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Travel and the social environment: Evidence from Alameda County, California

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Abstract

The relationship between travel and the environment has been the subject of much study but the focus has mainly been on the physical and built environment. This ignores a large body of research in sociology showing that social processes are spatially embedded and affect individual behavior. This analysis asks whether the neighborhood social environment – in addition to the built environment – influences children's decision to walk to school in Alameda County, California. The results show that social factors, particularly neighborhood cohesion, do influence the decision to walk particularly when children face trips of less than 1.6 km. These findings provide initial evidence for transportation analysts to broaden their definition of the environment to include social factors.

Keywords: Social environment; Urban sociology; Walking

1. Introduction

There has been a long-standing interest with the relationship between travel and the environment. However, many analysts have seen the environment as only a physical entity. Great care has been taken in developing measures of the built and physical environments to isolate whether sidewalk availability, land use mixing, distance, or topography has the greater influence on travel behavior. But the definition and measurement of the environment has focused only on the physical world and ignored the role of neighborhood relations – the social environment – in people's travel behavior.

Studies in urban sociology show that social processes are spatially embedded and have strong impacts on individual behavior. By ignoring the social dimensions of space, previous research may have mis-specified the relationship between the built environment and travel choices and ignored how neighborhood social interactions affect behavior. This could lead to an incorrect estimation of the built environments' impact on behavior and lead to poor policy choices. Particularly now, when many health policymakers are interested in promoting walking and biking, it is important that they look at all aspects of the environment (Transportation Research Board and Institute of Medicine, 2005).

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To better understand the significance of the social environment affecting transportation analysis and practice, it is asked whether the social environment, as measured by neighborhood cohesion and trust, influences children's decision to walk to school. Here I focus on children for two reasons. First, the US Department of Health and Human Services (2000) identified increasing walking rates to school as a goal in its *Healthy People 2010* report and several studies have suggested that walking to school can be an important source of physical activity in children's lives, potentially leading to lower rates of childhood obesity (Tudor-Locke et al., 2001). In addition, children's travel patterns may be particularly sensitive to the social environment due to parents' control over children's travel choices. Surveys show that many parents will not allow their children to walk to school because they are concerned about 'stranger danger' (Martin and Carlson, 2005).

2. Background

Although the study of environmental impacts on behavior has recently been accused of being a cottage industry in urban sociology (Sampson et al., 2002) and transportation (Cervero, 2002), the fields have defined the environment very differently. Transportation researchers, perhaps because of the focus on evaluating the claims of New Urbanism, have considered the environment to be almost purely physical. The transportation literature has compared and contrasted auto and pedestrian-oriented neighborhoods (Cervero and Radisch, 1996) and evaluated the effects of three-way stops, land use mixing, and density (Cervero and Kockelman, 1997; Cervero and Duncan, 2003). In contrast, urban sociologists have conceptualized neighborhoods from a social resource perspective. Neighborhood socioeconomic status (SES) has been seen as a critical proxy for community resources and is often assessed using aggregations of individual measures, e.g. percent living below the poverty line. More recently, sociologists have explored methods to directly measure levels of social trust and neighborhood cohesion. The following briefly summarizes the literature on neighborhood effects in transportation and sociology.

2.1. Non-motorized travel and the environment

The relationship between non-motorized travel and the environment has been heavily studied in recent years – Ewing and Cervero (2001), Boarnet and Crane (2001), and Handy (2005). For utilitarian trips, many have found that land use mixing (Cervero and Duncan, 2003), sidewalk availability (Rodriguez and Joo, 2004), and density (Cervero and Kockelman, 1997; Forsyth et al., 2006) are positively associated with walking. Recreational trips have proved more difficult to characterize. In a study of strolling trips in Austin, Texas, Cao et al. (2006) found that neighborhood factors such as perceptions of safety, shade, and traffic did affect the number of leisure walking trips. A study of adults living in Minneapolis showed higher rates of leisure walking in low density areas (Forsyth et al., 2006).

