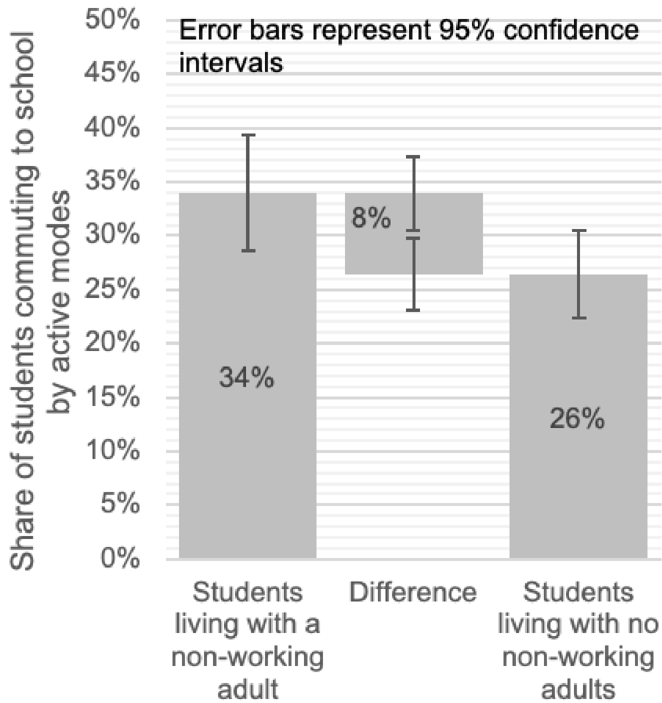

Figure 12. Difference in Active Mode Shares by Presence of a Non-Working Adult in the Students' Home

Table 6 also shows that Asian or Pacific Islander students are underrepresented among students who commute by active modes. This difference can also be expressed in terms of the differences in active commute mode shares among students belonging to different racial/ethnic categories. As shown in Figure 12, active mode shares are lower among Asian students than among other students.

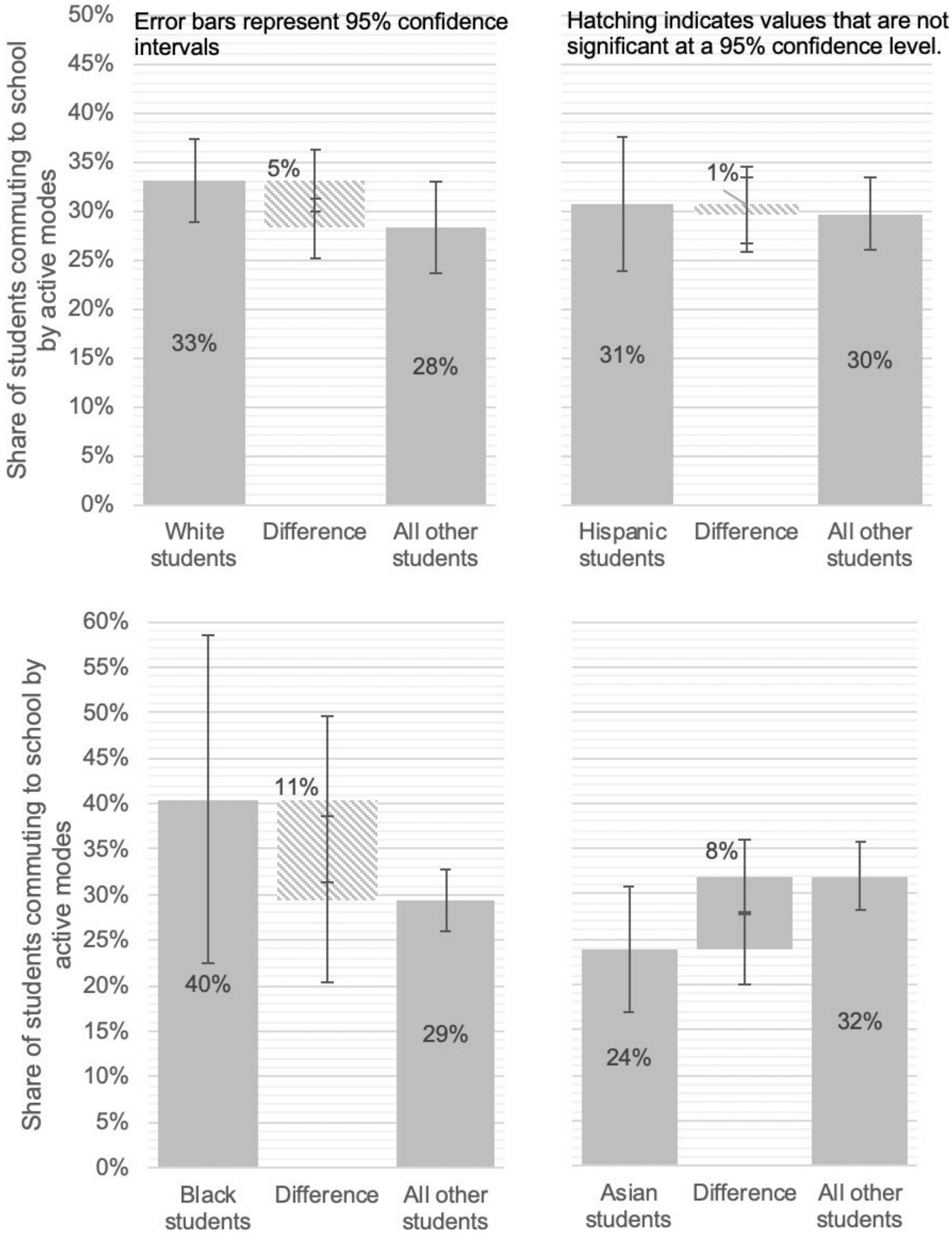

Figure 13. Difference in Active Mode Shares by Race and Ethnicity

Note: “White” indicates non-Hispanic white students, “Black” indicates non-Hispanic Black students, and “Asian” indicates non-Hispanic Asian and Pacific Islander students.

