Effect of School Quality and Residential Environment on Mode Choice of School Trips

Sylvia He

Trips to school are increasingly taken in automobiles. Smart growth and health advocates suggest that a better-designed built environment in a neighborhood can promote walking and biking to school and that children's walking and biking improve the environment, lower obesity, and increase physical activity. The effects of school variables on travel behavior, however, have rarely been documented. The objective of this research is to examine the impact of school location and characteristics on students' choice of travel mode. The argument is that if the local school is good, then a child is more likely to attend it. The chance increases that the child will commute actively to a school within a short distance, all else equal. School trips from the 2001 Post Census Regional Household Travel Survey of the Los Angeles, California, region were analyzed in relation to school quality in the area of the traveler's origin (residence) and destination. Results revealed that for young travelers who attended kindergarten to sixth grade, school quality and residential environment had no significant effect on nonmotorized modes. In addition, school quality had little impact on mode choice. Nonetheless, the distance from home to the nearest high school significantly increased the probability that students who attended seventh to 12th grades would choose the bus over a private vehicle. A 10% increase in the distance from home to the nearest high school raised the probability of taking the bus by 2.86%, while an identical increase in residential density increased the probability of walking or biking by 1.09%.

In the United States, trips to school are being increasingly taken in automobiles. The percentage of children ages 6 to 12 years who travel by that mode has increased from 15% in 1969 to 50% in 2001. The reason for this ever-increasing dependency on cars is the distance from home to school (*1*, *2*). In 2001, about 75% of children traveled a mile or more to school, compared with 54.8% in 1969 (*3*). An outcome of increased travel distance and car dependency is that children miss an important part of physical exercise outside their classrooms (*4*). Walking to school can be an important part of children's daily physical activities and a complementary part of in-school physical education classes (*4*). Moreover, it is postulated that children who are car dependent may continue this behavior into adulthood, thereby limiting their alternative travel modes (*4*, *5*). With these plausible behavioral consequences, some researchers suggest that it is important to provide exposure to alternative travel modes at early ages (*4*, *6*).

To encourage walking or biking to school, transportation and urban planners have endeavored to create safer and more walkable neighborhoods, addressing the road and personal safety issues that concern most parents. Positive results from empirical studies show that children are more likely to commute actively (i.e., walking or biking) to school in pedestrian- and bicycle-friendly neighborhoods (*7*–*9*). Nonetheless, such urban form elements, according to recent literature, have less impact on children's mode choice than travel distance (*10*–*13*). While travel distance is predetermined in part by school quality and parental school choice (*10*), the effects of school location and characteristics on travel behavior have rarely been documented (*14*–*16*).

The spatial distribution of school quality in the United States is not homogeneous. In particular, suburban districts are better because they receive significantly more financial aid from their local governments than their urban counterparts (*17*). To level the playing field, several reforms have been enacted over the past three decades. For example, in California, both intra- and interdistrict transfers allow students to apply to schools outside their neighborhoods. This open enrollment policy provides more choice of schools, especially for those living in low-performing neighborhoods. Students can apply to schools in districts that participate in this choice program. However, seats are not guaranteed for all applicants if applications exceed capacity, and the admission will be decided by random drawing, with priority given to those whose siblings are already enrolled or those whose parents work in the district. One of the most critical criteria in allowing a transfer is the difference in school characteristics between the district of residence and the accepting district. If a student's application is denied, an appeal can be filed when "the student has expressed a genuine interest in an educational class or program which is both available and beneficial to the student, which cannot be reasonably provided by the district of residence, and the student is in fact eligible for, and has committed to taking or has been accepted into, the desired class or program" (*18*).

Whether students eventually exercise the school choice option often depends on their transportation choices. Since school buses are provided only within district boundaries, students from other districts must make their own way into the district before boarding the school bus. Therefore, students whose families do not own a car or whose parents have strict time constraints are likely to be locked in the neighborhood school, regardless of its quality. Although children from low-performing districts may appear to need the school choice policy most, those who cannot afford a car may not benefit from this policy.

School of Policy, Planning, and Development, University of Southern California, 3518 Trousdale Parkway, Von KleinSmid Center 378, Los Angeles, CA, 90089. sylviahe@usc.edu.