Some studies have considered neighborhood social factors to be part of the built environment. Cervero and Duncan (2003) used the proportion of households with income less than $25,000 as an "admittedly less-than-ideal proxy" of neighborhood quality and safety; the factor was not significant in their model of walking in San Francisco. Handy, in studies of Austin and Northern California, included measures of neighborhood safety (e.g. "quiet neighborhood", "low crime rate", "safe neighborhood for walking") and socializing (e.g. "diverse neighbors", "lots of interaction among neighbors") and found safer areas with more socializing to have higher rates of strolling trips but no effect on vehicles miles driven (Handy et al., 2005).

2.2. Social processes and space

Several studies have found that measures of neighborhood SES derived from the Census have statistically significant effects on child and adolescent development (Brooks-Gunn et al., 1993) and school attendance (Ensminger et al., 1996) after controlling for individual and household factors. The indicators of neighborhood SES included census tract measures of the portion of families on public assistance, the fraction of male workers in professional occupations, the percent living below the poverty line, percent in white collar occupations, and the fraction of female-headed households.

Studies from the Project on Human Development in Chicago Neighborhoods (PHDCN) have developed direct measures of neighborhood social relations and found that two concepts – control and cohesion – were strong predictors of violence levels (Sampson et al., 1997), children's health outcomes (Morenoff, 1999), low birth weight (Morenoff, 2003), and children's physical activity (Molnar et al., 2004) even after controlling for individual and family characteristics. Informal social control described neighbors' "willingness to intervene on behalf of the common good"; social cohesion represented the degree of interaction among neighbors.

3. Data and variables

The analysis required data on trip patterns, sociodemographics, the built environment, and the social environment. To accomplish this, I utilized information from multiple sources including regional transportation agencies, the US Census, and health surveys. Complete data were obtained for Alameda County, California which is located on the eastern shore of the San Francisco Bay and has a highly diverse population and varying land uses. The eastern portion of the county contains the cities of Oakland and Berkeley and is characterized by higher density development patterns. The western portion of the county is typified by classic suburban residential development patterns with large office parks and separated single-family residential development. These types of development patterns are common around many metropolitan areas and make the study generalizable to the larger population.

3.1. Trip and sociodemographic information

The main source of travel data is the 2000 Metropolitan Transportation Commission Bay Area Travel Survey (BATS) which provides information on activities and travel choices as well as sociodemographics for 15,000 households in the nine county San Francisco Bay Area (Morpace International, 2002). Each participating household was assigned a two-day travel period and reported all activities during this time period. Travel data for children under 15 were proxy-reported by the parents which may introduce an unknown amount of error. However, it seems likely that the school trip is less subject to reporting errors than other trip purposes and activities. Besides trip and activity data, the BATS survey provides information on the demographic characteristics of the children and their family members. This includes: age, sex, race/ethnicity, household income, vehicle ownership, household workers, and household size. Table 1 shows summary statistics for all variables tested for inclusion in the model.

The sample has been restricted to children between the ages of 5 and 18 living in Alameda County who traveled before 10 a.m. between home and school. If children repeated their trip between home and school on each of the survey days, only the first occurrence was included in the analysis. This was done because nearly 95% of children traveling to school on consecutive days used the same mode both days. In addition, only children with geocoded home and school locations were included in the analysis to allow calculation of trip distance and to compute measures of the built environment. Here, trip distance is defined as a modified air-line distance assuming children followed a gridded street network, i.e. distance is the sum of the x and y vectors between two points A and B. Given these requirements, the BATS sample consisted of 706 children meeting the criteria. After accounting for missing data, the final sample was 614 children reporting all information for required explanatory variables.

3.2. Built environment

To characterize the built environment, data were obtained from several sources. The Metropolitan Transportation Commission in conjunction with the Association of Bay Area Governments provided data at the traffic analysis zone (TAZ)-level about land use including number of dwelling units, number of employees by sector, and land area by land use type. Geographic Information Systems (GIS) analysis using Census 2000 Tiger files was used to characterize the street network near children's residences. No data on the environment at the school were included in the analysis because of the potential for multi-collinearity particularly for children who walked to school. For example, 49% of all walking trips to school occurred within the same TAZ or census tract.