Trip Length

The difference in average trip length between active and motorized commuters is even greater than the difference between those who attend schools in SRTS tracts and those who do not, as shown in Table 7 and illustrated in Figure 13. Students who commute to school by active modes have commutes that are, on average, 2.4 miles shorter than those of students who commute by motorized modes. This is consistent with prior research that indicates that trip distance is among the most important factor explaining the decision to travel by active modes, among both adults (Ewing & Cervero, 2010) and school children (McDonald, 2008a).

Table 7. Trip Length, By Students' Mode of Travel to School

		Students who travel to school…		
95-percent confidence interval for…	**Full sample of students who travelled to school on survey day (n = 950)**	**… by active modes (n = 296)**	**… by motorized modes (n = 654)**	**Difference**
Distance students travel to school (miles)	1.9 to 2.6	0.5 to 0.7	2.6 to 3.5	-2.9 to -2.0

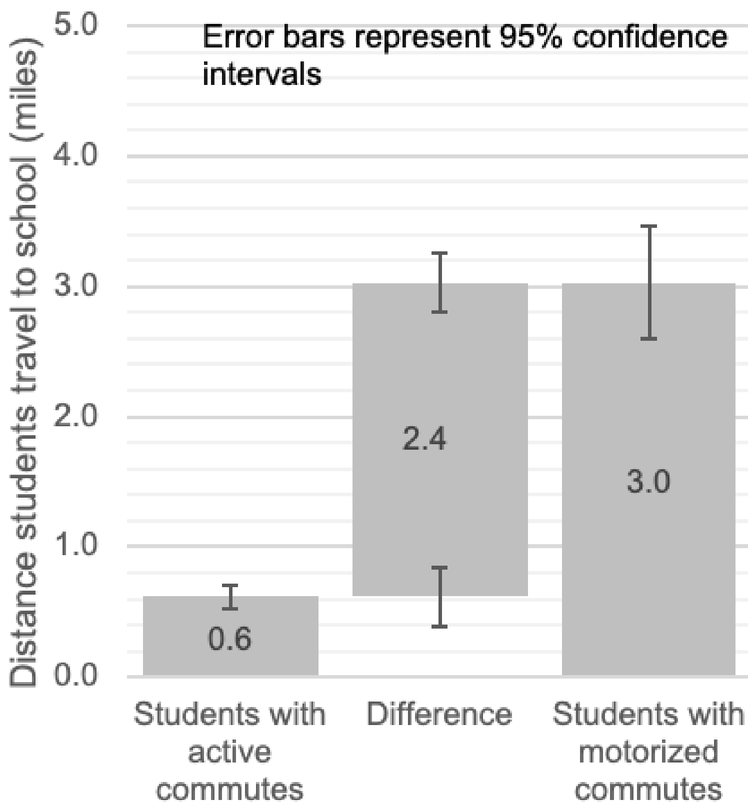

Figure 14. Difference in Distance Students Travel to School by Commute Mode

Independent Predictors of Active Travel to School

Regression models can help untangle the interrelated effects of SRTS programs and the individual, household, and neighborhood characteristics described above regarding whether a student will travel to school by an active mode. As described in the methodology section, four different logistic regression models were estimated to predict the likelihood of traveling to school by an active mode. Two of these models ignore the presence of SRTS programs for trip distances above a threshold. For both models, the research team tested the model fit for commute distance threshold values ranging from 0.5 miles to two miles. The results are shown in Figure 14. As shown, the best-fitting model was Model 4 with a threshold commute distance value of 0.71 miles.

