

Drive or Walk?

Utilitarian Trips within a Neo-Traditional Neighborhood

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ABSTRACT

An extensive literature has developed on the relationship between the physical environment and travel behavior. While many studies have found that neo-traditional neighborhood development supports non-auto travel by providing good street connectivity, pedestrian and cycling facilities, and internal destinations, questions remain about individual travel behavior within such neighborhoods. This study uses travel diaries to examine utilitarian trip-making behavior within a neo-traditional neighborhood, and compares total trips with mode-specific (i.e., walk and drive) trips. We use negative binomial regression to examine the effect of a set of independent variables including personal and household characteristics, select attitudinal factors, and distance from residences to the commercial center. We find that, within the neo-traditional neighborhood, walk trips drop off quickly with increasing distance to destinations, while drive trips increase. Our analysis demonstrates the importance of short distances for within-neighborhood travel, and the merit in considering trips separately for walk and drive modes to avoid obscuring important factors associated with trip-making.

INTRODUCTION

The debate over the physical environment and its influence on travel behavior has matured in recent years, and has benefited from growing sophistication of inquiry, including such techniques as activity-based travel demand modeling and GIS-supported analysis of activities and environment. A growing body of work has confirmed that the physical environment—both natural and built—is important in shaping the travel behavior of the people who live, work, and visit in residential neighborhoods, commercial districts, and other settings.

Alternatives to conventional large-lot residential-only suburban-style development continue to penetrate the landscape, partly in response to the strain on municipal budgets for infrastructure and services, and growing traffic congestion and air quality concerns, as well as to fulfill demand for the opportunity to live in architecturally interesting and socially satisfying settings. Such neo-traditional developments—under the rubrics of new urbanism, low-impact or context-sensitive, transit-oriented, active living, smart growth, and other labels—are now popular with homebuyers as well as developers and planners, as reflected in the price premium often paid for homes in these neighborhoods (1). Despite the growing popularity and acceptance of compact, mixed-use development among the planning community and the population at large, uncertainty remains about how such developments actually perform in reducing private auto travel and increasing non-motorized travel.

While most previous studies have compared travel behavior across neighborhood types or diverse environmental settings, few studies have examined individual travel patterns within a specific neighborhood. This question takes on greater importance in considering neo-traditional designs, where a significant share of the trips may be internal to the neighborhood. In this context, this study builds on earlier work comparing conventional and neo-traditional developments, to consider specifically utilitarian trips made *within* a neo-traditional

neighborhood. We compare models for number of total trips with mode-specific trips, using as explanatory variables personal and household measures, along with distance from residences to the commercial center, and measures of attitudes towards walking, environmental protection, and mixed land uses. By examining trips together and by mode, and by explicitly considering the influence of distance to destinations on short internal trips, we contribute to more nuanced trip generation and mode choice modeling using disaggregate data.

LITERATURE REVIEW

The need for an integrated approach to analyzing the interaction between land use and transportation has been argued forcefully even as the challenges have been acknowledged (2-6). The role of the physical environment in shaping travel behavior has come under intensive scrutiny as scholars, developers, planners and citizens try to understand and predict how certain urban design strategies will perform (7-10). The results of the trend away from conventional low-density single-use developments remain mixed (4, 11, 12), in part because of the difficulty of identifying how individual and combined elements of neo-traditional design relate to measurable outcomes.

Such alternative development strategies often are pitched to different audiences with various claims; planning professionals may be interested particularly in opportunities to reduce vehicle miles traveled (VMT) and increase travel options, including non-motorized and transit modes, while the house-hunting public may be tempted by design elements and architectural appeal, or the perception of safety and sociability associated with the popular image of traditional neighborhoods. Developers may be interested in efficient building practices and the opportunity to build complete neighborhoods that benefit from economies of scale and scheduling, although they also are likely to be held to high standards for environmentally sensitive building practices and high-quality products. The trend toward compact mixed-use development is well established, with 1.4 million residents in new urbanist communities, as defined by Berke (13), and many more projects approved or in planning.

Some studies have found higher pedestrian or transit travel in neo-traditional neighborhoods (14-17). Cervero and Kockelman (18) found that the “3Ds” of density, diverse land uses, and neo-traditional design were positively associated with reduced trip generation and greater use of non-auto modes, although the relationships are difficult to measure because of collinearity. Friedman et al. (19) found that neo-traditional development offered greater mode diversity, while residents of conventional neighborhoods relied more on private autos. Ewing and Cervero (20) reviewed dozens of studies of urban form and travel, and concluded that trip generation depends more on household factors than on access measures, while mode choice is more responsive to local urban form.