Transportation Research Record: Journal of the Transportation Research Board, No. 2213, Transportation Research Board of the National Academies, Washington, D.C., 2011, pp. 96–104.
DOI: 10.3141/2213-13

LITERATURE REVIEW

Much research on school transportation has been conducted to identify what factors influence children's travel-to-school mode choice and how to incorporate the information into urban design and transportation engineering (*6, 11, 12, 14, 19–25*). Several critical variables have been identified, including trip distance, sidewalk presence, car availability, age, number of children in the household (*6*), parent's work schedule (*2*), and parents' and children's perceptions of their local neighborhoods about traffic density, road safety, and personal security (*26*). In the United States, the freedom of movement enabled by the car culture has led to increased car ownership and to decreased nonmotorized mode usage, especially when compared with other countries (*27*). The effect of car ownership has frequently been found to be negatively correlated with active commuting to school (*11, 14, 28*). An inverse association has also been found between active commuting and income. Children from higher-income families are less likely to commute actively (*12, 14, 28*). With respect to demographics, an important factor in explaining travel mode is gender. Male students tend to be more likely to conduct their journey on foot or by bicycle than females (*21, 26, 27*). Ethnicity was tested in a number of studies as well. Ethnic minorities often exhibit a higher tendency to commute actively (*28*).

School location and characteristics have been taken into consideration in recent transportation literature on children's journey to school (*12, 14, 19*). By balancing the supply of and demand for schools, it is possible to reduce long commute distances and increase active commutes. From these recent studies, two important points with respect to land use and spatial distribution of schools are noteworthy. First, the spatial distribution of schools and residents causes long travel distances and low walking and biking rates. Second, one way to shorten the distance and encourage walking and biking is that existing schools can be improved or more new facilities can be built in residential areas (*12, 19, 29*). When deciding on a new site, one must consider its catchment area and the number of students living near the school so that the new location can maximize the number of pedestrians and bicyclists. Alternatively, improving the quality of existing schools can also encourage walking and biking (*12, 19*).

McMillan examined which factors affect the probability of walking or biking to school (*12*). Several common factors were tested, including neighborhood safety, traffic safety, transportation options, attitudes, sociodemographics, and urban form. Whether the home–school distance is less than 1 mi turned out to be highly significant. Children living within 1 mi are three times more likely to walk or bike than to use a private vehicle. The effect of urban form on children's travel behavior is rather modest when distance is controlled.

McDonald suggested that current policies such as Safe Routes to School, which is a program that encourages more children to walk and bike through improving safety and reducing traffic in the community, may not be enough to change children's travel behavior, because it does not change the spatial distribution of schools and residents (*19*). The results from her study showed that travel time has the strongest effect on walking. McDonald proposed a long-term land use and school planning policy: a community school (*19, 29*). This strategy brings schools closer to residents, which can essentially decrease trip lengths and increase school accessibility. The author also discussed a community school's viability (*19*). On the one hand, given an annual budget of billions of dollars for construction of new school facilities in the case of several states, such as California and New Jersey, it is possible to build community schools that are located closer to students. On the other hand, a community school is feasible only in communities with a density greater than 4,000 persons per square mile, making community schools an impossible choice in many American neighborhoods. In these areas, McDonald concluded that retrofitting existing schools in high-density areas will be more economic than building new community schools (*19*).

Despite the proposed school and land use planning strategies, there are actually very limited empirics to buttress the possible relationship between school characteristics and travel behavior (*14–16*). Ewing et al. tested the effects of school location on mode choice from 709 trips of students attending a kindergarten to grade 12 school in Gainesville, Florida (*14*). Adding to the socioeconomic and built environment variables, they included two school variables, enrollment and whether it is a high school (dummy variable), in a multinomial logit model to predict mode choice. They tested the hypothesis that a larger school enrollment will draw students from a larger catchment area, which might decrease the likelihood of walking or biking. The school variables, however, turned out to be insignificant in all model specifications when controlling for travel time. Nonetheless, the authors still suspected that the variable of school size could affect mode choice beyond its effect on travel time. Land use variables did not prove significant either. The authors explained that school trips, which are mandatory, may not be sensitive to the walking environment as much as discretionary trips are.

Wilson et al. tested another attribute—school type—and found a negative association of magnet schools with active commuting in St. Paul, Minnesota (*15*). Compared with neighborhood schools, magnet schools drew students from a larger geographic area, which resulted in longer commute distances and reduced the likelihood of walking and biking. They expanded this research and surveyed parents of elementary school students in St. Paul and Roseville, Minnesota (*16*). The survey measured students' commute modes, routes, parental attitudes toward school choice, and their available transportation options. This survey confirmed the earlier results that students who attended magnet schools traveled longer distances and had higher busing rates than nonmotorized and auto rates (*15*). Parents of nonwhite and magnet school students in particular were more concerned about school bus service. In addition, the survey reported parents' attitudes toward travel modes, revealing that the lower active commuting rates were primarily due to the long distances, as indicated by 66% of the sample.