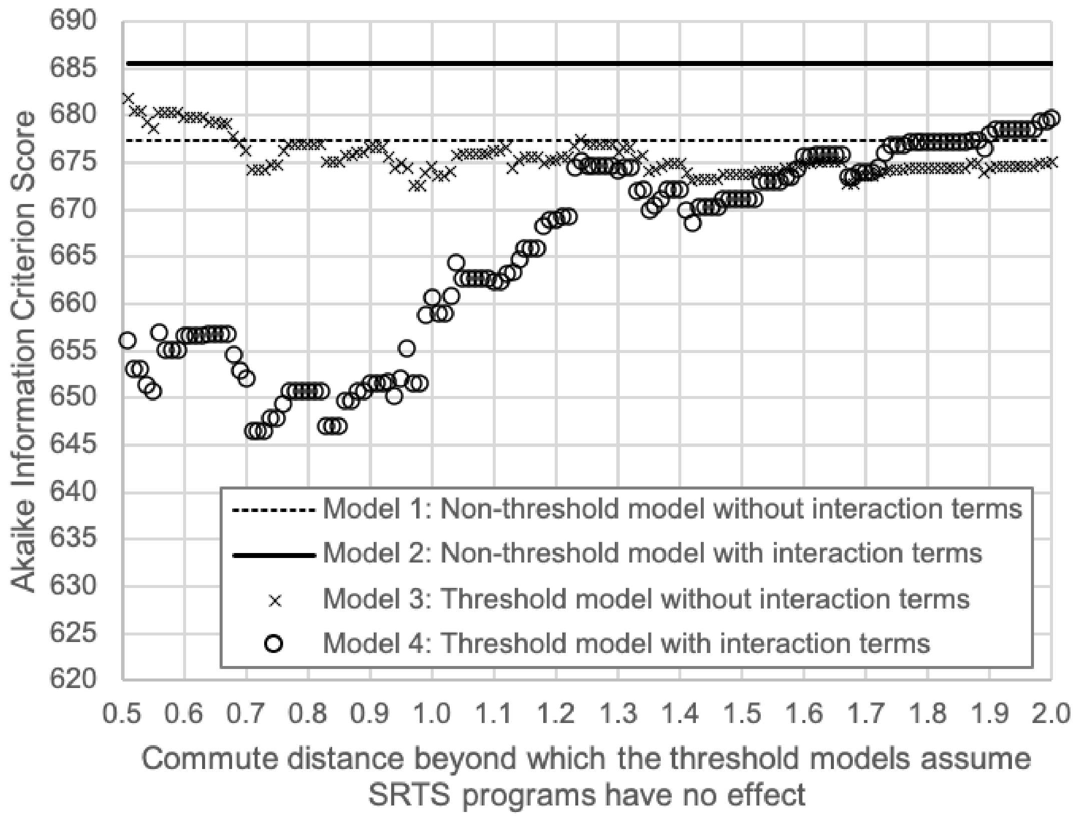

Figure 15. Comparison of Model Fit for Alternative Model Forms

Table 8 summarizes the results of the best-fitting logistic regression model predicting the likelihood that a student will travel to school by an active mode. This model tested for two types of SRTS program effects on the likelihood that a student will use an active mode for the journey to school. First, it tested for the direct effect of SRTS programs on the likelihood of using an active mode. Second, it tested for the effect of SRTS on the relationship between other variables and the likelihood of traveling to school by an active mode.

Based on the results summarized in Table 8, only two of the variables tested have a direct, statistically significant relationship (at a 95-percent confidence level) with the likelihood that a student will travel to school by an active mode: commute distance and race/ethnicity.

Unsurprisingly, students with longer-distance commutes are less likely to commute to school by active modes. Furthermore, non-Hispanic Black students are significantly more likely than white students to commute to school by active modes, and Asian and Pacific Islander students are significantly less likely than white students to commute by active modes.

Controlling for other factors, the presence of an SRTS program did not have a direct effect on the likelihood of commuting to school by an active mode, but it did have a counterbalancing effect on the effects of distance and race/ethnicity.

Table 8. Results of the Best-Fitting Model Predicting Active Travel

Akaike Information Criterion: 646			
Independent Variable		Coefficient	p-value
Distance to school (miles) (log transformed)		**-1.64**	**< 0.001**
School neighborhood characteristics	Presence of SRTS program (only for commutes less than 0.71 miles)	2.11	0.347
	Housing density (housing units per acre)	-0.02	0.782
	Percent of population ages 5 to 14 years old	5.70	0.139
	Percent of the population that walks to work	7.49	0.058
	Average block length	0.06	0.811
Individual and household characteristics	Household income (in units of $10,000)	0.01	0.417
	Presence of non-worker adult in household	0.23	0.334
	Sex: female	-0.14	0.532
	Non-Hispanic Black (compared to white)	**1.89**	**0.001**
	Asian or Pacific Islander (compared to white)	**-1.03**	**0.007**
	Hispanic (compared to white)	0.15	0.627
	Other race/ethnicity (compared to white)	-1.89	0.193
Interactions with presence of SRTS program (only for commutes less than 0.71 miles)			
Distance students travel to school (miles)		**2.34**	**< 0.001**
School neighborhood characteristics	Housing density (housing units per acre)	0.16	0.319
	Percent of population ages 5 to 14 years old	5.88	0.522
	Percent of the population that walks to work	6.81	0.731
	Average block length	-0.65	0.600
Individual and household characteristics	Household income	-0.02	0.748
	Presence of non-worker adult in household	0.04	0.948
	Sex: female	-0.32	0.602
	Non-Hispanic Black (compared to white)	-16.43	0.976
	Asian or Pacific Islander (compared to white)	**2.75**	**0.020**
	Hispanic (compared to white)	-1.35	0.101
	Other race/ethnicity (compared to white)	2.15	0.260

The coefficients in a logistic regression model can be difficult to interpret, since most people are accustomed to thinking of likelihood in terms of probabilities rather than in terms of log-odds, or odds in general. Interpreting model results can be still more complicated for interaction term coefficients, which must be combined with other coefficients to make meaningful predictions. To assist in the interpretation of the model results shown in Table 8, Figure 16 shows the predicted probabilities of using an active mode for the journey to school for non-Hispanic white students and Asian students attending school in tracts with and without SRTS programs for three different trip distances: 0.2 miles, 0.7 miles, and 1.2 miles. All other variables from the regression model are held at their base values for categorical variables (male, no non-working adult in the household) or mean values for continuous variables.