Table 1
Summary statistics

	All trip distances			Trips less than 1.6 km		Trips greater than 1.6 km	
	Obs	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Outcome							
Walked to school	700	0.19	0.39	0.38	0.49	0.05	0.21
Individual							
Distance (m)	691	4137	7399	859	390	6522	9001
Age (y)	700	10.9	4	10.2	4	11.4	4
Female	700	0.51	0.50	0.47	0.50	0.54	0.50
Black	686	0.07	0.25	0.06	0.23	0.07	0.26
Latino	686	0.10	0.30	0.12	0.33	0.08	0.27
Asian/Pac. Isl.	686	0.13	0.34	0.13	0.34	0.13	0.33
2 + races	686	0.08	0.27	0.09	0.28	0.07	0.25
Disabled	699	0.02	0.13	0.01	0.08	0.03	0.16
Driver's license	700	0.10	0.30	0.07	0.26	0.12	0.33
Household							
HH income ($000)	643	90.4	42.6	85.4	40.3	94.1	44.1
Single parent household	677	0.11	0.32	0.10	0.30	0.12	0.33
Vehicles per driver	690	1.09	0.37	1.06	0.35	1.10	0.39
# of Children	698	2.17	0.87	2.20	0.82	2.14	0.90
Built environment							
Dwelling units per sq km	700	1815	1533	1876	1455	1720	1399
Employees per sq km	700	6483	5803	6404	5476	6491	5995
Entropy	700	78	15	78	14	78	16
Residential index	700	59	21	61	19	58	22
Average block size	700	49,030	47,245	41,873	24,460	54,598	58,279
Intersection density	700	149	43	151	37	147	47
% 1-Way intersections	697	0.23	0.12	0.22	0.11	0.25	0.12
% 3-Way intersections	697	0.56	0.11				
% 4-Way intersections	697	0.20	0.16	0.21	0.17	0.18	0.15
Social environment							
% On public assistance	700	0.03	0.03	0.03	0.03	0.03	0.03
% Living below poverty line	700	0.07	0.07	0.07	0.07	0.07	0.07
% Female-headed families	700	0.09	0.06	0.09	0.05	0.09	0.06
% Unemployed	700	0.03	0.02	0.03	0.02	0.03	0.02
% Asian/Pac Isl.	700	0.21	0.14	0.19	0.12	0.21	0.15
% Latino	700	0.14	0.11	0.14	0.13	0.13	0.10
% Black	700	0.09	0.13	0.07	0.11	0.10	0.15
% Foreign born	700	0.23	0.12	0.23	0.11	0.24	0.12
% Owner-occupied housing	700	0.67	0.20	0.68	0.21	0.67	0.20
% Living in same house 1995	700	0.53	0.10	0.55	0.10	0.52	0.10
Neighborhood cohesion (5 pt Likert scale)	700	2.28	0.21	2.27	0.21	2.29	0.21

From the available data, we constructed measures of the built environment that were found to influence behavior in previous studies of walking behavior (see Handy et al., 2002 for a typology of such measures). These include entropy, calculated as

$$E = -\left[\sum_j p_j \ln p_j\right] \Big/ \ln k, \tag{1}$$

where p_j = proportion of land in use j and k represents the total number of land uses (single family, multi-family, retail/service, and manufacturing/trade/other), which produces an index between 0 and 1 measuring how mixed the land uses are within an area (Cervero and Kockelman, 1997). A residential index adopted from Cervero and Duncan (2003) measures whether an area is predominantly residential or commercial and is calculated as dwelling units as a percent of dwelling units and total employment in a traffic analysis zone. Density measures of the number of dwelling units and employees per square kilometer in the TAZ were also computed from the land use data (Boarnet and Crane, 2001). Finally, several measures of street connectivity such as the number of intersections per square kilometer and the percentage of 1, 3, 4, and 5-way intersections within a 0.8 km radius of the home were calculated using GIS from the Census Tiger files. The 0.8 km distance was chosen because the majority of walking trips in the sample occurred within this distance and previous work has shown this to be an effective buffer distance (Lee and Moudon, 2006).

