Integrating Parental Attitudes in Research on Children’s Active School Commuting: Evidence from a Community School Travel Survey

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Abstract

Current active school travel research emphasizes travel distance and neighborhood walkability as major environmental conditions affecting the occurrences of children walking or biking to school. The impacts of how 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; it also highlights the moderating effects of parental travel attitudes on the predictive power of some environment conditions. Using data (1197 cases) from a school travel survey conducted in a mid-sized school district in Oregon, this paper reports that parental attitudes toward walking/biking to school and car-use are significant explanatory variables in models predicting occurrence of children walking or biking to school when important environmental variables are controlled for. The analysis also reveals that important built environment variables – school-travel distance 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.
1. Introduction

Over the past 40 years, the U.S. 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 (NHTS), about 65% of all children arrive at school via private automobiles, compared to 18% in 1969 (3). In some communities, school trips now account for 10% of all short trips and close to 30% of morning peak hour traffic (4). Similar trends have been documented in other developed nations (e.g., 5; 6).

Increased reliance on private automobiles for school travel has led to concerns regarding negative impacts of car travel on the environment (3) and possible adverse health impacts on children (7; 8; 9). The increase in automobile use for school travel has coincided with decreasing physical activity and rising obesity rates among children, and many authors have suggested that the three phenomena are related (see 10).

Increasing the rate of children walking or biking to school, or active school commuting (ASC), has become an important national health objective for the near future. Federal and state transportation and public health agencies have promoted programs such as “Safe Routes to School” and campaigns such as “Kids-Walk-to-School” in an effort to increase ASC. Many of these efforts have focused on road safety education, improvements of urban form (e.g., closing sidewalk gaps), and enforcement of traffic rules around school sites (11). Evidence of the effectiveness of these interventions has so far been limited and mixed (11; 12; 13; 14) and some has been less than encouraging (c.f., 15; 16).

Successful and sustained strategies to effect travel behavior change require a thorough understanding of people’s decision-making process. This involves considering not only attributes of environmental conditions that are necessary to support ASC (e.g., safe, complete...
walking or biking routes) but also decision-makers’ attitudes, beliefs, preferences, and other psychological variables (cf., 17; 18). However, current and past programs, interventions and academic research have primarily focused on environmental factors (e.g., sidewalk gaps, street connectivity) that mainly serve as barriers to ASC. Theoretical frameworks developed to analyze ASC do not appear to have fully (or successfully) integrated many psychological factors with other environmental and social influences (e.g., 19; 20; 21). In a recent comprehensive literature review of school travel research, Sirard and Slater pointed out that prominent psychological constructs such as attitudes, expectancies/beliefs, and social norms have not been explored sufficiently in school travel research. (10)

In this paper, we draw from a long tradition of behavior change research in social psychology to expand the active school travel literature. Looking beyond the environmental variables that have thus far dominated the active school commute literature, we explore the role psychological factors play in affecting parents’ school travel decision-making. The psychological variables at the center of our study include parents’ attitudes toward ASC and toward car use, which are conceptualized and measured separately to assess parents’ internal desire or tendency to use these two transportation means. We aim to uncover the degree to which attitudinal and environmental variables directly affect the likelihood of ASC, and the degree to which the attitudinal variables moderate environmental variables’ effects on ASC. Using survey data from a large community sample, we attempt to answer the following research questions:

1) To what degree do the attitudinal variables add to the predictive power of external variables in the study of children walking or biking to school?

2) How are the effects of environmental variables moderated by parental attitudes?
This study contributes to the literature regarding ASC on both theoretical and empirical fronts. We expand the current dominant ecological conceptual framework by integrating an important and previously under-studied component of parents’ decision-making process. Critically, our approach conceives ASC as a behavioral domain that requires strong motivation but is greatly constrained by environmental conditions. Our empirical study offers evidence that underscores the limitations of interventions focused solely on physical environment improvements.

2. Factors Affecting School Travel Behavior: A Brief Review

Existing school travel literature has identified a number of factors that have impacts on the choice of travel mode (see 10 for a recent review). These factors pertain to four primary domains: built environment; social environment; school characteristics; and, family/household characteristics.

