

# Integrating Parental Attitudes in Research on Children's Active School Commuting

## Evidence from Community School Travel Survey

Yizhao Yang and Ezra Markowitz

Current active research on school travel emphasizes travel distance and neighborhood walkability as major environmental conditions affecting the occurrences of children walking or biking to school. The impacts of parental travel attitudes on children's school travel behavior remain understudied. This paper outlines a conceptual framework that incorporates the relationships of attitudes, environment conditions, and children's walking or biking to school. The framework recognizes the predictive power that attitudinal factors have for children's walking or biking to school; the framework also highlights the moderating effects of parental travel attitudes on the predictive power of some environment conditions. By using data (1,197 cases) from a school travel survey conducted in a mid-sized school district in Oregon, this paper reports that parental attitudes toward walking or biking to school and car use are significant explanatory variables in models predicting occurrence of children walking or biking to school when the models control for important environmental variables. The analysis also reveals that important built environment variables—travel distance to school and neighborhood walkability—exhibit varying levels of impacts on the probability of children walking or biking to school when parents demonstrate different attitudes toward active school commuting and car use. The paper discusses implications of the research findings for the challenges facing Safe Routes to School Programs and explores approaches that can make these programs more effective.

Over the past 40 years, the United States has witnessed a precipitous decline in the rate of active school transportation (walking and biking) among all student age groups (1, 2). According to the 2001 National Household Travel Survey, about 65% of all children arrive at school via private automobiles compared with 18% in 1969 (3). In some communities, school trips account for 10% of all short trips and close to 30% of morning peak traffic (4). Similar trends have been documented in other nations (5, 6).

Increased reliance on private automobiles for school travel has raised concerns about negative environmental impacts (3) and possible adverse health impacts on children (7–9). The increase in auto-

mobile use has coincided with decreasing physical activity and rising obesity rates among children; many authors have suggested that the three phenomena are related (10).

Increasing the rate of children walking or biking to school, or active school commuting (ASC), has become an important national health objective. Federal and state transportation and public health agencies have promoted programs such as Safe Routes to School (SRTS) and campaigns such as Kids Walk to School in an effort to increase ASC. Many of these efforts have focused on road safety education, urban form improvements (e.g., closing sidewalk gaps), and enforcing traffic rules around schools (11). Evidence of the effectiveness of these interventions has been limited and mixed (11–14), and some has been less than encouraging (15, 16).

Successful and sustained strategies to increase ASC require a thorough understanding of people's decision-making processes. To gain such understanding involves consideration of not only attributes of environmental conditions necessary to support ASC (e.g., safe walking routes) but also of decision-makers' attitudes, preferences, and other psychological variables (17, 18). However, current and past programs, interventions, and academic research have primarily focused on environmental factors (e.g., street connectivity), which mainly serve as barriers to ASC. Theoretical frameworks developed to analyze ASC do not appear to have fully integrated many psychological factors with other environmental and social influences (19–21). In a recent comprehensive literature review of research on school travel, Sirard and Slater noted that prominent psychological constructs, such as attitudes, beliefs, and social norms, have not been explored sufficiently in the literature (10).

Here, research in social psychology will be drawn upon to expand the ASC literature and explore the role psychological factors play in affecting parents' school travel decision making. The psychological variables to be focused on include parents' attitudes toward ASC and toward car use, which are conceptualized and measured separately. The degree to which attitudinal and environmental variables directly affect the likelihood of ASC are examined, as are possible interactions between the two sets of factors. By using survey data from a community sample, an attempt is made to answer the following research questions:

1. What is the unique predictive power of parental attitudes beyond the effects of environmental variables in the context of ASC?
2. How are the effects of environmental variables moderated by parental attitudes?

This study contributes to the literature about ASC both theoretically and empirically. The current dominant ASC framework is expanded by integrating an important and previously understudied

Y. Yang, Department of Planning, Public Policy, and Management, 1209 University of Oregon, and E. Markowitz, Environmental Sciences, Studies, and Policy, University of Oregon, Eugene, OR 97403-1209. Current affiliation for E. Markowitz: Princeton Institute for International and Regional Studies, Princeton University, 326 Aaron Burr Hall, Princeton NJ 08544. Corresponding author: Y. Yang, yizhao@uoregon.edu.

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component of parents' decision-making processes. Critically, this approach conceives ASC as a behavioral domain that requires strong motivation but is greatly constrained by environmental conditions. This empirical study offers evidence underscoring the limitations of interventions focused solely on physical environment improvements.

## **FACTORS AFFECTING SCHOOL TRAVEL BEHAVIOR: A REVIEW**

Existing literature on school travel has identified a number of factors that have impacts on ASC (10). These factors constitute four primary domains: built environment, social environment, school characteristics, and family-household characteristics.

### **Built Environment**

Objectively measured or subjectively perceived, two built environmental factors have thus far received the most attention: home-school distance and neighborhood walkability. Greater distance between a student's residence and the school is a primary barrier to ASC: children are more likely to walk if they live within 1 mi of school (2, 3, 6, 19, 20, 22, 23). Walkability of the environment close to school (e.g., street connectivity) also correlates with ASC (23, 24), although the effect is often found to be smaller than that of distance (25, 26). Urban form elements believed to affect walkability include housing density, sidewalk connectivity, street connectivity, road type and function, and street tree coverage (11, 23, 27).