3.3. Social environment

Information on the neighborhood social environment was incorporated through measures of structural characteristics and direct measures of social relations. Structural characteristics are generally measured as aggregations of individual characteristics often using census data (Morenoff, 2003). Census measures that had been shown to affect behavior (Brooks-Gunn et al., 1993; Ensminger et al., 1996; Sampson et al., 1997) were computed at the tract level. The tract level was chosen because it is nearly identical to the TAZ, thereby assuring comparable geographic units. The census measures include the percent of residents that are: black/African–American; Latino/Hispanic; Asian/Pacific Islander; living below the poverty line; living in female headed households; foreign-born; unemployed; on public assistance; and living in the same house as 1995.

Direct measures of neighborhood social cohesion and control were available from the 2003 California Health Interview Survey (CHIS). Funded by the California Department of Health Services and several non-profit and other government agencies, CHIS collects data on all aspects of Californians' health and is the largest phone survey in the state (California Health Interview Survey, 2003). In 2003, a section on neighborhood cohesion was added into the survey. Respondents were asked how strongly they agreed or disagreed with statements such as "people in my neighborhood are willing to help one another", "people in this neighborhood generally do not get along with each other", "people in this neighborhood can be trusted", and "most people in this neighborhood know each other". These questions are nearly identical to those used in the Project on Human Development in Chicago Neighborhoods to develop measures of neighborhood relations (Sampson et al., 1997). These individual-level responses were transformed to tract-level aggregates by calculating the mean tract response to the series of questions after accounting for individual-level biases due to sex, age, race/ethnicity, and household income.

Sufficient responses at the tract level were only available for Alameda County due to a planned oversampling of that area (California Health Interview Survey, 2003). For this reason, the analysis is restricted to Alameda County as opposed to the nine-county Bay Area. In addition, there is a temporal mismatch between the 2003 CHIS and the 2000 BATS data. I have assumed that the measures of neighborhood cohesion were relatively stable during the three-years between the surveys. This assumption is reasonable over this time period because census data show that the majority of residents will have remained in the same house.

4. Methodology

To evaluate how the social environment affects children's behavior, I constructed a binary logit model of whether the respondent walked to school. The representative utility of walking for each person, V_n, is a function of trip, child, household, and neighborhood characteristics. Examination of the data showed that walking significantly declines for distances over 1.6 km (1 mile). For example, 38% of Alameda County students walked to school for distances of less than 1.6 km; only 5% of students walked when the trip was more than 1.6 km. These findings suggested that the factors influencing the decision to walk might change with trip distance. Because of this, each explanatory factor was interacted with dummy variables representing trip distances of less than and greater than 1.6 km. The estimated model is

$$V_n = \alpha + \omega D_L + \beta(T_n \times D_S) + \beta'(T_n \times D_L) + \delta(C_n \times D_S) + \delta'(C_n \times D_L) + \gamma(\mathrm{HH}_n \times D_S) + \gamma'(\mathrm{HH}_n \times D_L) + \kappa(\mathrm{BE}_n \times D_S) + \kappa'(\mathrm{BE}_n \times D_L) + \theta(\mathrm{SE}_n \times D_S) + \theta'(\mathrm{SE}_n \times D_L), \quad (2)$$

where V_n represents the observed utility to person n of walking to school; α is a constant; D_S is a dummy variable indicating trips of less than 1.6 km; D_L is a dummy variable indicating trips of at least 1.6 km; T_n represents trip characteristics such as distance and time of year; C_n represents the characteristics of the individual such as age and gender; HH_n represents household factors such as income and auto ownership; BE_n represents the built environment at the child's residence; and SE_n represents the social environment at the child's residence.

This model structure is functionally equivalent to estimating separate models for trips over and under 1.6 km, but allows easier testing of whether trip distance affects the coefficients on the explanatory variables. Robust standard errors were used to ensure conservative tests of variable effects. Variables were retained in the final models if they were significant at the 95% level or if there was an important theoretical reason for retaining them. Wald tests (equivalent to Chow-type tests in linear regressions) were then used to determine whether the coefficients were different for trips of different distances. For example, I tested whether $(\theta - \theta') = 0$ to see whether the social environment exerted a different influence for short and long trips. When there was no statistical difference between the sets of coefficients, the interaction term was removed.