2.1 Built Environment.

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

2.2 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 neighborhoods or communities (2; 28). Studies have shown that perceived crime danger is a major barrier to children walking and biking to school (29; 30; 23) and stronger social cohesion/control increases the likelihood of ASC, particularly for those living within one mile of school (2). Various proxy measures of neighborhood social conditions, such as socioeconomic characteristics (e.g., neighborhood household income levels, poverty levels, and occupational makeup), have also been found to correlate with the frequency of ASC (27, 2).

2.3 School Characteristics.

Some school characteristics have also received attention. Recent studies show that school type (magnet vs. neighborhood) has an effect on the likelihood of a child walking or biking to school (31; 26): attending neighborhood schools is associated with higher probability of ASC. Several studies have considered the potential effects of school enrollment size on school travel behavior, although findings appear inconclusive (32; 27). School policies, e.g., rules regarding student walking and drop-off/pick-up, may also affect ASC (29).

2.4 Family/Household Characteristics.

Some family and 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 (27; 6). Children’s own characteristics (e.g., physiological adequacy) also appear to play a role, although reported effects of gender and age are mixed in the literature (see 10). Other family characteristics, including race/ethnicity, also show mixed results.

2.5 Parent psychological characteristics
One understudied component of the family/household characteristics category is parental behavioral preference and travel attitudes. Attitudes, preferences, intentions, beliefs, values and norms are prominent constructs employed in theories of social cognition and intentional behavior (e.g., 33; 34). 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 (e.g., 35). Findings from these studies also tend to qualify the environmental impacts on travel behavior. For example, Bagley (2002) suggests that controlling for attitudes and preferences, environmental factors show little or no residual effect on travel mode choice (36).

While the relations of some of these constructs with travel behavior have been considered within the broader travel-behavior literature (cf., 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 (see 19; 37; 38; 39; 40; 41), and even fewer have sufficiently defined and operationalized measures of these variables (particularly “attitudes”). Moreover, possible interactions between psychological and environmental factors have been mostly ignored by past research efforts.

In one of the few studies that have explored such variables, Black et al. (2001) examined the effects of parents’ attitudes toward car use on for school-travel mode choice (19). Using a series of attitudinal statements, they identified three value orientations underlying parents’ car-use attitudes: environmental awareness, car-centeredness, and individual responsibility. Their analysis showed that these attitudinal variables had explanatory power after controlling for environmental conditions. Among the three dimensions they identified, “car-centeredness” exhibited the strongest (negative) impact on school travel behavior. McMillan (2007) 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 (37). Rodriguez and Vogt
(2009) explored children’s attitudes towards ASC among a sample of elementary students in
Michigan (39). The authors utilized semantic differential scales (e.g., fun/boring, safe/not safe)
to measure a limited set of “attitudes” towards walking to school, and found small but significant
positive effects of “safety attitudes” and “walking saves time” beliefs on self-reported ASC, after
controlling for a variety of environmental, demographic, and “access” factors using multivariate
logistic regression.

Very few studies have explored interactions between psychological and environmental
factors. Panter et al. (2010) examined how environmental factors moderated the relationship
between ASC and parental “attitudes.” They found that the attitude-ACS relationship was
stronger (and negative, such that stronger ‘convenience’ beliefs predicted lower odds of ACS)
for individuals who lived within one kilometer of school than for those who lived farther away
(38). Interestingly, they also found that the relationship between parental concern over safety and
ACS 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
depending on environmental factors.

The apparently low level of interest in investigating these psychological constructs within
the walking-to-school context may be due 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 many other
psychological constructs has likely resulted in weak enthusiasm in adopting those concepts in
analysis. We discuss in the next section a definition of attitude that bears policy relevance, and establish a conceptual framework that integrates attitudes in school travel research.