### **Social Environment**

Local social conditions, including (perceived) crime rates, child safety, and neighborhood cohesion-support, may affect parents' decisions about letting their children take part in physical activities within their communities (2, 28). Perceived crime danger is a major barrier to ASC (23, 24, 29), and stronger social cohesion-control increases the likelihood of ASC, particularly for those living within 1 mi of school (2). Various proxy measures of neighborhood social conditions, such as socioeconomic characteristics (e.g., neighborhood household income, poverty levels, and occupational makeup), have also been found to correlate with ASC (2, 27).

### **School Characteristics**

Some school characteristics have also received attention. For example, school type (magnet versus neighborhood) has an effect on the likelihood of ASC (26, 30): attending neighborhood schools is associated with higher probability of ASC. Several studies have considered the effects of school size on travel behavior, although findings appear inconclusive (27, 31). School policies (e.g., rules about student drop-off and pick-up) may also affect ASC (29).

### **Family-Household Characteristics**

Some family-household characteristics, such as number of cars owned, number of licensed drivers, and higher household income, appear to be associated with greater likelihood of automobile use for school trips (6, 27). Children's own characteristics (e.g., physiological

adequacy) also appear to play a role, although reported effects of gender and age are mixed (10). Other family characteristics, including race-ethnicity, also show mixed results.

## **Parent Psychological Characteristics**

Understudied components of the family-household characteristics category are parents' preferences and travel attitudes. Attitudes, preferences, intentions, beliefs, values, and norms are prominent constructs employed in theories of intentional behavior (32, 33). Recent studies that have considered people's environmental attitudes and travel mode preferences have provided evidence for the causal relationship between attitudes, preferences, and travel behavior (34). Findings from these studies also tend to qualify environmental impacts on travel behavior. For example, Bagley and Mokhtarian suggest that, when attitudes and preferences are controlled, environmental factors show little residual effect on travel mode choice (35).

Although the relations of some of these constructs with travel behavior have been considered within the broader literature on travel behavior (18), research on school travel has not paid sufficient attention to psychological variables. The number of school travel studies that have included psychological variables in their analyses is limited (19, 36-42), and even fewer have sufficiently operationalized measures of these variables. Moreover, possible interactions between psychological and environmental factors have been mostly ignored.

In one of the few studies that have explored such variables, Black et al. examined the effects of parents' attitudes toward car use on school travel decision making (19). By using a series of attitudinal statements, they identified three "value orientations" underlying parents' car-use attitudes: environmental awareness, car-centeredness, and individual responsibility. Among the three dimensions that they identified, car-centeredness exhibited the strongest impact on school travel behavior. Similarly, McMillan reported that caregivers' beliefs about the convenience of driving and in the value of children's social interaction along the journey to school had impacts on children's ASC (36). Rodriguez and Vogt explored children's attitudes toward ASC among a sample of elementary students in Michigan (38). The authors used semantic differential scales (e.g., fun-boring, safe-not safe) to measure a limited set of attitudes toward walking to school and found small but significant positive effects of safety attitudes and walking-saves-time beliefs on ASC, after controlling for a variety of environmental, demographic, and access factors.

Few studies have explored interactions between psychological and environmental factors. Panter et al. examined how environmental factors moderated the relationship between ASC and parents' car-use convenience attitudes (37). They found that the attitude-ASC relationship was stronger for individuals who lived within 1 km of school than for those who lived farther away (37). They also found that the relationship between parents' safety concerns and ASC was stronger for families who lived farther away from school. The moderation findings from this study are important from a transportation policy perspective because they suggest that soft factors such as parental attitudes and perceptions of safety matter to differing extents in relation to environmental factors.

The apparent low level of interest in investigating these psychological constructs within the walking-to-school context may be attributable to the difficulty in operationalizing psychological concepts and the lack of an integrating conceptual framework that clearly recognizes their role in affecting ASC. In addition, the perceived lack of policy relevance of psychological constructs has

likely resulted in weak enthusiasm in adopting those concepts in analysis. The next section provides a definition of “attitude” that bears policy relevance and establishes a conceptual framework that integrates attitudes in research on school travel.

## PARENTAL BEHAVIORAL ATTITUDES AND ASC: A CONCEPTUAL FRAMEWORK

### Defining Behavioral Attitudes

Behavioral attitudes reflect how much an individual is in favor of or against performing a given behavior. A frequently used method to measure behavioral attitudes is to infer them on the basis of “a person’s positive or negative evaluation of performing the behavior” (43, p. 6). The development of an attitude toward a behavior is shaped both by internal factors (e.g., previous experience) and external ones (e.g., the environment in which one lives). Internal factors pertain to one’s own judgment about benefits and costs associated with performing a behavior; they can also include perceived collective consequences and self-ascribed responsibility for social or environmental consequences. The second factor that can shape one’s behavioral attitude involves an individual’s perceived support for performing the behavior and perceived social pressure to do so. In other words, attitudes are shaped by a person’s deliberate calculation as well as by situational facilitators, barriers he or she perceives, or both (44, 45).

Individuals’ assessment of behavioral consequences may be amenable to change via education-oriented interventions. In light of findings that suggest education has effects on people’s awareness of environmental problems and their attitudes toward environmentally relevant behavior and policies (e.g., recycling), it is reasonable to speculate that people’s attitudes toward a travel behavior may change if they obtain more information about the consequences associated with that behavior (46). Furthermore, the situation-dependent component of parental attitudes may become amenable to policy instruments only when substantial changes occur in much broader social, physical, and institutional contexts. This component, while a difficult target from a policy perspective, may serve to qualify the effectiveness of policy implementations.

It is necessary to make a distinction between attitudes as they are defined here and other subjectively measured variables, such as environmental perceptions (e.g., perceived safety concerns), that have received consideration in existing travel behavior analyses. The former construct is considered as capturing people’s general feeling toward performing a behavior, whereas the latter constructs pertain in one way or another to subjective recognition and interpretation of sensory stimuli chiefly derived from the physical or social environments (47).