Sirard and Slater reviewed more than 100 papers on active commuting and suggested the need to examine school variables (*27*). Using the ecological and cognitive active commuting framework, which was built on several previous frameworks by experts in urban planning, transportation, and physical activity, they summarized most variables used in the related literature. These variables were categorized into three groups: policy level, neighborhood level, and parent–family level. While most variables fell into the latter two categories, few variables had been identified in the policy category. Only four variables have been tested: construction date, size, physical education class during the week, and whether a school discourages walking to school. Policy factors, however, can cause changes in people's travel behavior. One of the authors' examples was that an expanded school choice program coincided with a 20% increase in travel distance according to the 2005 U.K. National Travel Survey. The review by Sirard and Slater suggested that other policy-level variables (i.e., school busing policies, school choice, and school locations) as well as their interactions with neighborhood and parent- and family-level variables need to be further examined (*27*).

SCHOOL LOCATION CONSTRAINT

One method that may be useful in identifying factors that influence travelers in specific types of trips is categorizing school trips as mandatory trips and separating them from discretionary trips (*14*). What sets school trips apart from children's general trips is the additional constraint on school location. In other words, children's travel distance and time are conditional on the location and business hours of the school authority. Unfortunately, the important element of spatial opportunity distribution is often left out in mode choice analysis.

To comprehend children's travel behavior, it is important to identify children and their parents' preferences for schools and the constraints on school choices they face in their residential neighborhoods. It is known that school quality and land value are not distributed homogeneously across space. High-performing schools are often associated with high land values. The price of land in good school districts is often bid up by households with a high willingness to pay for education and certain financial affordability. The extra land price for school quality that parents need to pay is school premiums (*30*–*32*). The higher the premiums, the less affordable public education is. High premiums attached to a good school district may result in long-distance interdistrict travel for students who reside in low-performing yet more affordable districts. The same rationale can be applied to intradistrict school trips: within a district, house prices in neighborhoods with better schools are usually higher, causing long commutes for students coming from less expensive neighborhoods. Given that intradistrict and interdistrict transfers are permitted in California, students may benefit from the open enrollment programs, contingent on the enrollment policy and capacity of the accepting schools and students' willingness to commute.

The large number of vehicle school trips calls for an understanding of children's car dependency in terms of specific constraints. This paper investigates the impact of school location and characteristics on students' mode choice by using a spatial opportunity variable—the quality of the nearest school for each census tract. The objective is to examine the relationship between school quality and mode choice. Walking and biking are expected to be positively related to students' residential school quality. The higher the residential school quality, the shorter the travel distance, and thus the higher is the probability of walking or biking, all else equal.

METHODOLOGY

Data

The following two data sources were used: travel diary data from the Southern California Association of Governments and the 2001 academic performance index (API) from the California Department of Education. School quality in the traveler's residential and destination zone was included in the multinomial model to test for their effects on mode choice.

Travel Diaries

In this study, trip data came from the 2001 Post Census Regional Household Travel Survey (RHTS) by the Southern California Association of Governments. The survey covered six counties in the region: Los Angeles, Orange, Riverside, San Bernardino, Ventura, and Imperial. The survey, which occurs once every 10 years, gathers information on where, why, and how people travel. Travelers from 16,939 households reported a total of 134,247 trips from spring 2001 to spring 2002, including 6,058 school trips in which the primary or secondary trip purpose was attending classes. Because it does not belong to the Los Angeles region, Imperial County was excluded from further analysis, leaving 16,024 households in the sample. Travelers completed a 24-h travel diary for one weekday or a 48-h travel diary for a weekend. Weekend households reported travel during a Friday–Saturday or Sunday–Monday period.

The sample of school trips for this study was selected based on age (5 to 18 years) and the trip purpose indicated in the survey. School trips were divided into two types according to whether the students were attending kindergarten to sixth-grade or seventh- to 12th-grade schools. Such a division provides more detailed information on the most influential factors in mode choice for students in these two age groups, because parents of elementary and high school students have different preferences for schools (*33*). A trip was selected if the primary or secondary trip purpose was school (attending classes), which consisted of 2,117 trips by kindergartners to sixth graders and 1,529 trips by seventh to 12th graders. Figure 1 shows that, among