3. Parental Behavioral Attitudes and Active School Commuting: A Conceptual Framework

3.1 Defining Behavioral Attitude

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 based on “a person’s positive or negative evaluation of performing the behavior” (44, 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 one lives in). Internal factors pertain to one’s own judgment about benefits and costs associated with performing a behavior, which can be assessed on the basis of an individual’s pure self-interests (egoistic concerns). They can also be expanded to include perceived collective consequences and self-ascribed responsibility for social or environmental consequences (altruistic concerns). The second factor that can shape one’s attitude toward a behavior involves an individual’s perceived support for carrying out the behavior and perceived social pressure to perform the action. In other words, attitudes can be influenced by a person’s deliberate calculation as well as by situational facilitators and/or barriers he or she perceives in the social and physical environment.

Our working definition of attitudes integrates several other psychological constructs developed and used in theories of decision-making. Concepts such as social norms, subjective norms, perceived behavioral control, and intentions have been used together with the concept of attitude in behavioral analysis (e.g., 45; 46). While these constructs are theoretically distinctive and meaningful, here we combine them into one construct for the purpose of maintaining theoretical integrity and achieving parsimony. More importantly, we believe our definition bears
policy relevancy in the sense that it helps capture a psychological state that is somewhat malleable via interventions.

Individuals’ assessment of behavioral consequences may be amenable to change via education-oriented interventions. In light of findings that suggest adult education has effects on people’s awareness of environmental problems and their attitudes toward environmentally-relevant behavior and policies (e.g., recycling; see Preston & Feinstein, 2004), 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. The other component in our attitude definition, the situationally shaped aspect, may only become amenable to policy instruments when there are substantial changes in much broader social, physical, and institutional contexts. This component, while a difficult target from 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 perception and/or assessment (e.g., perceived safety concerns), that have received consideration in existing travel behavior analyses. We consider the former construct 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.

We examined two domains of parental attitudes likely important in the ASC behavioral context: attitudes towards ASC and attitudes toward car use. 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 (e.g., 49; 18). There may be other meanings 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 with together.

We measured parents’ attitudes toward car-use because we believe they capture a distinct attitudinal facet and play a unique role in explicating children’s school travel behavior. A growing body of literature suggests that 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 (e.g., 49; 50). 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 (51).

3.2 Parental Attitudes and Children’s Active School Commuting

We conceptualize ASC as a behavior that requires strong internal motivation, and postulate that parents’ decision to use ASC is directly affected by the balance between a desire for ASC and a tendency to use cars. Specifically, when parents have more positive attitudes toward ASC and weaker attitudes toward car-use, they should be more likely to allow their children to walk or bike to school. At the same time, recognizing ASC as a strongly environmentally-constrained behavior, we acknowledge the effects of environmental factors, such as travel distance and neighborhood walkability, on the use of ASC, and also suggest that parents’ attitudes condition the effects of those environmental factors (10).
We hypothesize that when parents’ ASC attitudes are very 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. In contrast, when ASC attitudes are strong, parents may become responsive to environment conditions, and supportive environmental qualities (e.g., shorter travel distance, better walkability) could induce greater likelihood of ASC use. Car-use attitudes, on the other hand, 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 for ASC. We hypothesize that in contexts where car-use attitudes are less predominant, the relationship between environmental conditions and ASC likely becomes stronger. In an empirical study described below, we test our hypotheses using surveys of parents of children attending elementary schools in a middle-sized school district in Oregon.

4. Research Design and Methodology

4.1 Study Area

Our study area was the 4J School District in Lane County, OR. This school district spans 155 square miles in the southern Willamette Valley of Oregon, mainly serving the City of Eugene. Twenty-six elementary schools in this district enrolled approximately 6,000 students in the 2007-2008 academic year. Among these schools, 18 are neighborhood schools with a defined service zone (catchment area/assignment district) and eight are so-called “alternative schools” that each houses certain special programs (e.g., foreign language education, art, or music curriculum). The school district adopts 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).
Our study area possesses some characteristics that are useful for revealing interactions between attitudinal factors and environmental factors with respect to their effects on ASC. The City of Eugene is known for active outdoor activities and good infrastructure for biking and walking. It 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 many other places in this country, residents of Eugene appear to view physical activity as more normative. This suggests that we can expect to see reasonably good variation in the strength of ASC attitudes and pro-car attitudes as well as generally supportive environmental conditions for walking and biking. All of these are necessary to allow the manifestation of attitude-behavior and environment-behavior relationships.