Two domains of parental attitudes likely important in the ASC behavioral context were examined: attitudes toward ASC and attitudes toward car use. [In the case of school travel of young children (e.g., kindergarten to Grade 5), it was anticipated that parents’ attitudes have significant impacts on their decision to choose active school travel modes for their children and assumed that decisions to commute actively are made primarily by parents.] Parents’ attitudes toward ASC are likely shaped by multiple meanings attached to ASC that go beyond school travel. These meanings are likely to involve environmental ones, as suggested by recent research that looks at commute mode choices as environmentally relevant decision making (18, 48). Other meanings may be attached to ASC that make it a desired behavior for its own sake, for example, a belief

that ASC could increase a child’s physical activity or that ASC accompanied by a parent represents quality time spent together.

Parents’ attitudes toward car use were measured because they may play a unique role in explicating children’s school travel behavior. People’s beliefs about the benefits and advantages associated with owning and using automobiles, as well as their environmental concerns or lack thereof, can determine car ownership and the level of automobile use (48, 49). Recent studies also highlight that the level of car dependence (as a psychological condition), which is shaped by a person’s perceived norm of frequent car use and perceived lack of choice of alternative means, has stronger impacts on automobile use than variables such as access to cars and to alternative transportation means (50).

### Parental Attitudes and Children’s ASC

The authors conceptualize ASC here as a behavior that requires strong internal motivation and postulate that parents’ decisions to use ASC are directly affected by the balance between a desire for ASC and a tendency to use cars. At the same time, by recognizing ASC as a strongly environmentally constrained behavior, the authors acknowledge the effects of environmental factors such as travel distance and neighborhood walkability on the use of ASC and suggest that parents’ attitudes condition the effects of those environmental factors (10).

Further, the authors hypothesize that, when parents’ ASC attitudes are particularly weak, the occurrences of ASC are unlikely to be induced by supportive environment conditions alone. Within this sort of psychological context, environmental variables may have little impact on ASC. By contrast, when ASC attitudes are strong, parents may become responsive to environmental conditions, and supportive environmental qualities (e.g., shorter travel distance, better walkability) could induce greater likelihood of ASC. Car-use attitudes, by contrast, likely have opposite moderating effects on the environment–behavior relationship. In a highly pro-car or car-dependent context, the occurrence of ASC is likely to be suppressed regardless of environmental supportiveness. The authors also hypothesize that, in contexts in which car-use attitudes are less predominant, the relationship between environmental conditions and ASC likely becomes stronger. These hypotheses are tested through surveys of parents of children of elementary school age in Oregon.

## RESEARCH DESIGN AND METHODOLOGY

### Study Area

The study area was the 4J school district in Lane County, Oregon. This school district spans 155 mi<sup>2</sup> in the southern Willamette Valley and mainly serves the city of Eugene, Oregon. Twenty-six elementary schools in this district enrolled approximately 6,000 students in the 2007–2008 academic year. Among these schools, 18 were neighborhood schools with a defined service zone (catchment area–assignment district) and eight were so-called alternative schools that house certain special programs (e.g., foreign language education, art, or music curriculum). The school district has an open enrollment policy that allows a student living in the district to attend any desired school through a lottery process, provided space is available (see Figure 1).

The study area possesses some characteristics that are useful for revealing interactions between attitudinal factors and environmental

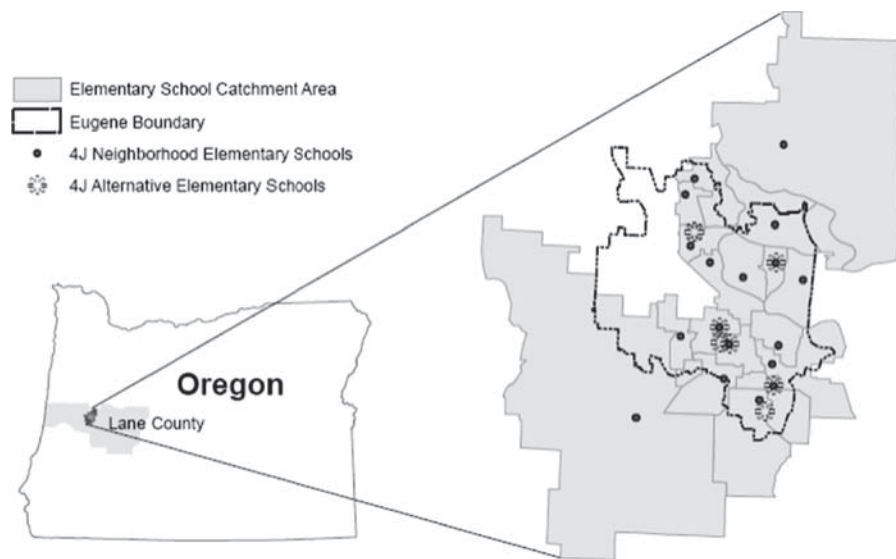


FIGURE 1 Study area and study schools.

factors with respect to their effects on ASC. Eugene is known for active outdoor activities and good infrastructure for biking and walking. Eugene has an extensive bicycle path network. Other environmental facilitators of active commuting, such as sidewalks, traffic calming, and crosswalks, are considered well developed in this city. Compared with people in many other places in this country, residents of Eugene appear to view physical activity as more normative. This suggests that reasonably good variation can be seen in the strength of ASC attitudes and pro-car attitudes as well as generally supportive environmental conditions for walking and biking. All of these elements are necessary to allow the manifestation of attitude–behavior and environment–behavior relationships.