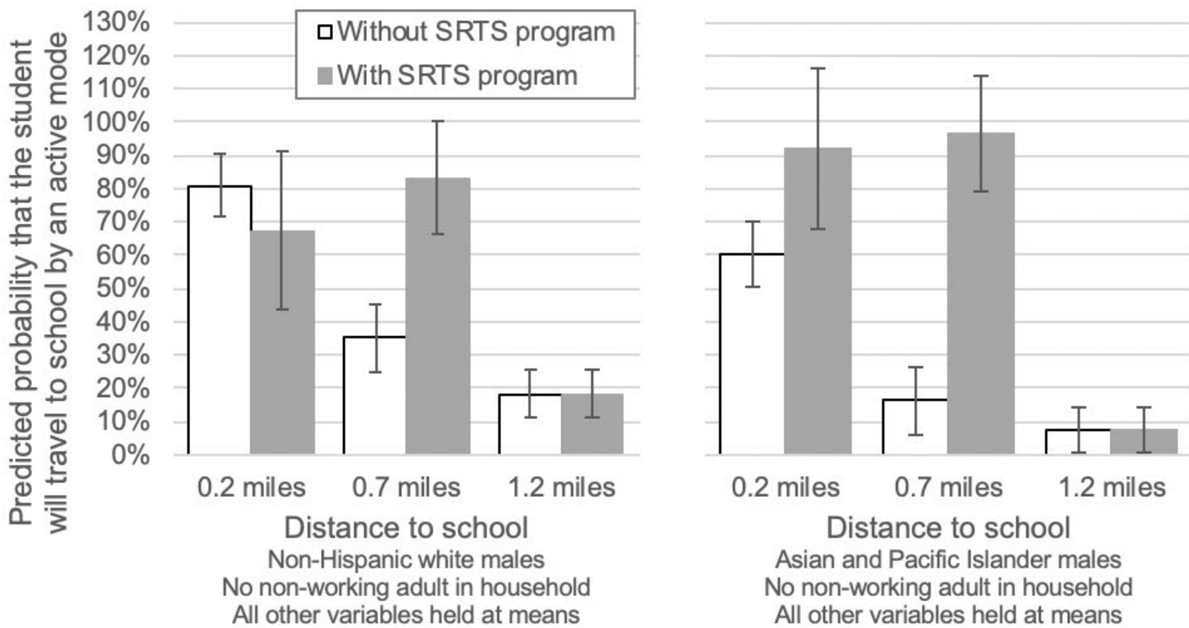

Figure 16. Predicted Probabilities of Active Travel to School, by Race/Ethnicity, Distance to School, and Presence of SRTS

As shown in Figure 16, for students with a commute to school that does not exceed 0.7 miles, the presence of an SRTS program essentially eliminates the effects of commute distance for all students, and race for Asian and Pacific Islander students, on the likelihood of traveling to school by an active mode.

Independent Predictors of the Presence of a Safe Routes to School Program

Another logistic regression model was used to determine which factors were associated with the likelihood that a student in 2012 attended school in an SRTS tract. Table 9 summarizes the results.

Table 9. Results of Model Predicting Presence of Safe Routes to School Program: Full Sample

		Full Sample	
Independent Variable		Coefficient	p-value
Distance to school (miles) (log transformed)		**-0.16**	**0.023**
School neighborhood characteristics	Housing density (housing units per acre)	**0.17**	**< 0.001**
	Percent of population ages 5 to 14 years old	4.50	0.105
	Percent of the population that walks to work	-0.32	0.918
	Average block length	0.08	0.748
Individual and household characteristics	Household income (in units of $10,000)	0.00	0.773
	Presence of non-worker adult in household	0.23	0.334
	Sex: female	-0.22	0.198
	Non-Hispanic Black (compared to white)	-0.25	0.636
	Asian or Pacific Islander (compared to white)	-0.28	0.230
	Hispanic (compared to white)	**-0.674**	**0.004**
	Other race/ethnicity (compared to white)	**1.08**	**0.030**

As shown in Table 9, three factors had a statistically significant relationship with the likelihood that a student in the study area attended school in an SRTS tract in 2012. First, students with shorter journeys to school were more likely to attend school in an SRTS tract. Second, students attending school in a higher-density tract were more likely to attend school in an SRTS tract. Finally, there were racial/ethnic differences in exposure to SRTS programs, where Hispanic students were less likely than non-Hispanic white students to attend school in an SRTS tract and students classified in the “other” race/ethnicity category were more likely.

Since, again, the coefficients in a logistic regression model can be difficult to interpret, Figure 16 shows the predicted probabilities of students with a half-mile commute attending school in an SRTS tract for each of four race/ethnicity categories, for three different density levels: two homes per acre, four homes per acre, and eight homes per acre. All other variables from the regression model are held at their base values for categorical variables (male, no non-working adult in the household) or mean values for continuous variables.