4.2 School Travel Survey

We conducted a mail survey in late April of 2008 to 5,700 households with children attending elementary schools (K-5) in the 4J school district and residing within the city boundary of Eugene. The survey included questions about children’s school travel behavior similar to those used in other studies and national SRTS programs (e.g., 23). It also included questions tapping parents’ attitudes, their perceptions of environmental conditions, and household socio-demographic information. Parents were instructed to fill out the survey for their eldest elementary school child if more than one child in the household was attending elementary school.

4.3 Measures

4.3.1 Active School Commuting.
Parents reported the number of days that their child travels to and from school using different transportation means during a typical school week. We then combined the days that a child walked or biked to school into one measure of the frequency of using ASC. We believe this is a better measure of ASC, compared to measures based on the occurrence of ASC on or prior to the day when the 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 (2009) showed that a questionnaire with an almost identical design as ours had high reliability of the self-reported frequencies of different school travel means used. (52)

4.3.2 Attitudes.

We used a series of questions 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, less auto-dependent life style, and increased opportunity for children to know their environments, are those frequently discussed in the literature as reasons for promoting ASC. We also included items related to the consequences of automobile travel for school trips (such as traffic congestion and air pollution). Parental attitudes towards car use were assessed with another seven items that elicit 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 explicit effort to analyze the independent influence of attitudes on travel behavior (19; 53). All items were tested for semantic clarity. All attitudinal questions were assessed on a 5-point
Likert scale (response choices: 1 = ‘Strongly Disagree,’ 2 = ‘Disagree,’ 3 = ‘Neutral,’ 4 = ‘Agree,’ 5 = ‘Strongly Agree’). We factor analyzed the 14 items to verify that they indeed tapped two distinct attitudinal domains. All items are presented in section 5.2.

4.3.3 Environmental Variables.

We focused on physical/environmental variables in the present study. These variables include two measures based on parents’ perceptions, travel distance and neighborhood walkability, and a GIS-based measure of street connectivity (percentage of 4-way street intersections) for a quarter-mile area around a school site. These variables have been examined in past studies, and are considered important urban form indicators with significant impacts on active school commute. However, their predictive power has not been examined in relation to parents’ attitudes.

4.3.4 Control Variables.

The set of control variables included those pertaining to school characteristics and non-psychological household and child characteristics (e.g., demographics). School characteristics considered involved school type (neighborhood school vs. choice-school) and school enrollment size. Household socio-demographic 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 sections 5.4 and 5.5 due to multicollinearity issues,

4.4 Analysis

Factor analyses were conducted in order to assess the internal consistency of the multiple-item attitudinal measures. We next created two composite measures by averaging the most reliable items (six for ASC; five for car-use). To test our hypotheses, we next performed
stratified logistic multiple regression analyses, which allowed us to examine how the effect of
the environmental variables might differ by parental attitudes toward ASC and car use.

5. Results

5.1 Sample Descriptive Findings of Major Variables

A total of 5,700 surveys were mailed. Discounting 126 non-deliverables, we received
1,197 returned surveys, at a 22% response rate. This response rate is similar with other school
district-wide surveys conducted recently for school travel research (see 31). A comparison of
several socio-demographic and housing characteristics of the sample to those of the population
suggests that the survey response is reasonably representative of our study population. We
imputed from the survey answers that the median family income was $62,500 in 2008,
comparable with the median family income ($48,347 and $60,157) for Eugene families with
dependent children reported in the 2008 American community survey. We identified in our
sample that 22% of children were from non-white families and 75% lived in owner-occupied
housing, compared to the corresponding percentages of 29% and 74%, respectively, based on
school district data.

In our sample, about 32.9% of the children walked or biked to school at least one day a
week, 13.5% walked or biked to school at least 3 days a week, and 8.8% every day to school.
The corresponding percentages for children who walked or biked leaving school are similar,
being 42.9%, 13.0%, and 7.7%, respectively (see Table 1). The predominant mode of school
travel is by private automobiles. More than 60% of children in our sample rode cars (including
car pool) to school at least three days a week; close to half of the children rode a car to school
every day. In the analysis presented below, we focus only on morning travel to school.