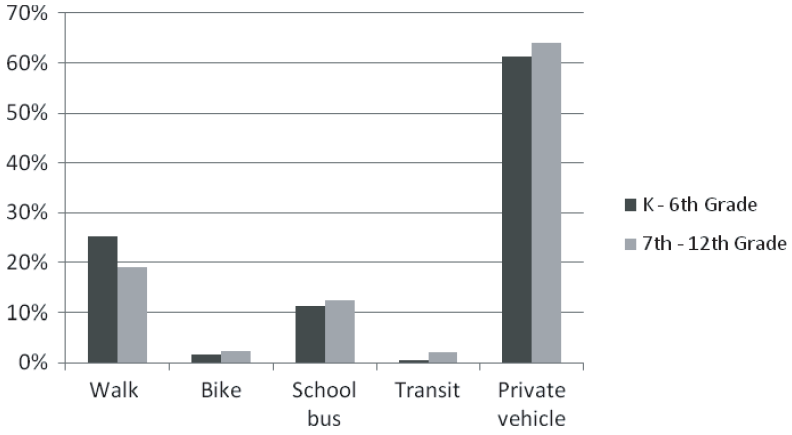

FIGURE 1 Mode of arrival to school by students ages 5 to 18 years. (Source: 2001 RHTS.)

students 5 to 18 years old, more than 60% traveled by private vehicle, 20% to 25% traveled on foot or by bicycle, and slightly more than 12% traveled by school bus; few students traveled by transit bus or subway. In this study, the analysis focuses on three mode choices: walking or biking (nonmotorized modes), bus (school bus and transit bus), and private vehicle, which reduces the sample size to 3,603 trips of students ages 5 to 18, who attended either kindergarten to sixth-grade or seventh- to 12th-grade schools.

Nonmotorized modes are often less popular as travel distance increases. Figure 2 reports the frequency of trips in different travel distances and modes. The travel distance for each trip was not recorded in the original survey data. However, the trip origins and destinations have been geocoded to the nearest census tract—a U.S. census statistical unit that covers a population between 2,500 and 8,000, which can be used to calculate the distance from home to school. In Figure 2, the distribution of the major modes shows that about 50% of school trips of less than ½ mi were made by walking or biking, and the rate decreased with distance. When the trip length was more than 2 mi, the rate dropped to only 15%. Travel by school bus or local bus accounted for a small percentage of short-distance trips, but the mode share of bus rose to almost 20% for trips of more than 2 mi. A private vehicle was used for most trips, accounting for 44.39% of the mode share even for trips of less than ½ mi. When the distance was greater than 1 mi, almost 70% of trips were made by private vehicles.

School Quality Measure

A significant factor in parental schooling decisions and home buyers' residential location choice is school quality (*33–35*). Extensive literature on urban economics and public finance has discussed which characteristics of school performance are valued by parents (*30–33*, *35–37*). Parents tend to value school outputs (i.e., proficiency scores) more than inputs (i.e., per pupil expenditures) (*32*). They are also likely to choose a school based on peer group quality, such as test scores and student characteristics, rather than the value-added measure of school effectiveness (*36*, *38*, *39*). Parents use test scores and reputation to rule out schools with lower performance, even though sometimes they are "ambivalent" about test scores (*33*, p. 77). On the one hand, test scores may signal academic achievement. On the other hand, they may reflect the socioeconomic status of the students rather than the quality of the learning experience. Some parents still think test scores are a good measure of quality. Part of the reason is that test scores are publicly available, and quite often they are the only tangible evidence of quality that many parents have.

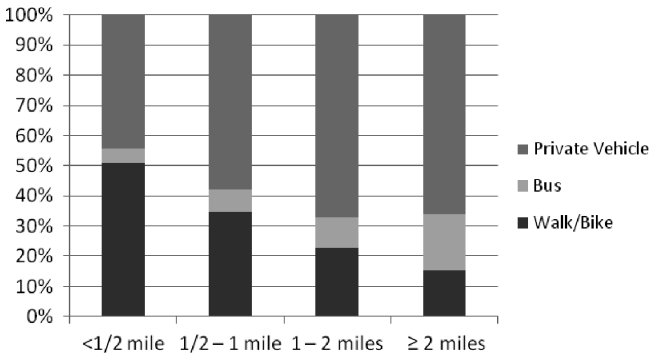

FIGURE 2 Mode of travel to school by distance for students ages 5 to 18 years. (Source: 2001 RHTS.)

Because parents prefer proficiency scores over per pupil expenditures and school effectiveness measures, a proficiency score in California, the API, was used to measure school quality. This score measures a school's academic performance and growth on the basis of test scores of students who participate in the Standardized Testing and Reporting Program and the California High School Exit Examination. API scores are calculated by the California Department of Education and disseminated directly to schools and districts. The API scores also are posted on the California Department of Education and most schools' websites, making the API the most commonly used measure of academic performance. The API score measures only public school performance for elementary, middle, and high schools. Therefore, this paper selected school trips of students attending either a kindergarten to sixth-grade or a seventh- to 12th-grade school as defined in the survey, whereas trips related to other school types (i.e., daycare or preschool, trade or technical, college, postgraduate) were excluded because of a lack of comparable quality measures.