4.1. Developing measures of the environment

Many studies of the relationship between behavior and the environment use factor analysis to decrease the number of environmental variables and account for problems with multicollinearity (Cervero and Duncan, 2003). This approach was tried but rejected for this analysis because a large number of the environmental measures had uniqueness statistics greater than 0.5 suggesting they did not share a strong relationship with other measures and analyses conducted with the factors that were created (representing neighborhood poverty, mixed land use, and residential stability) did not predict behavior better than the original variables and were more difficult to interpret.

In addition, measures of the social environment were translated into standardized z scores following Morenoff (2003) and Sampson et al. (1997). Models were tested with both the raw and standardized variables. Results were not significantly different with either set of measures and I have chosen to present the results based on the raw scores.

4.2. Evaluating marginal effects

Coefficients from logit models tend to be uninformative at face value. In linear models, the coefficient on any variable succinctly describes the effect of that variable on the outcome variable of interest. In logit models, the effect of any one variable on the outcome depends on the values of all variables and coefficients (Ben-Akiva and Lerman, 1985). Because of this, I have calculated marginal effects or discrete changes for variables of interest. For any dummy variable, D, the marginal effect for each individual is computed as

$$\frac{\Delta \Pr(Y_n = \text{Walk})}{\Delta D_n} = \Pr(Y_n = \text{Walk}|D_n = 1) - \Pr(Y_n = \text{Walk}|D_n = 0). \tag{3}$$

For a continuous variable, X, the marginal effect is

$$\frac{\partial \Pr(Y_n = \text{Walk})}{\partial X_n} = \beta_{X_n} \Pr(Y_n = \text{Walk})[1 - \Pr(Y_n = \text{Walk})]. \tag{4}$$

As is clear from the formulae above, the marginal effect of any variables depends on all other coefficients and variables. I report estimates of the marginal effects at the mean of other variables.

5. Results and discussion

Table 2 summarizes the results. The restricted model shows coefficient estimates for a model which does not include social environmental variables; the full model includes measures of the social environment. While the

Table 2
Results

	Restricted model: no social environment variables			Full model			
	Coef.	Robust std. err.	$P > \|z\|$	Coef.	Robust std. err.	$P > \|z\|$	Marg. effect
Trip							
D_L (dummy)	−9.404	2.286	0.00	−13.751	8.037	0.09	−0.99
Distance × D_S	−0.003	0.000	0.00	−0.003	0.001	0.00	0.00
Distance × D_L	0.000	0.000	0.69	0.000	0.000	0.50	0.00
Individual							
Age	0.165	0.044	0.00	0.174	0.050	0.00	0.01
Driver's license	−1.168	0.552	0.03	−1.129	0.597	0.06	−0.03
Black	1.937	0.626	0.00	3.740	0.784	0.00	0.56
Disabled	−2.733	1.417	0.05	−4.379	1.758	0.01	−0.04
Household							
Income ($000)	0.005	0.004	0.19	0.007	0.004	0.07	0.00
Vehicles per driver	−0.156	0.474	0.74	−0.126	0.502	0.80	−0.01
# of kids × D_L	0.944	0.225	0.00	1.115	0.262	0.00	0.04
Built environment							
Dwelling units per sq km × D_S	0.000	0.000	0.85	0.000	0.000	0.40	0.00
Dwelling units per sq km × D_L	0.000	0.000	0.42	0.001	0.000	0.00	0.00
Avg. block size × D_S	0.000	0.000	0.00	0.000	0.000	0.00	0.00
Avg. block size × D_L	0.000	0.000	0.25	0.000	0.000	0.62	0.00
Entropy × D_S	0.028	0.013	0.04	0.018	0.014	0.23	0.00
Entropy × D_L	0.043	0.020	0.04	0.049	0.027	0.07	0.00
Social environment							
% Black × D_S				−5.365	2.885	0.06	−0.21
% Black × D_L				−12.639	9.542	0.19	−0.51
% Below poverty line × D_S				7.071	5.359	0.19	0.28
% Below poverty line × D_L				−15.727	13.701	0.25	−0.63
% Same residence 1995 × D_S				−1.733	2.187	0.43	−0.07
% Same residence 1995 × D_L				4.276	4.197	0.31	0.17
Social control/cohesion × D_S				2.486	0.932	0.01	0.10
Social control/cohesion × D_L				1.962	2.099	0.35	0.08
Constant	−2.683	1.426	0.06	−6.877	2.980	0.02	
N				612		612	
Log likelihood				−178.855		−165.128	
McFadden's adjusted rho square				0.31		0.33	
Likelihood ratio test of parameterized vs. constant-only model				$\chi^2 = 153.10$ ($p < 0.001$)		$\chi^2 = 174.62$ ($p < 0.001$)	
Likelihood ratio test of full model vs. restricted model						$\chi^2 = 27.454$ ($p < 0.001$)	
Wald test of full model vs. restricted model						$\chi^2 = 28.25$ ($p < 0.01$)	