Beyond trips and mode choice, the distinction between internal and external trips is important for neo-traditional neighborhoods, because of the potential to reduce mean trip lengths by keeping some trips within the neighborhood rather than loading them onto the regional network. Although Ewing (21) describes total travel as a function of regional access and thus largely beyond the power of individual neighborhoods to shape, others have found that neo-traditional design may influence trip length. Khattak and Rodríguez (16) found fewer external trips and fewer regional trips (more than 10 miles) for residents of the neo-traditional neighborhood studied here compared to its matched conventional neighborhood, and much

higher internal capture, which translated into shorter mean trip lengths and lower household VMT.

The distinction between utilitarian (destination-focused) and non-utilitarian trips has received only limited attention. Handy (22) has studied how destinations and access to them inform trip-making: "... certain aspects of urban form can play an important role in encouraging walks to a destination, but ... savings in travel from substitution of walking for driving is likely to be small." Since distance to destinations dampens walking, even the most hospitable and interesting environment will be able to generate only a limited number of walk trips and may not overcome the pull of attractive destinations out of the immediate, that is, walkable, neighborhood. Still, Rodríguez et al. (17) found utilitarian walk trips substituting for other trips in their examination of physical activity in the same neighborhood considered in this study.

In addition to the empirical and practical motivations for this study, we examine an underlying theoretical question raised by Crane (9) and Boarnet and Crane (4), among others. That is, when residences and commercial centers are brought closer together, the net cost of making a trip decreases and the total number of trips may increase. Therefore, even in cases where mixing land uses leads to a replacement of pre-existing automobile trips by non-auto trips, the net effect of neo-traditional neighborhoods on a particular travel mode will depend on how speed and distance change for that mode, relative to its impact on all other modes. Their analysis suggests that the magnitude and direction of the expected connection between containment policies and travel patterns is ambiguous and, therefore, actual effects are a matter of empirical debate.

In sum, the transportation benefits of neo-traditional neighborhoods hinge on the development's ability to capture trips within the neighborhood, and on the impacts on the behavior of travelers with respect to particular transportation modes. Prior research has highlighted the importance of examining utilitarian trips within neo-traditional neighborhoods, but there is a paucity of such research. This question is of interest to researchers and practicing planners because it relates to the relationship between distance to commercial land uses and the choice between walking and driving, and the importance of mixed land uses for within-neighborhood trips. By examining differences in purposeful walk and drive trips within a neighborhood that includes a variety of destinations, this study illustrates the value of predicting the number of trips separately for different modes, rather than predicting mode choice after the decision of whether and where to travel is made.

CONCEPTUAL MODEL

Figure 1 illustrates the relationships we consider in this study. This is a subset of a larger set of relationships examined for the subject neighborhood in comparison with a conventional neighborhood (23). That matched-pair quasi-experimental design provided data for comparing travel between the two neighborhoods, and generated studies of auto ownership and use (24), physical activity (17), and trip-making behavior including trip generation, mode choice, household VMT, regional trips, and mean travel time and distance (16).

This study focuses on internal trips within only the neo-traditional neighborhood, where the lively commercial center provides a rich set of destinations, and may help explain the higher internal trip capture of 21%, compared to approximately 5% for the conventional neighborhood (16).