Models

Explanatory variables in the model include travel distance, calculated on the basis of census tract location information, and several traveler sociodemographics from the 2001 RHTS: age, gender, number of vehicles in the household, race, and household income category. Records for trips with unknown household income were removed. The survey's original eight categories of household annual income were reclassified into three categories: low (less than $35,000), medium ($35,000 to $75,000), and high (over $75,000). The grouping of the household income categories was a compromise between the 2001 RHTS's eight original categories and the income categories defined by U.S. Department of Housing and Urban Development (HUD). According to HUD, the 2000 low-income limit in the Los Angeles area was below $37,500 for a family of three and $41,700 for a family of four. Generally, household income is slightly lower than family income as family counts only households with at least two members. Thus, this study chose $35,000 as the upper bound for low-income households. Also a median family income from HUD of $52,100 was used as a baseline, then 30% of the median was subtracted and added as the lower and upper bounds for medium income, which are $36,450 and $67,750. These values are reasonably close to the recategorized medium income boundary of $35,000 and $75,000.

Two additional variables were added from the 2000 census: residential density to measure the compactness of the urban form and median house value of owner-occupied units to proxy neighborhood quality. Increases in density were expected to lower the size of each school's catchment area and to shorten potential travel distances, thus encouraging walking and biking. In housing research, median house value often is used to proxy neighborhood amenities and a community's socioeconomic status. The socioeconomic status was found to have a positive association with older students but no association with younger ones (*40*). However, the socioeconomic status of a neighborhood is often correlated with household income and car ownership. When the household income effect is greater than the neighborhood

TABLE 1 Description of Variables for Travelers to School, Ages 5 to 18 Years

Continuous Variable	Mean	SD	Categorical Variables	Percentage
Trip distance (mi)	2.50	0.06	Female	45.83
Age	10.87	0.07	Black	5.95
Total vehicles	2.05	0.02	Asian or Pacific Islander (PI)	3.16
Residential density (1,000 people/mi^2)	8.03	0.15	Hispanic	36.49
Median house value (in $10,000)	19.07	0.21	White	42.64
Origin school quality (K–6th grade)	660.96	2.78	Low income	36.79
Destination school quality (K–6th grade)	673.23	2.81	Medium income	35.05
Nearest elementary school (mi)	0.69	0.02	High income	28.16
Origin school quality (7th–12th grade)	612.95	2.97		
Destination school quality (7th–12th grade)	619.93	2.92		
Nearest high school (mi)	1.74	0.05		

NOTE: SD = standard deviation; K = kindergarten.

amenity effect, the median house value is inversely related to walking and biking.

Finally, to measure neighborhood school quality in the origins and destinations, API scores were used for kindergarten to sixth graders and seventh to 12th graders. Origin refers to a student's residential neighborhood, whereas destination refers to a student's destination neighborhood (Table 1). Student travelers' mode choice was predicted with a discrete choice model (i.e., multinomial logit model), which is based on discrete consumer choice observed in real markets and random utility theory (*12, 19*).

RESULTS

Results from the multinomial logit model are shown in Table 2. For kindergarten to sixth-grade travelers, three factors appear to dominate their decision making with regard to the choice of walking or bicycling: travel distance, number of vehicles in the household, and age. The significance of these factors is not surprising, as they have been identified in previous studies (*11, 13, 19*). Age is a particularly important element for this group, probably because parents are especially concerned about personal safety and road safety when their children are that age. Regardless of the traveler's age, distance and number of vehicles appear to be universally important in mode choice models.

With seventh- to 12th-grade travelers, age is still a significant determinant but shows a negative effect on active commuting. The older the students are, the more likely they are to use a private vehicle or bus. The variables of distance and number of vehicles are still significant for walking and biking, but the magnitude, especially for distance, decreases markedly, from –0.567 to –0.110. Household income variables also become significant for seventh to 12th graders in their mode choice. Medium- and high-income groups are less likely than students from low-income families to walk, bike, or ride the bus.

A large percentage of Hispanics live in the Los Angeles region and they have distinctive commute patterns. Hispanic students are more likely to commute by foot, bicycle, or bus and less likely to use private vehicles. This is especially true for kindergarten to sixth graders; on average, being Hispanic is associated with a 0.084 decrease in the probability of choosing private vehicles, holding all other factors constant.

The variable of school quality is significant only at the 95% level for kindergarten to sixth graders' bus mode choice; a higher neighborhood school quality tends to increase the probability of choosing a bus over a private vehicle. However, for seventh to 12th graders, it is the distance from home to the nearest high school that increases the probability of taking a bus rather than the variable of school quality.