[Table 1 about here]
5.2 Attitude Measures

Table 2 reports results from the factor analysis (using oblique rotation). None of the items showed a cross-loading above 0.4. Eleven items loaded on their predicted factor above .5 and were retained for creating the two composite measures. We computed a single measure of ASC attitudes 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 inter-item correlation = .35). Using 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 toward ASC; and values above 4 indicate a strong, positive attitude toward ASC. Similarly, we constructed a single measure of attitudes towards car use by taking the mean of five items ($\alpha = .71$, mean inter-item correlation = .38). The two attitude measures were moderately and negatively correlated, $r(1109) = -0.22, p < 0.01$.

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 regarding the positive health and environmental consequences associated with ASC. This contrast is particularly evident between parents with a post-graduate degree and those without a bachelor degree. However, the agreement levels toward the statements related to car-use attitudes do not seem to correlate with parental educational levels as strongly, as few significant differences emerged.

5.3 Correlations among Key Variables
Table 4 reports correlations between the attitude measures and the environmental measures that we focused on. The purpose of examining correlations among 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 among 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. The correlations between the two attitudinal measures and ASC frequency are of similar magnitude.

Table 4 about here

5.4 Direct Effects of Attitude Variables on ASC Behavior

We ran a series of logistic models to test our primary hypotheses regarding the direct effects of the attitudinal predictors of ASC. Logistic regressions were used because of the highly skewed distribution of ASC frequency, which led us to dichotomize our outcome variable. We tested the additional effects of attitudinal measures on the likelihood of using ASC at two different frequencies (at least one day a week, and at least three days a week) separately, controlling 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 the models (Models A.1 and A.2) predicting ASC at least one day a week, the Nagelkerke R-square increased from 0.171 to 0.214 after the two attitude variables were included; reduction in the -2 Log Likelihood is statistically significant after the two variables were included. The
improvement is similar for models (Models B.1 and B.2) predicting weekly occurrence of ASC at a higher level (at least 3 days a week).

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. When predicting ASC at least one day a week, a one-mile increase in travel distance leads to a 21% reduction 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 three 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. It is interesting to note that including the attitude variables in the model does not appear to affect the effects of travel distance.

[Table 5 about here]

5.5 Moderation Effects

We ran a series of stratified regression analyses using attitudes as the moderating variables. The full sample was stratified into three groups based on the 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 once per week.\(^6\) 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 weak ASC-attitude group, the odds of ASC were unrelated to the environmental variables. The only factor that had a statistically significant coefficient was very low household income. Compared with higher income households, low-income families with weak ASC-attitudes were more likely to use ASC. This 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.

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 strong ASC attitudinal context than in the moderate attitudinal context. A one-mile 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 to 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 6 about here)

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 were statistically significant when car attitudes were strong. A similar pattern of change applies to the ASC attitude’s effects on the dependent ASC behavior variable. Parents’ ASC attitudes did not have a statistically significant influence on ASC behavior when their car attitudes were moderate or strong. Since ASC attitudes and car attitudes are negatively correlated, parents who had moderate or strong car-attitude tended to have low ASC-attitude. Together, these findings suggest that weaker ASC attitudes are unlikely to exert influence on ASC behavior above and beyond the effect of car-use attitudes in the pro-car attitudinal context.

(Table 7 about here)

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 our survey data. The graphs confirm the findings discussed earlier: the probability of using ASC is higher when ASC-attitudes are stronger, controlling for environmental and family characteristics. The graphs also reveal that ASC-attitude induced changes 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 for ASC. These findings are in line with evidence from psychological studies indicating that the attitude-behavior relationship is stronger when there is a more favorable environment supporting the behavior in question (55). These graphs suggest a symmetric nature of the interactional relationship between the environment and attitudinal variables: there are stronger influences of these environmental conditions on the ASC probability when ASC attitudes are stronger, as reflected by the steeper slopes of the lines associated with stronger ASC attitudes.