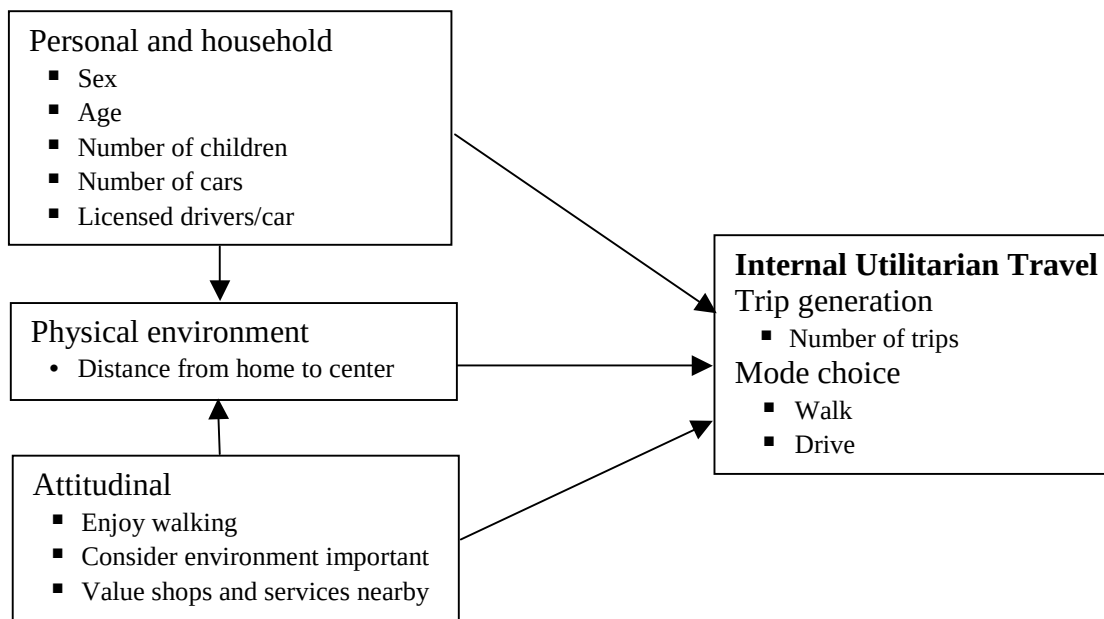


Figure 1 Conceptual Framework of Utilitarian Trips within Neo-Traditional Village

We focus on numbers of trips because of the possible influence neo-traditional design exerts on the capture of internal trips (rather than external trips, including regional), and on utilitarian trips possibly induced by the presence of a variety of destinations within the small (roughly 300 acres), pedestrian-supportive development. Mode choice is interesting because of the purported opportunity neo-traditional design provides for walk trips, both by offering a richer set of destinations than a conventional neighborhood, and by clustering uses together and providing pleasant and safe conditions for walking through sidewalks and crosswalks, landscaping, benches, greenways, and other traffic-calming features.

Age and sex are included as independent variables, albeit with uncertain expected impact on internal utilitarian trips. Kim and Ulfarsson (25) found that mode choice for the elderly (over 65) and retired is sensitive to neighborhood and trip characteristics, as well as personal and household factors. Walking is an appealing choice for the elderly, likely because of the freedom it offers. Although it might be reasonable to expect trips to decrease with age, that may be true primarily for people sufficiently advanced in age to experience reduced physical mobility; meanwhile, some individuals may find themselves making *more* trips with age because of more disposable time, freedom from a work schedule, a change in life cycle (e.g., stay-at-home parent of young children, or a young retiree), or the desire to become physically active (and use utilitarian trips as a motivator). That is, age-related differences may be more accurately described as life-cycle factors. Sex likewise is not clear as an explanatory variable for utilitarian trips, and may depend in part on life cycle changes, as women in particular move in and out of the labor market with the birth and aging of children. Women may be more willing to reduce auto use than men, partly because of environmental sensitivity and weaker auto habits (26).

While household size (not included here) reflects general demand for travel, the number of children under the age of 16 represents a particular kind of travel demand. Since diaries were kept by individual adults (over 16) rather than for families, the variable for number of children represents demand for travel that requires an adult to provide any drive trips or—for young

children—an escort on walk trips. The number of licensed drivers per auto in the households to which the adults in the sample belong reflects relative access to the drive mode, as well as individuals' expectations and preferences about travel.

Personal attitudes towards the physical environment are recognized as important factors for trip generation and mode choice. This study includes three measures of personal attitudes, each measured on a five-point ordinal scale (where 1 is lowest and 5 is highest): "I enjoy walking," "Environmental protection is an important issue," and "Having shops and services close by is important to me."

Although we had partial data on household income and home value, we did not include either in the models. First, missing values, totaling more than one-quarter of the observations, would have required imputation. Furthermore, since the site is a new development experiencing rapid appreciation in value for all units, both single- and multi-family, there is limited variation in measures of wealth or affluence.

Finally, because all residents in the neo-traditional village inhabit the same environment, there is no call to include such neighborhood-level measures of the built environment as density, land use mix, or design elements. The only environmental measure used in this study is aerial distance from the residence to the commercial center. While the path distance would have been a better measure, had it been available, the direct distance is adequate because this neighborhood is characterized by a generally well-connected street design, and most residences enjoy a similar degree of connectivity. Moreover, since the commercial and retail uses are clustered together in the centrally located market center, nearly all utilitarian trips are drawn to the same location.

METHODS

Study Site

The neo-traditional neighborhood of Southern Village in Chapel Hill, North Carolina, characterized by moderately high density, mixed residential and commercial land uses, and pedestrian- and bicycle-supportive design, provides an ideal site for considering how destination-focused utilitarian travel within a small and connected development may differ by mode and across distance. Southern Village is the town's first neo-traditional development allowed under an ordinance designed to encourage village-type mixed-used neighborhoods (Figure 2). The development is located several miles from downtown Chapel Hill and the campus of the University of North Carolina, just off a state highway that carries significant traffic into the city from outlying areas.