Marginal effects and the elasticity of the explanatory variables on walking or biking and bus and private vehicle usage are shown in Table 3. Again, for kindergarten to sixth graders, distance, age, and number of vehicles are the only factors that are significant at the 95% level in the choice to walk or bike. These factors are also highly elastic, meaning that a percentage change in these variables causes a large percentage change in nonmotorized modes. For bus mode, several household and built environment variables become significant. A higher residential density and median house value reduce the probability of taking a bus. Because the original travel diaries (Figure 2) suggested that the bus was much more likely to be used for long-distance trips, a higher density implies shorter potential distances and, hence, a lower likelihood of taking the bus. For seventh to 12th graders, the importance of age drops, whereas several socioeconomic and built environment variables become significant with regard to the walking and biking mode choice. A 10% increase in the distance from home to the nearest high school raises the probability of taking a bus to school by 2.86%, while an identical increase in residential density increases the probability of walking or biking by 1.09%. It is consistent with the expectation that an increase in density lowers a school's catchment area and thus raises the probability of walking or biking. This modest effect was shown to be associated with older but not younger students for whom age and distance probably have an overriding influence. As Calvo's study shows, distance is a primary consideration for most parents in school choice decisions, especially at the elementary school level (*33*).

The models have a modest goodness of fit; the pseudo-R^2 is between 12% and 13%. One possible way to increase the explanatory power of the model is to include other influential factors, such as parents' work schedules (*2*) and travelers' perceptions about the local neighborhood (*26*). Unfortunately, these pieces of information either were not collected by the survey or were not reported by a large number of travelers.

TABLE 2 Multinomial Model Results

	Kindergarten to Sixth Grade				Seventh to 12th Grade			
	Walk or Bike		Bus		Walk or Bike		Bus	
	Coeff.	*P*	Coeff.	*P*	Coeff.	*P*	Coeff.	*P*
Intercept	0.277	0.623	−1.926**	0.018	2.281***	0.006		
Trip characteristics								
Distance	−0.567***	0.000	0.058**	0.016	−0.110***	0.004	0.026	0.163
Student characteristics								
Age	0.121***	0.000	0.090**	0.020	−0.092**	0.019	−0.044	0.334
Female	−0.065	0.598	−0.051	0.749	−0.578***	0.000	−0.207	0.252
Household characteristics								
Black	0.224	0.423	0.183	0.610	0.524	0.107	0.588	0.104
Asian or Pacific Islander	−0.021	0.954	0.501	0.294	−0.410	0.392	−0.714	0.259
Hispanic	0.352**	0.033	0.458**	0.026	0.331*	0.096	0.272	0.227
Other ethnicity	−0.371	0.239	0.677**	0.030	0.022	0.954	−0.560	0.318
No. of vehicles	−0.623***	0.000	−0.324***	0.001	−0.422***	0.000	−0.439***	0.000
Medium income	−0.076	0.637	−0.545**	0.009	−0.423**	0.039	−0.643**	0.008
High income	−0.196	0.353	−0.356	0.161	−0.629**	0.011	−0.525*	0.062
Built environment								
Residential density	0.005	0.571	−0.031**	0.031	0.018*	0.090	0.003	0.846
Median house value	−0.007	0.358	−0.039***	0.001	−0.009	0.339	−0.022*	0.062
School opportunity								
Residential API	0.001	0.456	0.002**	0.041	0.001	0.572	0.000	0.779
Destination API	−0.001	0.223	−0.001	0.335	−0.001	0.286	−0.000	0.882
Distance to nearest elementary school	0.238*	0.057	0.037	0.581	−0.104	0.221	0.167***	0.001
Summary statistics								
N	1,744				1,233			
Log likelihood								
Null model	−1,562.8137				−1,085.1885			
Full model	−1,359.2941				−952.2484			
Pseudo-R^2	.1305				.1225			
Model chi square	407.99				265.88			
P	0.0000				0.0000			

NOTE: Coeff. = coefficient; no. = number.
* indicates significance at 90%, ** indicates significance at 95%, *** indicates significance at 99%.

CONCLUSION

There is an urgent call for researchers' attention to reduce car dependency among children and adolescents to cope with their increasing physical inactivity and obesity rates. Although car ownership and household income are two of the most common socioeconomic factors contributing to children's car dependency (*10, 11, 41, 42*), researchers have endeavored to discover other important factors so as to provide innovative policies and programs to encourage walking and biking. Among these factors, some researchers believe that redesigning the built environment can provide a pedestrian- and bicycle-friendly and safe path to school and increase active commuting (*9*). The exercise during students' journeys to school complements students' limited in-school physical education classes and improves students' well-being (*4*). However, are these changes in built environment sufficient to influence students' mode choice?