D_S = Dummy for trips of less than 1.6 km; D_L = Dummy for trips greater than 1.6 km.
Note: Coefficients on dummy variables for the survey month are not shown and are available from the author.

focus is on the effects of the environment on children's walking behavior, it is instructive to first review the coefficient estimates on individual and household factors. In general, the estimated parameters are reasonable and match the sign of previously findings (Ewing and Greene, 2003; Schlossberg et al., 2006; McMillan, 2007). Children are increasingly likely to walk to school as they age until they obtain driver's licenses. The only racial variable that was significant was an indicator for African–American students. Being African–American increases the probability of walking by 0.56 (holding other variables at their mean) that suggests that even after controlling for factors such as income and auto ownership and trip distance, black students may face a significantly different choice situation than their peers. It is surprising that neither vehicle ownership nor household income produce significant coefficients. However, this may be explained by the correlation between those two variables. Both factors were retained because they represent slightly different aspects of access and class.

In addition, the model structure shows the non-linear influence of trip distance on the decision to walk to school. For trips of less than 1.6 km, distance has a strong linear effect. But once children face trip distances of more than a mile, the actual distance does not matter. Instead, the probability of walking drops a constant amount once students face trips longer than 1.6 km. Wald tests that the coefficients on trip distance are equal for trips under and over 1.6 km confirm the highly non-linear nature of the effect of trip distance ($\chi^2(1) = 42.67$, $p < 0.01$). These findings highlight the importance of developing models which are conditioned on distance, i.e. estimating models for trips less than a critical distance, or explicitly accounting for the non-linear way distance affects the probability of walking.

5.1. Effect of the environment

The results show that the social environment has a statistically significant effect on whether children walk to school as shown by Wald and likelihood ratio tests of the full vs. restricted models. Not surprisingly, the strongest social environment influence on behavior came from the direct survey measures of neighborhood-level social trust and cohesion. A one-point increase in rating of neighborhood social trust would increase the probability of walking for short trips by 0.1, holding all other variables at their mean. As Fig. 1 shows, the neighborhood environment has an effect at all trip distances but its effects are strongest for trips under 1.6 km.

The census-based measures of the social environment were not significant, perhaps because they reflected measures that were simply aggregations of individual measures which were already included in the model. For example, race and income were accounted for at the individual level. However, the census measure of residential stability was also insignificant even though there was no comparable individual measure of this factor. These findings highlight the importance of obtaining direct measures of the social environment rather than relying on census data. Within the transportation field, this means including questions on the social environment in future travel surveys.