Construction of Southern Village began in the late 1990s; at the time of the 2003 data collection, several dozen businesses with 432 employees operated in approximately 200,000 ft² of commercial space. At the same time, over 750 residences were complete, including 250 condominiums and apartments in or adjacent to the commercial core, and 514 single-family homes in the areas spreading out from the center. Since the first residential units became available, Southern Village has enjoyed rapid growth in both residential population and activity in the commercial core, which includes restaurants, retail stores (including a popular community grocery), and a well-attended movie theatre. A bank, financial services office, spa and clinic also operate in the commercial center, along with a church, daycare, and nearby public elementary school. Office space fills several buildings in the center, and occupies floors above ground-level retail in others; tenants include research institutes, non-profit organizations, and commercial ventures. The center attracts trips from both outside and within the neighborhood. Public events, including outdoor movie screenings and concerts, serve as additional draws. Two transit routes

serve the neighborhood, including one that runs through the residential area. The park-and-ride lot adjacent to the commercial center, with space for over 400 cars, is used by both Southern Village residents and commuters from the southern county taking advantage of the fare-free transit system and free parking.

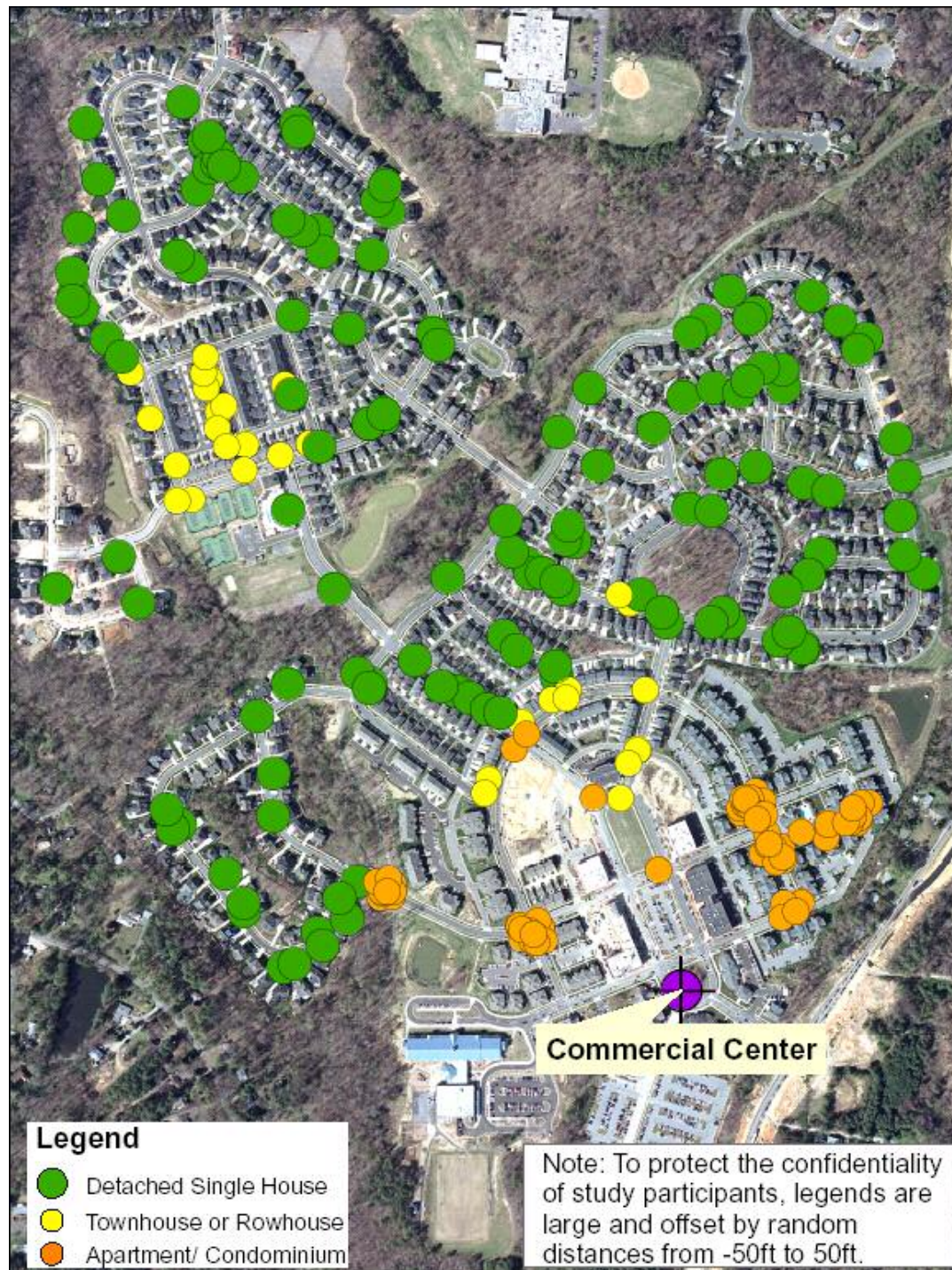


Figure 2 Southern Village, a Neo-Traditional Development in Chapel Hill, North Carolina