While 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 is perhaps due to 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 lowered probability of ASC. Although this relationship was not statistically significant as indicated in Table 7, it is still worth paying attention to. One explanation could be that a better-connected street network supports pedestrian travel, but can also make automobile travel more convenient (55). In a pro-car or car-dependent context, this environmental quality may well encourage more car use at the expense of walking or biking.
6. Discussion

Our research offers insights into parents’ decision-making process regarding ASC. First, our analyses show that ASC attitudes exert impacts on the probability of ASC behavior above and beyond the effects of environmental and household characteristic factors. Additionally, stronger attitude-behavior relationships, as well as stronger environment-behavior relationships, were observed when predicting a higher threshold measure of ASC (at least 3 days per week) than a weaker one (ASC at least once per week). This suggests, not surprisingly, that as ASC frequency increases, sensitivity to internal and external conditions also increases. Our findings also reveal the opposite effects that car-use attitudes have in influencing ASC behavior as well as the diminishing efficacy of ASC attitudes in affecting behavior as car attitudes become stronger.

Second, our findings suggest that when internal motivation is lacking (i.e., weak ASC attitude), favorable environmental conditions are insufficient to bring about ASC. This 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. This 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 very strong, environmental conditions showed an insignificant relationship with ASC behavior. This is likely just the flip side of the ASC attitude findings. It is also 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 had greater marginal impacts on the probability of ASC behavior. This
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 the environment-behavior correspondence observed in one place may not be replicated in another because of difference in psychological context.

Finally, our 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 critically, how such factors interact with one another. Many well-intentioned efforts at increasing rates of ASC may have failed to reach their full potential due to a failure to identify such effects.

Furthermore, the study highlights the need to explore how parents’ ASC attitudes develop over time. Our findings suggest 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 the car-use attitude appears to be more situationally determined.

Indeed, 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 our understanding of the factors that shape parents’ attitudes toward ASC.

7. Policy Implications

Existing literature on school travel has mainly adopted what we call 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 following this perspective. Current intervention strategies also emphasize improving the physical environment. Currently, Safe Routes to School programs allocate the majority of funding (70%) to physical improvement projects. We argue that a psychological approach should be adopted to understand the decision-making process of parents and for devising more effective intervention strategies.

Following this approach, locations or communities with strong ASC attitudes and relatively weak car-use attitudes should be targeted to receive environmental interventions. In order 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 periodical surveys of school travel. But so far these surveys have included few questions aimed at investigating parental attitudes and other potentially significant socio-psychological constructs (e.g., social norms regarding ASC). On the other hand, schools where parental acceptance of and support for ASC is weak could benefit from SRTS non-infrastructure 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, our research highlights the importance of disseminating information about the likely health and environmental consequences associated with different transportation modes and especially those related to school trips. This could be an effective strategy to shifting parents’ attitudes. SRTS programs should take advantage of the findings generated through academic research to help build a strong case for ASC. This also means that the research on school travel can be of stronger policy relevance when adopting an approach that integrates perspectives from multiple disciplines, such as public health, social psychology, and urban planning.
In the case of school travel of young children (e.g., K-Grade 5), we anticipate that parents’ attitudes have significant impacts on their decision to choose active school travel modes for their children, and assume that decisions to commute actively are made primarily by parents.

We conducted interviews with parents to test the clarity of the survey questions. The surveys were tested on six parents before being sent out.

We also created a number of other urban form measures, including housing density, land use mix, road network density. 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 (see Schlossberg et al., 2006)

While the travel distance and neighborhood walkability variables are not direct measures of objective environmental characteristics, they are indicative of the environmental conditions that can better predict active school travel. We also used GIS-based indicators to verify the reliability of some of the measures. Using the subjective measures of the environment is consistent with the attitude theories developed in social psychology that outside world affects a behavior mainly through an individual’s perception of environment conditions (cf., Guagnano, et al., 1995).

We were able to geocode 780 cases, and computed distance for these 780 cases. We decided against using the GIS measure in our subsequent analyses because of the smaller sample size.