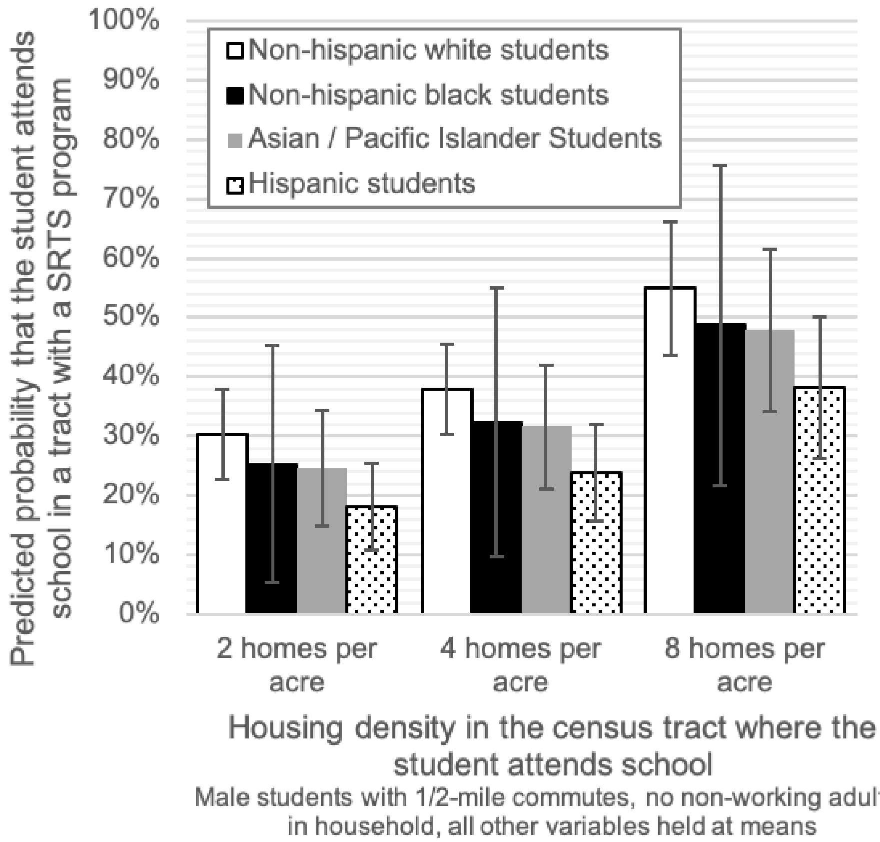

Figure 17. Predicted Probabilities of Attending School in a Tract with a Safe Routes to School Program, by Race/Ethnicity and Housing Density

As shown in Figure 16, the likelihood of the tract in which a student attends school being an SRTS tract increases with housing tract density for all four race/ethnicity categories. For any given density and a constant commute distance to school, non-Hispanic white students were most likely to attend school in an SRTS tract, and Hispanic students were least likely.

DISCUSSION

The results presented above suggest that children attending schools in neighborhoods with SRTS programs are more likely to commute to school by active modes than children attending schools in other tracts. This difference appears to result from the tendency of SRTS programs to mitigate the detrimental effects of distance and race/ethnicity on the children's likelihood to use active modes for the commute to school.

SRTS programs are more likely to be found in places with higher housing densities and shorter block lengths. Both of these neighborhood characteristics are associated with shorter or more direct routes to school. The effect of block length on the presence of an SRTS program disappears when incorporated in a model controlling for density.

White students are more likely to attend schools with SRTS programs, and when controlling for other factors, the difference between white students and Hispanic students remains significant. The reasons for this difference warrant further study. Racial disparities in the availability of SRTS programs are particularly concerning because it appears that an important effect of SRTS programs is to reduce or eliminate racial/ethnic disparities in the propensity to travel to school by active modes.

A major limitation of this study is the potential for some tracts with SRTS programs to be miscategorized as schools without SRTS programs because the schools in those tracts did not submit data to the NCSRTS data collection system. To the extent that this occurred, the results presented above may underestimate the effects of SRTS programs on the likelihood that children travel to school by active modes.

A second limitation of this study is that it relies on cross-sectional data that cannot be used to determine whether rates of walking and biking to school changed with the introduction of SRTS projects and programs. The ideal study of SRTS effectiveness would include longitudinal data on students' mode choice before and after SRTS implementation as well as longitudinal data on a control group that is not affected by SRTS programs and projects.

Finally, the analysis categorized all SRTS programs and projects in a single category, without collecting data on the relative extent to which any schools in the identified SRTS tracts emphasized evaluation, engineering, education, encouragement, enforcement, and/or equity (6 “Es”)approaches to facilitate active travel to school.

CONCLUSION AND RECOMMENDATIONS

The results of the analysis presented in this study suggest that race/ethnicity and distance to school have a significant relationship with the likelihood that children will walk to school. In particular, students with longer commutes to school are less likely to use active modes, and Asian/Pacific Islander students are less likely than their white peers to commute by active modes. Based on the results of this study, SRTS programs seem to reduce or even eliminate race-based and distance-based barriers to commuting to school by active modes, at least for commutes shorter than about three-quarters of a mile.

IV. STAKEHOLDER PERSPECTIVES SAFE ROUTES TO SCHOOL PROGRAM SUCCESS

To place the findings presented in the previous chapter in proper context, the research team also conducted a qualitative analysis through in-depth interviews of stakeholders. Qualitative methodology is extensively used in a wide range of scientific areas, such as sociology and psychology, and it is been used to study individual and household decision-making processes. Qualitative methods applied to travel behavior studies focus on the subjective experiences of individuals related to travel (Mars et al., 2016).

INTERVIEW METHODOLOGY

The research team conducted extensive outreach to the school districts through SVBC and Bay Area SRTS working groups. The interviewed stakeholders included three administrators and two parents. The research team recorded each interview and used a transcription service to thoroughly capture the responses provided by the interviewees. Outreach and the subsequent participant selection may be classified as purposive sampling in that the team attempted to capture both parents and school administrators for the interviews. All interviewees were involved and very aware of the SRTS programs in their school and as such they were vested in the success of their respective programs. Hence, their opinions on the degree of success of individual programs may potentially be biased. However, their point of views on specific challenges and opportunities are still valuable and worthy of consideration. The complete list of questions is provided in the appendix.