The inclusion of social environmental variables also influences the point estimates and significance of built environment variables. For example, density measures became more significant once the social environment factors were included while measures of land use mix (entropy) became less significant. These shifts in point estimates and significance could be caused by correlation between the measures of the social and built environment, but the correlations between these variables are relatively low (about 0.15). If the shifts in the estimates of built environment factors are the result of more than statistical factors, it suggests that previous studies which ignored the role of the social environment may have incorrectly estimated how much the built environment affects behavior. To assess in what direction previous studies may have been biased, it will be necessary to conduct further studies with a richer set of social environment measures. Ideally, those measures

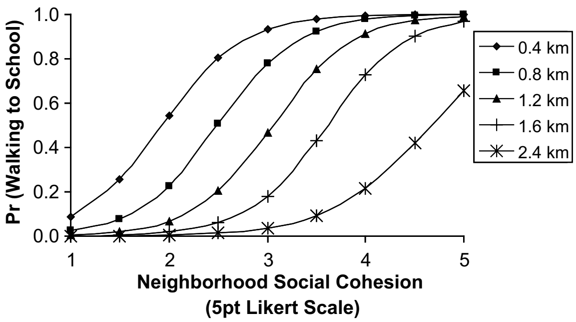

Fig. 1. Effect of neighborhood social cohesion on walking.

would come directly from travel surveys to allow direct assessment of how an individual's built and social environments interact.

5.2. Interaction of trip distance and the environment

Trip distance also affects how the built and social environments influence children's walking behavior. Built environment factors, particularly dwelling units per square kilometer and entropy, significantly influenced children's behavior for trips of more than 1.6 km, but were not important for shorter trips. While it may be tempting to explain this simply as a lack of variation in the built environment for shorter trips, i.e. short trips tend to occur in high-density places with smaller block sizes, and greater land use mixing, the summary statistics (Table 1) show a substantial amount of variation in these variables for shorter and longer trips. Instead, these results suggest that while distance is the primary determinant of whether children walk to school, the built environment is particularly important for trips that are 'at the margin.' For trips that are walkable, but not short, children and their parents appear to weigh the quality of the built environment.

In contrast, the social environment appears to matter most for shorter trips. The direct measure of neighborhood social control and cohesion was only significant for trips of less than 1.6 km. This suggests that parents are more likely to let their children walk when they live in neighborhoods where adults trust their neighbors. While this seems a logical behavior, it has important policy implications. Many advocates concerned with increasing walking to school have begun promoting neighborhood schools. The basic premise is that school siting guidelines in place during the latter part of the 20th century, which have only recently been revised, encouraged large school campuses which could only be accommodated on the outskirts of communities (Beaumont and Pianca, 2002; Council of Educational Facility Planners, International, 1991; Council of Educational Facility Planners, International, 2004).

If districts instead focus on maintaining and restoring existing schools within neighborhoods and planning new schools to be walkable, more children will live closer to their school. The model findings suggest that decreasing trip distance will be an effective means of increasing walking to school. However, the effectiveness of these school-siting policies will be mediated by the neighborhood social environment. The results suggest that parents require a short trip distance *and* a neighborhood with high levels of social trust to allow children to walk to school. From a policy perspective, this means advocates and planners must include softer programs in their school siting plans. These softer programs can range from including parents in safe routes to school planning to more general community building efforts (community gardens, community policing, community meetings) that include people with and without children.

6. Conclusions

This analysis shows a need for a broadening the definition of the environment to include social factors as well as the natural and built environments. Practice and policy implications follow from this finding. Many regional travel demand models include school trip mode choice elements. For example, the travel demand models for the San Francisco Bay Area include school trips as one of the primary categories of trips. In the current system, mode choice is determined by travel time, travel cost, household income, persons per household, vehicles per household, and built environment measures (a rural indicator and residential density). These models could be improved by the inclusion of a social environment variable.

In addition, the new era of school building the US is embarking on will require transportation planners and school officials to estimate mode splits for new schools. Transport planners will need to know how the new school will load existing roads and school planners may wish to consider transportation costs of potential school sites, which are strongly affected by the proportion of students that will walk to school. In either case, officials will require mode choice models that accurately predict walking to school.

Recognizing that the social environment influences the decision to walk also increases policy options for encouraging children to walk to school. Many of the current efforts to increase walking focus on infrastructure improvements and changes to built form. My findings suggest that coupling the infrastructure and design policies with programs aimed at encouraging relations among neighbors is appropriate.

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