Data Collection and Analysis

Although earlier work on this dataset looked at household trip generation, this study takes the individual as the unit of analysis, as we focus on internal utilitarian trips—walk and drive—that may be sensitive to short distances. Our final data set includes all 348 adult residents of Southern Village who completed travel diaries and for whom we have values for all the measures used in this analysis, including those who made no internal utilitarian trips on their travel days. The surveys and travel diaries that provide the data were administered in the spring of 2003. Participants were asked to fill out diaries on Tuesday, Wednesday, or Thursday. Although diaries filled out on other days (including weekends) were retained, these accounted for less than 1% of the responses. Of the internal trips reported, easily identified by an “internal” field coded 1, we identified all those that had a stated destination, and eliminated the remaining trips, which included strolls, dog walks, and other recreational or casual trips that did not involve a fixed location with a purpose other than sociability or physical exercise.

These 125 trips by 348 individuals constitute the dependent variable of total internal utilitarian trips, which is regressed against the nine independent variables described above. Further, the internal utilitarian trips were split into walk and drive trips, and each regressed against the same nine independent variables, to observe how the number of trips differs for the two modes. Because the number of internal utilitarian trips is small (between 0 and 4) for any individual on the travel diary day, negative binomial regression was used to model the three dependent variables of total trips, walk trips, and drive trips. Regression of the dependent variables proceeded in stages, beginning with personal and household factors, then the three attitudinal measures, and finally distance from residence to commercial center.

RESULTS

Descriptive statistics provide a general view of central tendencies and variation in the variables of interest. Table 1 shows descriptive statistics for all Southern Village residents for whom we obtained complete data, that is, a household survey, travel diary, and geocoded residential location. The study sample is 40.8% male, with an average age of 41. Number of children averaged 0.66. The number of licensed drivers per car, 1.07, is comparable to auto ownership levels across the country, and represents saturation of the driving population with vehicles. Given the five-point ordinal scale used for attitudinal measures, the means of 4.3, 4.5, and 4.4 indicate that most people agreed with the sentiments that walking is enjoyable, the environment is important, and nearby shops and services are useful. The average distance of the residence from the commercial center is 0.607 kilometer. The minimum and maximum distances are 0.151 km and 1.255 km, suggesting that even within a neo-traditional neighborhood there is considerable variation in access to commercial land uses, which may impact travel choices of residents. Most of the individuals in the sample made no internal utilitarian trips at all, and none made more than 4 on the travel day. The percentage distribution of people making 0, 1, 2, 3, and 4 trips is 74, 17, 7, 1, and <1%, respectively. The mean number of trips per person is 0.36, including 0.20 walk trips and 0.16 drive trips.

TABLE 1 Descriptive Statistics for Southern Village Study Participants

Variables	N	Median	Mean	Std. Dev.	Min.	Max.
<i>Dependent variables</i>						
Number of total internal utilitarian trips	348	0	0.359	0.696	0	4
Number of internal utilitarian walk trips	348	0	0.201	0.547	0	4
Number of internal utilitarian drive trips	348	0	0.161	0.459	0	3
<i>Independent variables</i>						
Sex (1=Male)	348	0	0.408	0.492	0	1
Age (years)	348	39	41.261	14.037	16	81
Number of Children	348	0	0.655	0.949	0	4
Number of cars/household	348	2	1.871	0.651	0	4
Number of licensed drivers per car	348	1	1.065	0.296	0	2
Walking is enjoyable (1=strongly disagree, 5=strongly agree)	348	5	4.299	0.912	1	5
Environmental protection is important (same scale as above)	348	5	4.500	0.746	1	5
Value shops and services close by (same scale as above)	348	5	4.431	0.690	1	5
Distance from home to activity center (km)	348	0.567	0.607	0.302	0.151	1.255

Regression Analysis

Negative binomial regression for the non-negative count variables of total trips, walk trips and drive trips reveals associations between these dependent variables and select individual and household measures. To avoid the biased results possible with ordinary least squares regression when working with small counts in dependent variables, we estimated negative binomial regression models for numbers of trips. The model specification for total number of internal utilitarian trips was:

$$\text{Total trips} = \beta_0 + \beta_1 \text{sex} + \beta_2 \text{age} + \beta_3 \text{no_kids} + \beta_4 \text{no_cars} + \beta_5 \text{lic_car} + \beta_6 \text{enjwalk} + \beta_7 \text{envipro} + \beta_8 \text{shopsnb} + \beta_9 \text{distance}$$

where “sex” is 1 for males (0 for females), “age” is counted in years, “no_kids” is number of children under the age of 16, “no_cars” is number of autos in the household, “lic_car” is the number of licensed drivers in the household divided by the number of autos, “enjwalk,” “envipro” and “shopsnb” are ordinal responses to the statements “I enjoy walking,” “Environmental protection is an important issue,” and “Having shops and services close by is important to me,” respectively, and “distance” is Euclidean distance from the residence to the commercial center in kilometers. The models for walk trips and drive trips regress those dependent variables against the same nine independent variables. Because of potential correlation among individuals of the same household, we corrected standard errors for heteroskedasticity as suggested by White (27).