INTERVIEW RESULTS

The results in this section are organized based on questions included in the list provided in the appendix. Based on the questions, this section is divided into three subsections exploring benefits and barriers, activities and interviewee roles, and the evaluation of results.

Benefits and Barriers

All interviewees agreed with the desirability of more children taking active modes (walking or biking to school). Interviewees noted that if children get their exercise in the morning, they are more settled and alert in class. Besides, encouraging healthy habits for children and having more children bike or walk to school will reduce air pollution and traffic around the schools, which makes it safer for the children making their morning and/or afternoon commute by non-auto modes. A remarkable benefit mentioned by one of the parents was the social connections children and their families made during walk-to-school days.

According to the interviewees, the main factors keeping children in the communities from biking and walking to school include lack of infrastructure and lack of time for parents/caregivers in their morning routine. One of the interviewees noted that in some communities, streets do not have sidewalks and/or have a few bike lanes or paths, while some others even lack crosswalks and safe areas to cross busy streets. The lack of infrastructure feeds parents' perception that it is not safe to allow their kids to walk or bike to school. On the other hand, interviewees noted that if better infrastructure (e.g., in the form of bike trails and good sidewalks) were implemented along the routes leading to the school, it would improve safety for active commuters.

The interviewees noted that dedicated events that encourage parents and students to bike together to school are beneficial. All interviewees stated that encouragement for both the parents and children motivates the children to want to bike or walk to school. In terms of bike and walk events, it was noted that the events need to be well advertised and supported by the relevant community. Promotional events get children excited, and they then encourage their parents to participate. One of the interviewees noted that the novelty of these events can also create excitement because the bike and walk events do not happen every day, so kids show more excitement towards the next event day.

Many of the interviewees stated that consistent support and collaboration between the community, schools, and school district is the key to get more children using active modes to school. One of the parents stated that it would be wonderful to offer children free or inexpensive resources to make their daily commute to school on bikes safer. At the school level, if the school increased the number of teachers/staff involved in supporting active modes (e.g., supervising the crosswalks near schools), it would assure parents that someone is paying appropriate attention to their children's safety. Therefore, they would allow their children to bike or walk to school. On the school district level, interviewees felt consistent funding would be helpful, as well as placing a sustainable plan and appropriate regulations in place. At the community level, they hope to see the implementation of safer infrastructure along the key routes to school and more involvement from law enforcement to help with directing the heavy traffic surrounding the school.

SRTS Activities and Interviewee Roles

All interviewees are either the school coordinator or a parent facilitator who regularly commutes as a pedestrian or cyclist. In terms of involvement, interviewees have set up activities, facilitated the events, hosted parent–teacher meetings, and acted as the school's on-site program manager in efforts to promote biking and walking to school. With their efforts in hosting these events and activities, they hope to promote the benefits of cycling to the community. Some see their involvement as a way to give back to the community and to share their passion for active transportation.

All the subjects interviewed are currently involved with the Safe Route to School program. The interviewees cited several elements common to the SRTS programs. These common elements included presentations and assemblies to educate and raise awareness and promote walking and biking to school. Some of the more unique recent initiatives cited by subjects included providing free bike repair services to the children and the community. One interviewee emphasized the need to increase visible safety measures within the community and near schools. Suggestions include having more parent volunteers for more visibility of safety measures, adding speed bumps to slow down traffic at surrounding straight streets, and potentially increasing the number of teachers out on yard duty to increase the perception of safety for the parents and students.

The most significant benefits of the initiatives, according to the interviewees, are raising awareness of car-free transportation and showing the positive impact of biking and walking to school. In some communities, a larger walking mode share has been reported following the efforts of various programs and events held by the school. The interviewees noted no specific downside or disadvantages to the program but did note the challenge of extra time and efforts needed to promote the programs and events. The other challenge in making these programs successful was the lack of funding and resources available at the community level.

Evaluation

The interviewees consistently cited mode shift as the metric to measure success. The process to measure the mode shift, according to the interviewees, included tallying numbers of student participants, tracking the mode share via traffic counts, sending out class surveys, and/or asking for parent feedback via surveys. The recorded number of student participants is used to compare and observe the trend of weekly, monthly, or yearly participation. Class surveys are done a couple of times a year to gather a snapshot the transportation activities of students. Parent surveys are used to determine whether the initiatives are successful from their perspective and learn about the challenges faced. Parent surveys are also a way for the school to gather feedback on how the programs and events are run, such as feedback on the best ways to conduct outreach to the parents and to communicate with them. It should be noted that not all these mechanisms were consistently applied at all schools. Tally counts were the most common, likely because they are a requirement for the SRTS funding program.

According to the interviewees, the outcome of these programs is a mixed bag. For some of the communities, the program is deemed unsuccessful because there is no growth in the proportion of children biking and walking to school. Interviewees suspect this result is due to the current state of society and infrastructure, where car dependence is the default choice. Two of the interviewees claimed their initiatives as successful because they are noticing a small growth in the number of students walking to school regularly following the initiatives from the SRTS programs. At one interviewee's school, the program is relatively new and hence it was too early to assess the program's success. These responses are generally consistent with the findings from the quantitative analysis in Chapter 3.