School location and characteristics could be one of the biggest obstacles for walking and biking (*13, 14, 19*). A recent national household travel survey suggests that school supply has not kept up with population movements (*3*). Since the locations of schools and homes are relatively immobile, the distance from home to school cannot be easily changed in the short term or through current school transportation policies. Before an innovative policy to shorten travel distance can be initiated, it is necessary to understand how students' travel behavior responds to school quality. In the current literature, there are, nevertheless, very few empirical studies that estimate the effects of school quality on students' travel behavior.

This study links school quality and location to student's mode choice in school trips. Although the results do not suggest a strong correlation between school quality and walking and biking, they do reveal a strong relationship between school location and bus mode choice for seventh- to 12th-grade students. A long distance from home to the nearest high school increased the likelihood that students chose a bus over a private vehicle, probably because it was convenient for parents to let their children take the bus when the travel distance was long. Parents were likely to have a limited time budget that they allocated to chauffeuring. Therefore, they might substitute car use with bus when the travel cost was too high.

DISCUSSION OF RESULTS

The school choice policy, which is a major policy that attempts to provide more education opportunities to low-income families, allows students to attend non-neighborhood schools. While this

policy and alternative schools are still in the experimental stage, the effect of district boundaries on travel behavior is undeniable. Parents who are aware of this policy apply for the limited number of seats. Students who have the opportunity to leave their neighborhood schools are prone to travel greater distances and use different modes of travel compared with those who attend neighborhood schools. This study tested the hypothesis that students living in areas with lower-quality schools are more likely to travel farther for better schools and hence have a lower tendency to walk or bike.

The results of this study, nonetheless, showed that students living in areas with better quality schools did not exhibit higher rates of active commuting compared with those living in low-performing school service areas. The outcomes have several complex implications. Ostensibly, distance, car ownership, and age still dominate the decision on mode choice over school quality. On the other hand, the results may suggest that students from low-performing areas did not travel very far because they would have had lower active commuting rates otherwise. Although there was insufficient information to disentangle who exercised the intradistrict and interdistrict transfer options, the limited geographic coverage of school buses could have prevented families without cars from leaving their neighborhood schools. While the school choice policy is well intended to increase students' school options, transportation assistance for students is often neglected. The state government, school districts, and local education agencies should consider providing school buses for a wider geographic area because they may be the only transportation means for low-income families to reach distant schools and it may be more convenient for parents than chauffeuring their children in private vehicles for high- and medium-income families.

ACKNOWLEDGMENTS

The author thanks Ruben Mercado, Lisa Schweitzer, and Genevieve Giuliano for their constructive comments on an earlier version of this paper and the four anonymous reviewers for their insightful comments and suggestions.