Table 2 shows the results of regressing total internal utilitarian trips against, first, the personal and household characteristics of sex, age, number of children and cars, and licensed drivers per car (model 1). Model 2 adds in the three attitude variables, but these do not prove to be significant. Indeed, only the number of children is significant for either the first or second model. The full model (model 3) includes, in addition, the distance variable. The coefficients and p-values in model 3 show that both number of children in the household and the attitude of “enjoy walking” have significantly positive relationships with the number of total internal utilitarian trips. The incident rate ratios (IRR), calculated as $\exp(\text{coefficient})$, indicate that if the number of children in a household increases by one, an adult in this household will increase the total number of internal utilitarian trips by 55.7% (IRR= 1.557), holding other variables constant.

An increase of one ordinal category in the response to the “enjoy walking” statement is associated with a 26% increase (IRR=1.260) in the total number of internal utilitarian trips. The significance of the α value for the models justifies the use of negative binomial rather than Poisson modeling.

Testing variables for distance-squared did not reveal significant results in this or the other two modeling series, perhaps because the limited range in distance (0.15 -1.26 km) is too small to capture any non-linearity in the relationship between trips and distance. The failure to find significant relationships by testing several variables (including sex and number of children) for interaction with distance also likely relates to the very small variations in distance.

Pseudo- R^2 is a goodness-of-fit measure that varies between 0 and 1, with higher values indicating a better fit of the model. It represents the proportional reduction in the - 2log-likelihood statistic. More intuitively, it is the ratio of the estimated information gain from using the full model compared with the constants-only model. Thus, it estimates the additional information gained by including explanatory variables.

TABLE 2. *Negative Binomial Regression of Total Utilitarian Trips within Neo-Traditional Neighborhood

Variables	Model 1			Model 2			Model 3		
	Coef.	IRR	P	Coef.	IRR	P	Coef.	IRR	P
Constant	-0.953		0.221	-2.965		0.015	-3.002		0.014
Sex	-0.197	0.821	0.356	-0.186	0.830	0.385	-0.167	0.846	0.441
Age	0.002	1.002	0.848	-0.001	0.999	0.924	0.001	1.001	0.855
Number of children	0.413	1.512	0.000	0.393	1.481	0.000	0.443	1.557	0.000
Number of cars	-0.179	0.836	0.368	-0.137	0.872	0.482	-0.084	0.920	0.677
Licensed drivers/car	-0.068	0.934	0.860	-0.046	0.955	0.902	-0.101	0.904	0.784
Enjoy walking				0.220	1.246	0.112	0.231	1.260	0.085
Environmental protection				0.195	1.215	0.276	0.212	1.237	0.225
Shop & services close by				0.034	1.035	0.812	0.049	1.050	0.737
Distance (km) to center							-0.557	0.573	0.143
Summary statistics									
Number of observations			348			348			348
LR statistic			17.14			24.64			26.09
P (alpha) $\approx$ 0			0.0042			0.0018			0.0020
Pseudo- R^2			0.0303			0.0416			0.0453

*Standard errors adjusted for clustering on household ID

When the trips are split by travel mode (walk and drive), the results change. Table 3 shows walk trips regressed against the same explanatory variables (p value for the full model = 0.0155). For the first two models (first with personal and household attributes, then with attitudes), only age is significant at the 90% confidence level ($p = 0.048$ and 0.012 , respectively), with a negative coefficient. The number of children in the household, which might have been expected to have a positive relationship with walk trips in this pedestrian-friendly neighborhood with an elementary school and day care located near the commercial center, is not significant. However, when distance is added to the independent variables (model 3), the number of children shows a significant and positive relationship with internal utilitarian walk trips ($p=0.032$), and age remains significant ($p=0.082$) and negative. With an IRR of 1.365, the effect on walk trips of children is smaller than their effect on total trips (36.5%, compared to 55.7%, from Table 2). The relationship between distance and walk trips is significant and negative ($p = 0.007$). The IRR of distance (0.199) indicates that with an additional one kilometer of distance, on average a person will take 80.1% fewer walk trips.