In their concluding remarks, all interviewees indicated their positive attitude towards what the SRTS programs offer the children and their parents. However, to increase the share of K–12 students who walk and bike to school, the interviewees stressed the need for more support from the community, as well as better communication from the school. Interviewees noted that it was mostly parent volunteers who lead and persuade the school administration to provide more support for Safe Routes to School and help out in administrating the program.

Lastly, an interviewee noted the program is a great initiative to get schools thinking about how to get kids biking and walking to school. It should, however, be understood as a starting point. One way that the community can step in and augment the initiative is by upgrading and maintaining the safe routes and bike routes leading to schools, such as by repainting curbs, updating stop signs, and replacing signs.

DISCUSSION

Overall, all interviewees agreed that there were several benefits to students taking active modes to school. The benefits most often cited included morning exercise that improves students' ability to focus, cost savings compared to driving, relief from traffic congestion, and benefits to the environment. The parents' attitudes about benefits are consistent with past research (e.g., (Dwyer et al., 2001)) indicating that the use of active modes by school children leads to improved academic performance in addition to promoting health and fitness. A remarkable benefit mentioned by one of the parents was the social connections children and their families made during walk-to-school days.

The main factors that are preventing children in the communities from biking and walking to school include lack of infrastructure and parents'/caregivers' lack of time in their morning routine. Many of the interviewees mentioned that consistent support and collaboration between the community, schools, and school district is the key to making sure more children use active modes to school.

The findings from these detailed interviews point to the importance of each of the five steps of the operational theory of routine mode choice decisions proposed by (Schneider, 2013). The results from the qualitative analysis of the interviewees' response can be understood in the context of Schneider's theory. According to the theory, active modes could be promoted through each of the following five steps:

- Awareness and availability (e.g., through proper communication by the schools to parents),
- Basic safety and security (e.g., through improvements to the routes to school and increasing school staff and law enforcement involvement in the SRTS programs),
- Convenience and cost (e.g., through long-term changes in land use; perhaps the most difficult to implement for the school context),
- Enjoyment (e.g., through the novelty of the SRTS events and social connections created by walking or bicycling together), and
- Habit (e.g., targeting information about sustainable transportation options to people making key life changes).

Each of the five steps listed above is from Schneider (2013) and is followed by a parenthetical comment containing the suggestions by the interviewees that relate to that step. The travel behavior field has traditionally focused on time, cost, and socioeconomic factors, but it has more recently evaluated perceptions of the local environment and attitudes towards specific modes. The detailed interviews provide examples of the steps schools and communities can take to alter the mode share. However, the structural issue of reducing costs and increasing the convenience of active modes to school is something that remains to be addressed for the long term. Another noteworthy finding is that the interviewees essentially echoed the need to gather consistent and reliable data to assess the success of the program, as noted by MTC in a 2015 study (Metropolitan Transportation Commission, 2015).

V. CONCLUSIONS

This chapter provides a summary of the findings from the quantitative and qualitative analysis along with recommendations for future projects funded by the SRTS program.

SUMMARY OF FINDINGS

The findings from the quantitative analysis conducted using control groups and California household travel survey data from the Bay Area are in line with the existing literature. Students with longer commutes to school are less likely to use active modes. In terms of ethnicity, Asian/Pacific Islander students are less likely than their white peers to commute by active modes. The presence of SRTS programs at the school seems to reduce or even eliminate race-based and distance-based barriers to commuting to school by active modes. Data analysis shows that in the Bay Area White students are more likely to attend schools with SRTS programs compared to Hispanic students. Racial disparities in the availability of SRTS programs warrant further attention especially in light of finding from this research that elimination of racial/ethnic disparities in the propensity to travel to school by active modes is an important effect of these programs.

Based on the qualitative analysis, the research team can confirm that walking and bicycling could be promoted through the five elements outlined in Schneider's theory of routine mode choice decision: awareness and availability, basic safety and security, convenience and cost, enjoyment, and habit. The school staff and volunteers identified several effective SRTS program elements related to each of these five steps. Parents may have significant time constraints that make the convenience of driving more important than the social and environmental benefits of walking or bicycling. However, addressing the convenience and cost issue remains a long-term challenge that requires changes to the surrounding land use. One of the interviewees cited the importance of social connections made by the students and parents with their peers during the active commute. The extent and benefit of these connections merit further exploration by social scientists.

RECOMMENDATIONS

Based on the findings, the following recommendations might apply to three types of SRTS programs.

Engineering

Engineering SRTS projects involve physical improvements to enhance the real or perceived safety and walkability of students' walking and cycling routes to school. The analysis presented in this research suggests that SRTS programs have the greatest impact on the mode choice of the students who live less than about three-quarters of a mile to school. This result can inform decisions about where to focus engineering SRTS projects.

Projects that are located close to schools benefit the greatest number of students. Those located at moderate distances from schools benefit fewer students but may have the greatest impact on those they do benefit. Projects located a mile or more from schools might have minimal impact, because students who would pass those projects on their way to school would be unlikely to travel to school by active modes under any circumstances, so walking and biking are not part of their set of available choices. In the long-term, changes in land use brought about by policy choices that encourage more dense development (e.g., SB 743 in California) would be helpful in addressing some of the challenges for commuters considering use of active modes to school.