### School Travel Survey

A mail survey was conducted in late April 2008 to 5,700 households with children attending elementary schools (kindergarten to Grade 5) in the 4J school district and residing within the city boundaries of Eugene. The survey included questions about children's school travel behavior similar to those used in other studies and national SRTS programs (23). The survey also included questions tapping parents' attitudes, their perceptions of environmental conditions, and household sociodemographic information. Parents were instructed to complete the survey for their eldest elementary school child if more than one child in the household was attending elementary school.

### Measures

#### *ASC Data Collection*

Parents reported the number of days that their child traveled to and from school by using different transportation means during a typical school week. The days that a child walked or biked to school were then combined into one measure of the frequency of using ASC. The authors believe that this frequency is a better measure of ASC

than are measures based on the occurrence of ASC on or before the day a survey is taken (e.g., National Household Travel Survey) or on parents' self-identification of the travel means used on most days of a week (e.g., parent surveys conducted by the SRTS program). A recent study by Bere and Bjørkelund showed that a questionnaire with an almost-identical design as the one used here had high reliability on the self-reported frequencies of different school travel means used (51).

#### *Attitudes*

A series of questions were used to assess the two attitudinal constructs: attitude toward ASC and attitude toward car use. For ASC attitudes, parents reported their level of agreement with seven statements pertaining to various outcomes associated with walking–biking in general and to school. These outcomes, such as increased physical activity, a less automobile-dependent lifestyle, and increased opportunity for children to know their environments, are those frequently discussed in the literature as reasons for promoting ASC. Items related to the consequences of automobile travel for school trips (such as traffic congestion and air pollution) were also included. Parental attitudes toward car use were assessed with another seven items that elicited parents' agreement with various outcomes associated with car use, such as comfort and convenience, and their assessment of their general car dependence, such as lack of alternative options.

Development of these questions was informed by several recent studies that have made an explicit effort to analyze the independent influence of attitudes on travel behavior (19, 52). All items were tested for semantic clarity. (Interviews were conducted with parents to test the clarity of the survey questions. The surveys were tested on six parents before being distributed.) All attitudinal questions were assessed on a five-point Likert scale (response choices: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The 14 items were subjected to factor analysis to verify that they indeed tapped two distinct attitudinal domains. All items are presented in the later section on attitude measures.



### Environmental Variables

This study focused on physical–environmental variables. These variables include two measures that are based on parents' perceptions—travel distance and neighborhood walkability—and a geographic information system–based measure of street connectivity (percentage of four-way street intersections) for a quarter-mile area around a school site. [A number of other urban form measures, including housing density, land use mix, and road network density, were also created. The street connectivity measure was ultimately chosen because it had the weakest correlation with other variables included in the models. It is also a measure suggested as having statistically significant impacts on school travel mode choice by past research (23).] These variables have been examined in past studies and are considered important urban-form indicators with significant impacts on ASC. Although the travel distance and neighborhood walkability variables are not direct measures of objective environmental characteristics, the variables are indicative of the environmental conditions that can better predict active school travel. The geographic information system–based indicators were used to verify the reliability of some of the measures. Use of the subjective measures of the environment is consistent with the attitude theories developed in social psychology that the outside world affects a behavior mainly through an individual's perception of environment conditions (53). However, their predictive power has not been examined in relation to parents' attitudes.

### Control Variables

The set of control variables included those pertaining to school characteristics and nonpsychological household and child characteristics (e.g., demographics). School characteristics considered involved school type (neighborhood school versus choice school) and size of school enrollment. Household sociodemographic variables included household income, employment status, education levels, race–ethnicity of adults in households, and number of cars owned. Child characteristics included a child's age. Some of the control variables were not maintained in the final models reported in later sections on the effects of variables because of multicollinearity issues.

### Analysis

Factor analyses were conducted to assess the internal consistency of the multiple-item attitudinal measures. Then, two composite measures were created by averaging the most reliable items (six for ASC, five for car use). To test the hypotheses, stratified logistic

multiple regression analyses were performed; the analyses allowed examination of how the effect of the environmental variables might differ by parental attitudes toward ASC and car use.

## RESULTS

### Sample Descriptive Findings of Major Variables

A total of 5,700 surveys were mailed. After discounting 126 non-deliverables, 1,197 surveys were returned, a 22% response rate, which is similar to other surveys recently conducted throughout a school district for school travel research (30). A comparison of several sociodemographic and housing characteristics of the sample with those of the population suggests that the survey response is reasonably representative of the study population. Imputed from the survey was information that the median family income was \$62,500 in 2008, or comparable to the median family income (\$60,157) for Eugene families with dependent children reported in the 2008 American community survey. In the sample, 22% of children were from nonwhite families and 75% lived in owner-occupied housing, compared with the corresponding percentages of 29% and 74%, respectively, from school district data.

In the sample, about 32.9% of the children walked or biked to school at least 1 day a week, 13.5% at least 3 days a week, and 8.8% every day. The corresponding percentages for children who walked or biked when leaving school are similar, being 42.6%, 13.0%, and 7.7%, respectively (Table 1). The predominant mode of school travel was by private automobile. More than 60% of children in the sample rode cars (including car pools) to school at least 3 days a week; more than half the children rode a car to school every day. The analysis that follows focuses only on morning travel to school.