One additional unit on the scale of “enjoy walking” is associated with a 38.7% increase in walk trips (IRR=1.387, compared to 1.260 for total trips). The variable for “I value shops and services nearby” is not significant for walk trips, suggesting that those valuing proximity to destination may not necessarily change their walking habits beyond the effect that distance to the commercial center exerts. The α value is significant for the saturated model.

Table 3. *Negative Binomial Regression of Utilitarian Walk Trips within Neo-Traditional Neighborhood

Variables	Model 1			Model 2			Model 3		
	Coef.	IRR	P	Coef.	IRR	P	Coef.	IRR	P
Constant	-0.438		0.661	-3.411		0.058	-3.695		0.042
Sex	-0.164	0.849	0.598	-0.171	0.843	0.577	-0.143	0.867	0.641
Age	-0.020	0.980	0.048	-0.025	0.975	0.012	-0.017	0.983	0.082
Number of children	0.212	1.236	0.132	0.178	1.194	0.215	0.311	1.365	0.032
Number of cars	-0.270	0.763	0.377	-0.207	0.813	0.483	-0.036	0.965	0.907
Lic. drivers/car	0.030	1.030	0.944	0.071	1.074	0.860	-0.026	0.975	0.949
Enjoy walking				0.303	1.354	0.136	0.327	1.387	0.088
Environmental protection				0.185	1.204	0.403	0.224	1.251	0.286
Shop & services close by				0.188	1.206	0.396	0.241	1.272	0.272
Distance (km) to center							-1.612	0.199	0.007
Summary statistics									
Number of observations			348			348			348
LR statistic			7.80			16.23			20.42
P (alpha) $\sim$ 0			0.1674			0.0391			0.0155
Pseudo-R ²			0.0153			0.0310			0.0503

*Standard errors adjusted for clustering on household ID

As in the models for total trips and walk trips, the regression of drive trips (Table 4) against the explanatory variables shows the number of children in the household to be significant and positive. In addition, age is positively and significantly associated with drive trips (compared to a negative association with walk trips), perhaps reflecting the increasing responsibilities of household maintenance that relate to age and progressive life-cycle stages, or changes in health status. The significant and positive association of number of children and age with drive trips is true for all three of the drive trip models, from the household and personal variables only, through the addition of attitudes and distance. The IRR coefficients in model 3 indicate that an additional year of age relates to a 3.2% increase in internal utilitarian drive trips, while an additional child is associated with a 79.4% increase in such trips. The sentiment of “I value shops and services nearby” is significantly related to a decrease in number of drive trips; the IRR of 0.707 relates to a 29.3% decrease in drive trips with a one-ordinal-category increase in agreement with the attitude statement. Neither of the other two attitude variables is significant for drive trips.

Drive trips are sensitive to distance, but in the opposite direction from walk trips. That is, internal utilitarian drive trips increase with increasing distance of the residence from the commercial center, while Table 3 suggests that shorter distances from residence to commercial center may encourage walking for already committed utilitarian trips. Living one kilometer farther away from the commercial center is related to a 132.1% increase in drive trips, compared to an 80.1% decrease for walk trips (IRR=2.32 and 0.199, respectively). The significance of the α values indicates that the negative binomial models are appropriate here.

Table 4. *Negative Binomial Regression of Utilitarian Drive Trips within Neo-Traditional Neighborhood

Variables	Model 1			Model 2			Model 3		
	Coef.	IRR	P	Coef.	IRR	P	Coef.	IRR	P
Constant	-3.939		0.002	-4.495		0.004	-4.602		0.004
Sex	-0.302	0.739	0.313	-0.299	0.741	0.313	-0.345	0.708	0.236
Age	0.034	1.035	0.004	0.033	1.033	0.006	0.031	1.032	0.011
Number of children	0.646	1.908	0.000	0.661	1.936	0.000	0.585	1.794	0.000
Number of cars	0.046	1.047	0.867	0.057	1.059	0.836	0.002	1.002	0.994
Lic. drivers/car	0.030	1.031	0.966	0.046	1.047	0.946	0.169	1.184	0.809
Enjoy walking				0.186	1.205	0.384	0.175	1.191	0.432
Environmental protection				0.250	1.283	0.419	0.222	1.249	0.492
Shop & services close by				-0.313	0.731	0.077	-0.347	0.707	0.061
Distance(km)							0.842	2.321	0.080
Summary statistics									
Number of observations			348			348			348
LR statistic			25.80			37.07			39.03
P (alpha) ~ = 0			0.0001			0.0000			0.0000
Pseudo-R ²			0.0771			0.0881			0.0951

*Standard errors adjusted for clustering on household ID

To gain a better view of distance effects on numbers of walk, drive, and total trips, we estimated the number of each at different distances, while holding all continuous variables constant at their medians and categorical variables at their modes. Figure 3 shows that for the typical resident who lives the minimum distance from the commercial center in Southern Village (0.15 km), the predicted number of walk trips is 0.52 trips. The model predicts that residents who live the mean (0.61 km) and maximum (1.25 km) distances away make 0.25 and 0.09 walk trips in one day, respectively. One additional kilometer of distance from the commercial center (from 0.61 to 1.61 km) is associated with 0.2 fewer walk trips (a decrease from 0.25 to 0.05). Thus, the farther away residents live, the fewer walk trips they make, with the trips dropping off quickly with only modest increases in distance.