We decided to use the lower-frequency of ASC as the dependent variable because of the imbalance of value distribution for higher-frequency ASC when segmented by attitude levels.

A typical family considered here had the following characteristics: a family income between $60,000 and $99,999, with two cars, no parents with a post-graduate degree, and the child attending his/her neighborhood school by residence. The typical environmental setting used in the calculation involves average walkable travel distance (0.7 mile), average neighborhood walkability (3.56), and an average street connectivity (% 4-way intersections, 17%).
Acknowledgement: This study was supported by Oregon Transportation Research and Education Center. We thank Community Planning Workshop at the Community Service Center, the University of Oregon, and the 4J school district at Lane County, Oregon for assistance with conducting the school travel survey. The authors want to express special thanks to Bethany Steiner, Robert Parker, and Marc Schlossberg.
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Table 6. Stratified logistic models based on ASC attitude categories (Predicting ASC at least one day a week)
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Figure 1. The study area and schools
Figure 2. Predicted ASC probability against major environmental variables in different attitudinal contexts
Table 1. School Travel Mode Frequency from the 4J Survey

<table>
<thead>
<tr>
<th>School Travel Mode and Frequency</th>
<th>Arriving School</th>
<th>Leaving School</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>at least one day a week</td>
<td>at least 3 days a week</td>
</tr>
<tr>
<td>Walk/bike to school</td>
<td>32.9%</td>
<td>13.5%</td>
</tr>
<tr>
<td></td>
<td>42.6%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Ride in a car</td>
<td>74.2%</td>
<td>60.4%</td>
</tr>
<tr>
<td></td>
<td>71.0%</td>
<td>51.2%</td>
</tr>
<tr>
<td>Ride in school bus</td>
<td>39.8%</td>
<td>22.8%</td>
</tr>
<tr>
<td></td>
<td>30.9%</td>
<td>25.2%</td>
</tr>
</tbody>
</table>
Table 2. Factor loading of component questions on attitude measures

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

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.
* initial item for assessing ASC attitude, excluded in the single ASC-attitude measure
** initial item for assessing car-use attitude, excluded in the single car-attitude measure
Table 3. Mean scores of answer to attitude questions by the highest educational achievement among family members

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

***. p<0.01, **. p<0.05, *. p<0.1
Mean comparison reference group: post-graduate degree
Table 4. Correlation between key measures

<table>
<thead>
<tr>
<th></th>
<th>ASC attitude</th>
<th>Car attitude</th>
<th>Travel Distance</th>
<th>Neighborhood Walk-ability</th>
<th>ASC frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC attitude</td>
<td>1</td>
<td>-0.224 ***</td>
<td>-0.085 **</td>
<td>0.110 ***</td>
<td>0.223 ***</td>
</tr>
<tr>
<td>Car attitude</td>
<td>1</td>
<td>0.049</td>
<td>-0.106 ***</td>
<td>-0.232 ***</td>
<td>0.224 ***</td>
</tr>
<tr>
<td>Travel Distance</td>
<td>1</td>
<td>-0.156 ***</td>
<td>-0.306 ***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighborhood Walk-ability</td>
<td>1</td>
<td>0.224 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N=1109, N=1036, N=1096, N=1109, N=1037, N=1041