### Attitude Measures

Table 2 reports results from the factor analysis (which used oblique rotation). None of the items showed a cross loading above .4. Eleven items loaded on their predicted factor above .5 and were retained for creating the two composite measures. A single measure of ASC attitudes was computed by taking the mean of six retained items. The reliability for this six-item measure of ASC attitudes is acceptable (Cronbach's  $\alpha = .76$ ; mean interitem correlation = .35). Use of the mean value as opposed to the factor scores makes interpretation of the attitude measure easier: values below 3 on the measure indicate a relatively negative (or weak) attitude toward ASC; values between 3 and 4 a slightly favorable attitude; and values above 4 indicate a

TABLE 1 School Travel Mode Frequency from 4J Survey

Mode Type	School Travel Mode and Frequency					
	Arriving at School			Leaving School		
	At Least 1 Day a Week (%)	At Least 3 Days a Week (%)	Every Day (%)	At Least 2 Days a Week (%)	At Least 3 Days a Week (%)	Every Day (%)
Walk or bike to school	32.9	13.5	8.8	42.6	13.0	7.7
Ride in a car	74.2	60.4	51.4	71.0	51.2	39.7
Ride in school bus	39.8	22.8	17.0	30.9	25.2	17.8

TABLE 2 Factor Loading of Component Questions on Attitude Measures

Survey Question	Rotated Component Matrix <sup>a</sup>	
	Attitude Measure	
	Factor 1. ASC	Factor 2. Car Use
Driving to school contributes to environment pollution.	.762	.023
Walking or biking when possible demonstrates commitment to protect environment.	.703	-.091
Children walking or biking to school is a good way to know their neighborhood.	.683	-.015
If possible, I'd like to have my kids walk or bike to school.	.680	-.192
Kids walking or biking to school is good way to increase physical activity.	.626	.001
Children may develop auto-dependent habit if traveling in car frequently.	.622	.007
Driving to school contributes to traffic jam. <sup>b</sup>	.493	.016
Driving is more comfortable than walking or biking.	-.258	.724
I'd like to drive whenever I need to go around the town.	-.389	.718
Owning a car contributes to a comfortable lifestyle.	.111	.655
I drive my car as much as others.	-.053	.622
I feel I need to drive around (for daily activities), even if I would rather not.	.224	.521
Car ownership is status symbol. <sup>c</sup>	.010	.346
Traffic congestion does not bother me. <sup>c</sup>	-.208	.219

NOTE: Extraction method = principal component analysis. Rotation method = varimax with Kaiser normalization.

<sup>a</sup>Rotation converged in three iterations.

<sup>b</sup>Initial item for assessing ASC attitude, but excluded in the single ASC-attitude measure.

<sup>c</sup>Initial item for assessing car-use attitude, but excluded in the single car-attitude measure.

strong, positive attitude. Similarly, a single measure of attitudes toward car use was constructed by taking the mean of five items ( $\alpha = .71$ , mean interitem correlation = .38). The two attitude measures were moderately and negatively correlated [ $r(1,109) = -0.22, p < .01$ ].

Table 3 reports mean scores on the attitudinal measures as a function of parental educational achievement. The mean differences among the three groups, although small in magnitude, are indicative of the fact that higher educational achievement is related to stronger beliefs about the positive health and environmental consequences associated with ASC. This contrast is particularly evident between parents with a postgraduate degree and those without a bachelor's degree. However, the agreement levels toward the statements related to car-use attitudes do not seem to correlate with parental educational levels as strongly in that few significant differences emerged.

### Correlations Between Key Variables

Table 4 reports correlations between the attitude measures and the environmental measures on which the study focused. The purpose of examining correlations between these measures is to verify whether parents' internal desire or motivations to use ASC or cars are associated with the environmental conditions they face. The weak correlations between the attitude measures and the environmental measures suggest that parents' attitudes toward ASC and car use are somewhat independent of the environmental characteristics of their residence. All correlation coefficients are in the expected direction. The distance measure has the strongest correlation with the frequency of ASC, as expected. (It was possible to geocode and to compute distance for 780 cases. The authors decided against using the geographic

TABLE 3 Mean Scores of Answers to Attitude Questions by Highest Educational Achievement Among Family Members

Survey Question	Highest Educational Achievement		
	No College Degree N = 294	Bachelor's Degree N = 368	Postgraduate Degree N = 440
Kids walking or biking to school is good way to increase physical activity.	4.34***	4.39*	4.53
Walking or biking when possible demonstrates commitment to protect environment.	3.80***	4.10**	4.32
Driving to school contributes to traffic jam.	3.64*	3.94	3.81
Children may develop auto-dependent habit if traveling in car frequently.	3.49***	3.65	3.76
If possible, I'd like to have my kids walk or bike to school.	3.56***	3.93***	4.21
Children walking or biking to school is a good way to know their neighborhood.	3.70***	3.79***	4.00
Driving to school contributes to environment pollution.	3.81***	4.03**	4.21
Driving is more comfortable than walking or biking.	3.83***	3.83	3.57
Prefer driving whenever I need to go around the town.	3.79***	3.65	3.32
Car ownership is status symbol.	1.91**	1.93***	1.70
Owning a car contributes to a comfortable lifestyle.	3.88**	4.10	4.08
I feel I need to drive around (for daily activities), even if I would rather not.	3.67	3.76	3.85
I drive my car as much as others.	3.21	3.18	3.07
Traffic congestion does not bother me.	2.84	2.84	2.97

NOTE: Mean comparison reference group: postgraduate degree.

\* $p < .1$ ; \*\* $p < .05$ ; \*\*\* $p < .01$ .