REFERENCES

1. Waygood, E., D. Owen, and R. Kitamura. Children in a Rail-Based Developed Area of Japan: Travel Patterns, Independence, and Exercise. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2125,* Transportation Research Board of the National Academies, Washington, D.C., 2009, pp. 36–43.
2. McDonald, N. C. Household Interactions and Children's School Travel: The Effect of Parental Work Patterns on Walking and Biking to School. *Journal of Transport Geography,* Vol. 16, 2008, pp. 324–331.
3. *Travel to School: The Distance Factor.* NHTS Brief 2008. http://nhts.ornl.gov/briefs/Travel%20To%20School.pdf.
4. Tudor-Locke, C., B. E. Ainsworth, and B. M. Popkin. Active Commute to School: An Overlooked Source of Children's Physical Activity. *Sports Medicine,* Vol. 31, 2001, pp. 309–313.
5. Roberts, I. Children and Sport: Walking to School as Future Benefits [Letter]. *British Medical Journal,* Vol. 312, 1996, p. 1229.
6. McMillan, T. E. Urban Form and a Child's Trip to School: The Current Literature and a Framework for Future Research. *Journal of Planning Literature,* Vol. 19, 2005, pp. 440–456.
7. Staunton, C. E., D. Hubsmith, and W. Kallins. Promoting Safe Walking and Biking to School: The Marin County Success Story. *American Journal of Public Health,* Vol. 93, 2003, pp. 1431–1434.
8. Boarnet, M. G., C. L. Anderson, K. Day, T. McMillan, and M. Alfonzo. Evaluation of California Safe Routes to School Legislation: Urban Form Changes and Children's Active Transportation to School. *American Journal of Preventive Medicine,* Vol. 28, 2005, pp. 134–140.
9. Lin, J.-J., and H.-T. Chang. Built Environment Effects on Children's School Travel in Taipai: Independence and Travel Mode. *Urban Studies,* Vol. 47, 2010, pp. 867–889.
10. Bradshaw, R. Why Do Parents Drive Their Children to School? *Traffic Engineering and Control,* Vol. 36, 1995, pp. 16–19.
11. DiGuiseppi, C., I. Roberts, L. Li, and D. Allen. Determinants of Car Travel on Daily Journeys to Schools: Cross Sectional Survey of Primary School Children. *British Medical Journal,* Vol. 316, 1998, pp. 1426–1428.
12. McMillan, T. E. The Relative Influence of Urban Form on a Child's Travel Mode to Distance. *Transportation Research, Part A,* Vol. 41, 2007, pp. 69–79.
13. Yarlagadda, A., and S. Srinivasan. Modeling Children's School Travel Mode and Parental Escort Decisions. *Transportation,* Vol. 35, 2008, pp. 201–218.
14. Ewing, R., W. Schroeer, and W. Greene. School Location and Student Travel: Analysis of Factors Affecting Mode Choice. In *Transportation Research Record: Journal of the Transportation Research Board, No. 1895,* Transportation Research Board of the National Academies, Washington, D.C., 2004, pp. 55–63.
15. Wilson, E. J., R. Wilson, and K. J. Krizek. The Implication of School Choice on Travel Behavior and Environmental Emissions. *Transportation Research, Part D,* Vol. 12, 2007, pp. 506–518.
16. Wilson, E. J., J. Marshall, R. Wilson, and K. J. Krizek. By Foot, Bus, or Car: Children's School Travel and School Choice Policy. *Environment and Planning A,* Vol. 42, 2010, pp. 2168–2185.
17. Thorsnes, P., and J. W. Reifel. Tiebout Dynamics: Neighborhood Response to a Central-City/Suburban House-Price Differential. *Journal of Regional Science,* Vol. 47, 2007, pp. 693–719.
18. Los Angeles County Office of Education. *Interdistrict Attendance Appeal.* Los Angeles, Calif., 2010. http://www.smmusd.org/pupil_services/pdf/AppealPacket2010.pdf.
19. McDonald, N. C. Children's Mode Choice for the School Trips: The Role of Distance and School Location in Walking to School. *Transportation,* Vol. 35, 2008, pp. 23–35.
20. Müller, S., S. Tscharaktschiew, and K. Haase. Travel-to-School Mode Choice Modeling and Patterns of School Choice in Urban Areas. *Journal of Transport Geography,* Vol. 16, 2008, pp. 342–357.
21. Black, C., A. Collins, and M. Snell. Encouraging Walking: The Case of Journey-to-School Trips in Compact Urban Areas. *Urban Studies,* Vol. 38, 2001, pp. 1121–1141.
22. Schlossberg, M., J. Greene, P. P. Phillips, B. Johnson, and B. Parker. School Trips: Effects of Urban Form and Distance on Travel Mode. *Journal of the American Planning Association,* Vol. 72, 2006, pp. 337–346.
23. Babey, S. H., T. A. Hastert, W. Huang, and E. R. Brown. Sociodemographic, Family, and Environmental Factors Associated with Active Commuting to School Among US Adolescents. *Journal of Public Health Policy,* Vol. 30, 2009, pp. 203–220.
24. Zhu, X., and C. Lee. Walkability and Safety Around Elementary Schools: Economic and Ethnic Disparities. *American Journal of Preventive Medicine,* Vol. 34, 2008, pp. 282–290.
25. Davison, K. K., J. L. Werder, and C. T. Lawson. Children's Active Commuting to School: Current Knowledge and Future Directions. *Preventing Chronic Disease,* Vol. 5, 2008, pp. 1–11.
26. Timperio, A., D. Crawford, A. Telford, and J. Salmon. Perceptions About the Local Neighborhood and Walking and Cycling Among Children. *Preventive Medicine,* Vol. 38, 2004, pp. 39– 47.
27. Sirard, J. R., and M. E. Slater. Walking and Bicycling to School: A Review. *American Journal of Lifestyle Medicine,* Vol. 2, 2008, pp. 372–396.
28. McDonald, N. C. Active Transportation to School: Trends Among U.S. Schoolchildren, 1969–2001. *American Journal of Preventive Medicine,* Vol. 32, 2007, pp. 509–516.
29. McDonald, N. C. School Siting: Contested Visions of the Community School. *Journal of the American Planning Association,* Vol. 76, 2010, pp. 184–198.
30. Black, S. E. Do Better Schools Matter? Parental Valuation of Elementary Education. *Quarterly Journal of Economics,* Vol. 114, 1999, pp. 577–599.