***. p<0.01, **. p<0.05, *. p<0.1
### Table 5. Predicting ASC behavior with and without attitude variables

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
</tr>
</thead>
<tbody>
<tr>
<td>DV: ASC &gt;= 1 day a week (1=yes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model A.1</td>
<td>Model A.2</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Exp(B)</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.57</td>
<td>**</td>
</tr>
<tr>
<td>Perceived</td>
<td>-0.21</td>
<td>***</td>
</tr>
<tr>
<td>neighborhood</td>
<td>0.14</td>
<td>**</td>
</tr>
<tr>
<td>walkability (1-5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel distance</td>
<td>-0.35</td>
<td>***</td>
</tr>
<tr>
<td>Density</td>
<td>1.24</td>
<td>***</td>
</tr>
<tr>
<td>4-way intersection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child age</td>
<td>0.14</td>
<td>**</td>
</tr>
<tr>
<td>household income</td>
<td>-0.11</td>
<td>**</td>
</tr>
<tr>
<td>less than $30,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>household income</td>
<td>-0.05</td>
<td>**</td>
</tr>
<tr>
<td>$30,000 to $59,999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>household income</td>
<td>-0.10</td>
<td>**</td>
</tr>
<tr>
<td>above $100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(reference: income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>above $60,000-$99,999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>number of cars</td>
<td>-0.09</td>
<td>**</td>
</tr>
<tr>
<td>owned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>highest education</td>
<td>0.27</td>
<td>**</td>
</tr>
<tr>
<td>is post graduate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School type</td>
<td>0.43</td>
<td>***</td>
</tr>
<tr>
<td>(neighborhood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>school =1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASC attitude</td>
<td>0.36</td>
<td>***</td>
</tr>
<tr>
<td>Car attitude</td>
<td>-0.45</td>
<td>***</td>
</tr>
<tr>
<td>-2 log likelihood</td>
<td>1078.21</td>
<td></td>
</tr>
<tr>
<td>Reduction in -2LL</td>
<td>33.78 (p&lt;0.001, df=2)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>957</td>
<td></td>
</tr>
<tr>
<td>Nagelkerke R</td>
<td>0.171</td>
<td></td>
</tr>
<tr>
<td>Square</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 6. Stratified logistic models based on ASC attitude categories (Predicting ASC at least one day a week)

<table>
<thead>
<tr>
<th></th>
<th>Low ASC Attitude (1–3)</th>
<th>Moderate ASC Attitude (3–4)</th>
<th>High ASC Attitude (4–5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Exp(B)</td>
<td>B</td>
</tr>
<tr>
<td>Perceived neighborhood walkability (1–5)</td>
<td>0.01</td>
<td>1.01</td>
<td>0.16</td>
</tr>
<tr>
<td>Travel distance</td>
<td>-0.10</td>
<td>0.91</td>
<td>-0.23</td>
</tr>
<tr>
<td>% of 4-way intersection nodes around school</td>
<td>1.27</td>
<td>3.58</td>
<td>1.48</td>
</tr>
<tr>
<td>Child age</td>
<td>-0.04</td>
<td>0.97</td>
<td>0.19</td>
</tr>
<tr>
<td>Household income less than $30,000</td>
<td>1.42</td>
<td>*4.15</td>
<td>-0.30</td>
</tr>
<tr>
<td>Household income $30,000 to $59,999</td>
<td>0.08</td>
<td>1.09</td>
<td>0.14</td>
</tr>
<tr>
<td>Household income above $100,000</td>
<td>0.19</td>
<td>1.21</td>
<td>-0.17</td>
</tr>
<tr>
<td>(reference: Income above $60,000–$99,999)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cars owned</td>
<td>-0.15</td>
<td>0.86</td>
<td>0.14</td>
</tr>
<tr>
<td>Highest education is post graduate</td>
<td>0.61</td>
<td>1.84</td>
<td>0.19</td>
</tr>
<tr>
<td>School type (neighborhood school =1)</td>
<td>0.26</td>
<td>1.29</td>
<td>0.78</td>
</tr>
<tr>
<td>Car attitude</td>
<td>-0.20</td>
<td>0.82</td>
<td>-0.23</td>
</tr>
<tr>
<td>Constant</td>
<td>0.92</td>
<td>2.50</td>
<td>-4.38</td>
</tr>
<tr>
<td>N</td>
<td>84</td>
<td>392</td>
<td>480</td>
</tr>
<tr>
<td>Nagelkerke R Square</td>
<td>0.203</td>
<td>0.170</td>
<td>0.313</td>
</tr>
</tbody>
</table>
Figure 1. The study area and study schools

Location of Schools in 4J District, Oregon

- Elementary School Catchment Area
- Eugene Boundary
- 4J Neighborhood Elementary Schools
- 4J Alternative Elementary Schools
Figure 2. Predicted ASC probability against Major Physical Environment Variables in Different Attitudinal Contexts