TABLE 4 Correlation Between Key Measures

Measure	Attitude Measure		Environmental Measure		
	ASC Attitude	Car Attitude	Travel Distance	Neighborhood Walkability	ASC Frequency
ASC attitude	1	-0.224*** N = 1,109	-0.085** N = 1,036	0.110*** N = 1,096	0.223*** N = 1,109
Car attitude	—	1	0.049 N = 1,037	-0.106*** N = 1,096	-0.232*** N = 1,110
Distance	—	—	1	-0.156*** N = 1,024	-0.306*** N = 1,041
Walkability	—	—	—	1	0.224*** N = 1,096
ASC frequency	—	—	—	—	1

NOTE: — = numbers omitted to avoid repetition.

\* $p < .1$ ; \*\* $p < .05$ ; \*\*\* $p < .01$ .

information system measure in subsequent analyses because of the smaller sample size.) The correlations between the two attitudinal measures and ASC frequency are of similar magnitude.

### Direct Effects of Attitude Variables on ASC Behavior

A series of logistic models were run to test the primary hypotheses about the direct effects of the attitudinal predictors of ASC. Logistic regressions were used because of the highly skewed distribution of ASC frequency, which led to dichotomizing the outcome variable. Tested separately were the additional effects of attitudinal measures on the likelihood of using ASC at two frequencies (at least 1 day a

week and at least 3 days a week); those tests controlled for environmental and household characteristics.

The results from the full-sample models are reported in Table 5. The addition of attitudinal variables increases the explanatory power of the models significantly. In Models A.1 and A.2, predicting ASC at least 1 day a week, the Nagelkerke  $R^2$  increased from .171 to .214 after the two attitude variables were included; reduction in the -2 log likelihood was statistically significant after the two variables were included. The improvement is similar for Models B.1 and B.2, predicting weekly occurrence of ASC at a higher level (at least 3 days a week).

By comparing Models A and Models B, Table 5 shows that the important environmental and attitudinal variables have greater effects on the high-frequency ASC measure. For prediction of ASC at least 1 day a week, a 1-mi increase in travel distance leads to a 21% reduc-

TABLE 5 Predicting ASC Behavior With and Without Attitude Variables

Variable	Model A DV: ASC $\geq$ 1 Day a Week (1 = yes)				Model B DV: ASC $\geq$ 3 Days a Week (1 = yes)			
	Model A.1		Model A.2		Model B.1		Model B.2	
	B	exp(B)	B	exp(B)	B	exp(B)	B	exp(B)
Constant	-2.57***	0.08	-2.37*	0.09	-2.37**	0.09	-3.20**	0.04
Perceived neighborhood walkability (1–5)	0.21***	1.23	0.17***	1.19	0.25**	1.29	0.20*	1.23
Travel distance	-0.35***	0.71	-0.35***	0.71	-1.49***	0.23	-1.54***	0.21
Density of 4-way intersection nodes around school	1.24***	3.46	0.76	2.14	2.10***	8.15	1.32*	3.75
Child age	0.14***	1.15	0.14**	1.15	0.21***	1.23	0.21***	1.24
Household income < \$30,000	-0.11	0.90	-0.17	0.84	-0.69**	0.50	-0.82*	0.44
Household income \$30,000 to \$59,999	-0.05	0.95	-0.03	0.97	-0.29	0.75	-0.27	0.77
Household income $\geq$ 100,000 (reference = income of \$60,000 to \$99,999)	-0.10	0.91	-0.01	0.99	-0.59*	0.56	-0.53*	0.59
Number of cars owned	-0.09	0.91	-0.01	0.99	-0.52***	0.59	-0.35*	0.70
Highest education is postgraduate	0.27*	1.31	0.14	1.15	0.57**	1.78	0.40	1.49
School type (neighborhood school = 1)	0.43***	1.54	0.56***	1.74	-0.06	0.94	0.12	1.13
ASC attitude	—	—	0.36***	1.43	—	—	0.79***	2.21
Car attitude	—	—	-0.45***	0.64	—	—	-0.65***	0.52
-2 log likelihood	1,078.21	—	1,044.43	—	528.77	—	489.80	—
Reduction in -2LL	—	—	33.78	—	—	—	38.97	—
			( $p < .001$ , df = 2)				( $p < .001$ , df = 2)	
N	957	—	957	—	957	—	957	—
Nagelkerke $R^2$	.171	—	.214	—	.360	—	.420	—

NOTE: DV = dependent variable; — = coefficient did not pass statistical significance test; df = degrees of freedom.

\* $p < .1$ ; \*\* $p < .05$ ; \*\*\* $p < .01$ .

TABLE 6 Stratified Logistic Models Based on ASC Attitude Categories (Predicting ASC at Least 1 Day a Week)

Variable	Low ASC Attitude ASC Attitude (1~3)		Moderate ASC Attitude ASC Attitude (3~4)		High ASC Attitude ASC Attitude (4~5)	
	B	exp(B)	B	exp(B)	B	exp(B)
Perceived neighborhood walkability (1~5)	0.01	1.01	0.16	1.17	0.22**	1.25
Travel distance	-0.10	0.91	-0.23**	0.80	-0.59***	0.56
% of 4-way intersection nodes around school	1.27	3.58	1.48*	4.41	0.97	2.63
Child age	-0.04	0.97	0.19**	1.21	0.13*	1.14
Household income < \$30,000	1.42*	4.15	-0.30	0.74	-0.52	0.59
Household income \$30,000 to \$59,999	0.08	1.09	0.14	1.15	-0.09	0.92
Household income ≥ 100,000 (reference = income of \$60,000 to \$99,999)	0.19	1.21	-0.17	0.85	0.03	1.03
Number of cars owned	-0.15	0.86	0.14	1.15	-0.10	0.91
Highest education is postgraduate	0.61	1.84	0.19	1.20	0.01	1.01
School type (neighborhood school = 1)	0.26	1.29	0.78**	2.18	0.42*	1.52
Car attitude	-0.20	0.82	-0.23	0.80	-0.66***	0.52
Constant	0.92	2.50	-4.38**	0.01	0.81	2.24
N	84	—	392	—	480	—
Nagelkerke R <sup>2</sup>	.203	—	.170	—	.313	—