Enforcement and Equity

The SRTS guide notes that enforcement is more than just police officers writing tickets. This is a particularly important point when considering the potential differential effects of SRTS programs by race/ethnicity. Within particular communities, the visible presence of law enforcement could make some populations feel safer, while others may feel less safe as a result of visible law enforcement. Traffic enforcement activities and those involving uniformed law enforcement officers should be sensitive to the context and history of the local community. Community volunteers who reflect the diversity of students and their families might be especially effective in ensuring that enforcement activities intended to keep students safe are not counterproductive.

Recent massive protests against police brutality and discrimination across the nation have demanded a reform in law enforcement. As a result, many communities are considering to re-envision public safety by strengthening communities and investing in innovative alternatives to armed law enforcement. Examples of such alternatives include:

- Safety ambassadors: Safety ambassadors are unarmed, designated individuals that work with schools, transit agencies, downtown improvement districts, entertainment districts and other organizations that often do not have citation or arrest power but are trained in safety, conflict resolution, de-escalation, and self-defense (Dembo, 2020). Examples are San Francisco Muni Transit Assistance Program, Guardian Angels in New York City, and Downtown Cleveland Alliance Safety Ambassadors. Safety ambassadors can be employees or volunteers that are often recruited from the community, and thus represent its unique values.

- Social workers and mental health professionals: Several communities are advocating for hiring social workers and health professionals to help resolve urban safety problems. For example, the Los Angeles County Metropolitan Transportation Authority (LA Metro) is currently examining strategies to scale back policing, and hiring social workers, mental health professionals as well as safety ambassadors to deal with non-violent crimes and code of conduct violations on public transit (Fonseca, 2020).

- Creative placemaking strategies: Creative placemaking refers to efforts to incorporate arts and culture into urban spaces that can improve physical, social, and economic well-being of communities. Examples of creative placemaking efforts include adding murals and sculptures to urban spaces that reflect community character; encouraging performance art to create safer conditions for pedestrians; and promoting novel ways of utilizing public space and advancing community engagement. The Urban Institute has compiled successful case studies of creating placemaking, such as Eden Night Live community festival and pop-up marketplace to reimagine and rebuild community-police relationships, and the Marcus Garvey Youth Clubhouse that engages a developer, nonprofit organizations and the youth to design and build community space in a high-crime, low-income neighborhood. Creative placemaking strategies can be combined with SRTS programs to create safer and more welcoming conditions for children to use active modes of transportation to commute to school.

Encouragement and Education

Cultural context should also inform encouragement and education activities. For students or parents who speak a language other than English as a first language, it may be advisable to provide educational and promotional materials in their native language. Students' and parents' concerns about walking to school might also be informed by culture. For some families, the additional time required to commute by active modes may be a concern. For others, fear of traffic violence might be primary.

APPENDIX

The complete list of interview questions:

- Do you think it would be a good thing if more children in your community walked or biked to school? Why or why not?
- In your opinion, what are the main things keeping kids in your community from walking and biking to school?
- In your opinion, what are the main things getting kids in your community to walk and bike to school?
- In your opinion, what would be the best way to get more kids in your community to walk or bike to school?
- What can you tell me about current or recent initiatives at your school or in your community that are meant to get kids walking and biking to school?
- Can you tell me briefly about your own involvement or interest in initiatives to promote walking and biking to school?
- In your opinion, what have been the biggest benefits of the initiatives you've just described?
- In your opinion, what have been the main disadvantages, costs, or downsides of the initiatives you've just described?
- In your opinion, what would be a good way to figure out if an initiative like the ones you've described had been successful?
- Overall, do you think the initiatives you've just described have been successful? Why or why not?
- Do you have any other comments [or (for Safe Routes to Schools contacts only) materials] you would like to share about programs that are meant to increase the share of K–12 students who walk and bike to school?

ABBREVIATIONS AND ACRONYMS

FAST Act	Fixing America's Surface Transportation Act
ISTEA	The Intermodal Surface Transportation Efficiency Act
MAP-21	Moving Ahead for Progress-21 Act
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission
NCSRTS	National Center for Safe Routes to School
SAFETY-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SRTS	Safe Routes to School
SVBC	Silicon Valley Bicycle Coalition
TAP	Transportation Alternatives Program

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ABOUT THE AUTHORS

CAROLE TURLEY VOULGARIS, PHD

Carole Turley Voulgaris is an Assistant Professor of Urban Planning at Harvard University's Graduate School of Design. Prior to that, she was an Assistant Professor of Civil Engineering at California Polytechnic State University.

SERENA ALEXANDER, PHD

Serena Alexander is an Assistant Professor of Urban and Regional Planning at San Jose State University.

REYHANE HOSSEINZADE, MUP

Reyhane Hosseinzade is an MS student in the Urban and Regional Planning department at San José State University.

JAMES JIMENEZ

James Jimenez is an MS student at the City and Regional Planning Department at California Polytechnic State University.

KATHERINE LEE

Katherine Lee is an undergraduate Civil Engineering student at California Polytechnic State University.

ANURAG PANDE, PHD

Anurag Pande is a Professor of Civil Engineering at California Polytechnic State University. At Cal Poly, he also serves as the faculty liaison for community engagement to foster partnerships between Cal Poly and nearby communities and non-profit organizations.

PEER REVIEW

San José State University, of the California State University system, and the Mineta Transportation Institute (MTI) Board of Trustees have agreed upon a peer review process required for all research published by MTI. The purpose of the review process is to ensure that the results presented are based upon a professionally acceptable research protocol.

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