NOTE: — = coefficient did not pass statistical significance test.  
 \* $p < .1$ ; \*\* $p < .05$ ; \*\*\* $p < .01$ .

tion in the odds of a child walking or biking to school. But the same increase in travel distance results in a 79% reduction in the odds of a child walking or biking to school at least 3 days a week. Similar findings can be observed for street connectivity around a school site. Car-use attitudes showed a negative association with the dependent variables, as expected. Inclusion of the attitude variables in the model does not appear to influence the effects of travel distance.

### Moderation Effects

A series of stratified regression analyses were run by using attitudes as the moderating variables. The full sample was stratified into three groups on the basis of values of ASC attitude and on the values of car attitude, respectively. These models all predicted the odds

of a child walking or biking to school at least 1 day a week. (The decision to use the lower-frequency ASC as the dependent variable resulted from the imbalance of value distribution for higher-frequency ASC when segmented by attitude levels.) Table 6 reports output from models stratified by ASC attitudes and Table 7 from models stratified by car-use attitudes.

Table 6 shows that, for the group with the weak ASC attitude, the odds of ASC were unrelated to the environmental variables. The only factor that had a statistically significant coefficient was extremely low household income. Compared with higher-income households, low-income families with weak ASC attitudes were more likely to use ASC. This finding suggests that, in some cases, ASC is used not as a desired choice but more out of necessity: children from low-income households may have to walk or bike to school because of inadequate family resources.

TABLE 7 Stratified Logistic Models Based on Car Attitude Categories (Predicting ASC at Least 1 Day a Week)

Variable	Low Car Attitude Car Attitude (1~3)		Moderate Car Attitude Car Attitude (3~4)		High Car Attitude Car Attitude (4~5)	
	B	exp(B)	B	exp(B)	B	exp(B)
Perceived neighborhood walkability (1~5)	0.12*	1.13	0.28**	1.33	0.12	1.13
Travel distance	-0.50***	0.61	-0.49***	0.61	-0.09	0.91
Density of 4-way intersection nodes around school	2.41***	11.18	0.52	1.67	-1.65	0.19
Child age	0.14	1.15	0.09	1.09	0.23**	1.26
Household income < \$30,000	-0.13	0.88	-0.58	0.56	0.38	1.46
Household income \$30,000 to \$59,999	0.36	1.44	-0.10	0.90	-0.15	0.87
Household income ≥ 100,000 (reference = income of \$60,000 to \$99,999)	0.70*	2.01	-0.47	0.63	0.14	1.15
Number of cars owned	-0.25	0.78	0.09	1.09	-0.01	0.99
Highest education is postgraduate	-0.19	0.83	0.34	1.41	0.06	1.06
School type (neighborhood school = 1)	0.29	1.34	0.37	1.45	1.39***	4.01
ASC attitude	0.76***	2.14	0.11	1.11	0.39	1.47
Constant	-4.78***	0.01	-2.93**	0.05	-5.72*	0.00
N	238	—	423	—	295	—
Nagelkerke R <sup>2</sup>	.278	—	.224	—	.171	—

NOTE: — = coefficient did not pass statistical significance test.  
 \* $p < .1$ ; \*\* $p < .05$ ; \*\*\* $p < .01$ .



For parents with moderate to strong ASC attitudes, the effects of the major environmental characteristics on ASC appear discernible. The effect of travel distance on ASC is stronger in the context of a strong ASC attitude than in that of a moderate attitude. A 1-mi increase in travel distance leads to a 20% reduction in the odds of a child walking or biking to school when parents had moderate ASC attitudes compared with 44% when parents had strong ASC attitudes. The street connectivity and neighborhood walkability measures registered statistically significant impacts on ASC only when respondents had moderate or strong ASC attitudes.

Table 7 shows that variation in car-use attitudes had opposite moderating effects. The effects of the major environmental variables on ASC were all statistically significant when parents' car-use attitudes were weak, but none of the environmental variables was statistically significant when car attitudes were strong. A similar pattern of change applies to the ASC attitudes' effects on the dependent ASC behavior variable. Parents' ASC attitudes did not have a statistically significant influence on ASC behavior when parents' car attitudes were moderate or strong. Because ASC attitudes and car attitudes are negatively correlated, parents who had a moderate or strong car attitude tended to have a low ASC attitude. Together, these findings suggest that weaker ASC attitudes are unlikely to exert influence on ASC behavior beyond the effect of car-use attitudes in the pro-car attitudinal context.

Figure 2 shows the predicted likelihood of ASC plotted against travel distance, perceived neighborhood walkability, and school-site street connectivity separately and in different attitudinal contexts. Predicted likelihood is calculated for an 8-year-old child from a typical family living in a typical environmental setting empirically identified with the survey data. [A typical family considered here had the following characteristics: family income between \$60,000 and \$99,999, two cars, no parents with a postgraduate degree, and a child attending neighborhood school by residence. The typical environmental setting used in the calculation involved average walkable travel distance (0.7 mi), average neighborhood walkability (3.56), and average street connectivity (percentage of four-way intersections, 17%).] The graphs confirm the findings discussed earlier: the probability of using ASC is higher when ASC attitudes are stronger, with control for environmental and family characteristics. The graphs also reveal that changes induced by ASC attitude in the ASC probability are of greater magnitude when travel distance is shorter and neighborhood walkability is better, as reflected by the larger gaps between the lines when environmental conditions are more supportive of ASC. These findings are in line with evidence from psychological studies indicating that the attitude-behavior relationship is stronger when the environment is more favorable to supporting the behavior in question (53). These graphs suggest a symmetric nature to the interactional relationship between the environment and attitudinal variables: the influences of these environmental conditions on the ASC probability is stronger when ASC attitudes are stronger, as reflected by the steeper slopes of the lines associated with stronger ASC attitudes.

Although the environment-behavior relationships show a clear pattern of change when the ASC attitude varies, such a pattern is less apparent as a function of car-use attitudes. This difference perhaps results from the fact that car-use attitudes do not have direct correspondence with ASC behavior; their effects on ASC behavior are indirect. For people with strong car-use attitudes, higher street connectivity is associated with lower probability of ASC. Although this relationship was not statistically significant, as indicated in Table 7, the relationship is still worthy of attention. One explanation

could be that a better-connected street network supports pedestrian travel but can also make automobile travel more convenient (54). In a pro-car or car-dependent context, this environmental quality may well encourage more car use at the expense of walking or biking.

## DISCUSSION OF RESULTS

This research offers insights into parents' ASC decision-making processes. First, the analyses show that ASC attitudes exert impacts on the probability of ASC behavior beyond the effects of environmental and household characteristic factors. Furthermore, stronger attitude-behavior relationships, as well as stronger environment-behavior relationships, were observed when a higher threshold measure of ASC (at least 3 days a week) was predicted than when a weaker one was. This difference suggests that, as ASC frequency increases, sensitivity to internal and external conditions also increases. These findings also reveal the diminishing efficacy of ASC attitudes in affecting behavior as car attitudes become stronger.

Second, the findings suggest that, when internal motivation is lacking (i.e., weak ASC attitude), favorable environmental conditions are insufficient to bring about ASC. This conclusion suggests that parents take advantage of or respond to favorable environmental conditions only when they already have a sufficiently strong internal desire to use ASC. The conclusion also implies that the environmental conditions that have been identified as important predictors of active school commuting merely accommodate rather than shape parents' preference for different travel means. When car-use attitudes are extremely strong, environmental conditions showed an insignificant relationship with ASC behavior. It is possible that strong car dependence (in a psychological sense) makes parents insensitive to environmental cues regardless of their ASC attitudes.

Third, when parents hold stronger ASC attitudes and weaker car-use attitudes, environmental variables have greater marginal impacts on the probability of ASC behavior. This finding suggests that environmental improvements, such as shortened home-school distance and better neighborhood walkability, may have a bigger impact on increasing ASC rates when they are instituted in a context of supportive parental attitudes. These findings also suggest that the environment-behavior correspondence observed in one place may not be replicated in another because of differences in the psychological context.

Finally, this research confirms the importance of including attitudinal variables in the study of ASC and points to the importance of examining not only the direct effect of environmental, household, and psychological influences on ASC but also—and how critically—such factors interact with one another. Many well-intentioned efforts at increasing rates of ASC may have failed to reach their full potential because of a failure to identify such effects.

Furthermore, the study highlights the need to explore how parents' ASC attitudes develop over time. These findings suggest that parents' beliefs in the environmental and health implications of ASC are correlated with their educational levels. But car-use attitudes, especially the aspect related to car-dependence, had a weak connection with parents' educational background. Together, these findings indicate that parents' ASC attitude may be molded by making parents better informed whereas car-use attitudes appear to be more situationally determined. Interviews with parents suggested that many had never considered walking or biking to school as an option because driving to school was simply the default choice. As attitude is an important determinant of ASC, future research is needed to improve understanding of the factors that shape parents' attitudes toward ASC.

## POLICY IMPLICATIONS

Existing literature on school travel has mainly adopted what may be called the “barrier approach,” in which ASC is treated as a function of external factors. Barriers such as long distance and lack of walkable environment have been the foci of studies that follow this perspective. Current intervention strategies also emphasize improving the physical environment. Currently, SRTS programs allocate the majority of their funding (70%) to physical improvement projects. The authors argue that a psychological approach should be adopted to understand the decision-making process of parents and to devise more effective interventions.

By following this psychological approach, locations or communities with strong ASC attitudes and relatively weak car-use attitudes should be targeted to receive environmental interventions. To make such a suggestion tenable, assessment of ASC and car-use attitudes should be included in the screening process for funding decisions. Many SRTS programs conduct periodic surveys of school travel. But so far these surveys have included few questions aimed at investigating parental attitudes and other potentially significant sociopsychological constructs (e.g., social norms about ASC). However, schools where parental acceptance of and support for ASC is weak could benefit from SRTS noninfrastructure activities that may shift parents’ ASC attitudes. A better understanding of parents’ attitudes, desires, perceived behavioral control, perceptions of social norms, and behavioral intentions is necessary for predicting the effectiveness of SRTS and other pro-ASC programs.

Finally, this research highlights the importance of disseminating information about the likely health and environmental consequences associated with different transportation modes, especially those related to school trips. This action could be an effective strategy for shifting parents’ attitudes. SRTS programs should take advantage of the findings generated through academic research to help build a strong case for ASC. This strategy also means that, when research on school travel adopts an approach that integrates perspectives from multiple disciplines, such as public health, social psychology, and urban planning, the research outcomes can be of stronger policy relevance.

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