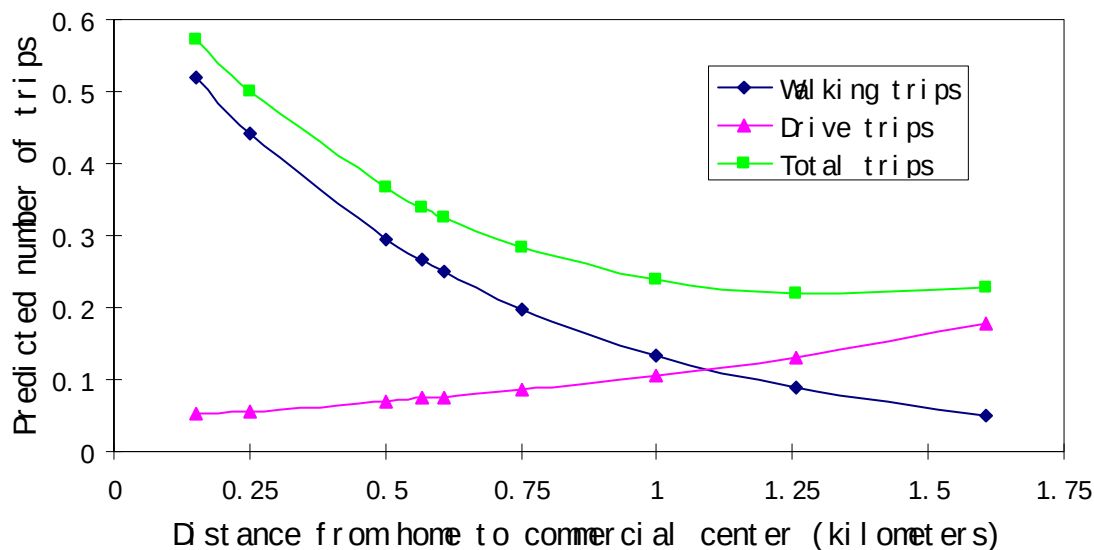
**Figure 3 Predicted Number of Internal Utilitarian Walk, Drive, and Total Trips by Distance**

Figure 3 also plots distance and drive trips, which show the opposite trend, albeit with a less steep curve. The minimum distance of 0.15 km is associated with 0.05 trips, the mean of 0.61 km with 0.08 trips, and the maximum of 1.26 km with 0.13 trips. An additional kilometer of distance (from 0.61 to 1.61 km) is predicted to result in 0.1 more drive trips (0.18 versus 0.08).

Finally, total trips drop off with increasing distance between residence and commercial center, but less steeply than walk trips. The minimum (0.15 km), mean (0.61), and maximum (1.25 km) distances between residence and commercial center are associated with 0.57, 0.33, and 0.22 total trips, respectively. Beyond 0.75 km, the total trips within the neo-traditional neighborhood are nearly insensitive to distance.

CONCLUSIONS

The results suggest that, within the distance range and neighborhood context studied here, distance matters for internal utilitarian trips. As distances between residences and commercial centers decrease, residents make more internal utilitarian walk trips; by contrast, as distances increase, drive trips increase and account for a greater share of internal utilitarian trips. Distance between residence and commercial center is significant for both walk and drive trips, but in different directions, such that the impact of distance on local (i.e., immediate neighborhood) travel may be obscured in models that look only at total trips. Thus, the results do not confirm the hypothesis of Crane (9) and Boarnet and Crane (4) of possible increased trip-making in neo-traditional settings, suggesting rather a substitution of modes, with walk and drive trips responding differently to distance between residence and commercial center, but total trips insensitive to this variable. Importantly, distance is important for mode choice even within this relatively small and coherently designed neighborhood with high (21%) internal capture of trips. Given a rich set of destinations and well-connected streets, the small distances found in this neo-traditional neighborhood were sufficient to impact the decision to walk.

The one factor that was found to be significant in the full models for all three dependent variables, i.e., number of children under 16, had a lesser effect on walk trips than on drive trips. This is notable because the elementary school in Southern Village was designed as a walkable school connected to the commercial center and to the greenway system, and intended to be a destination for parents and children. Since the neighborhood is a designated “walk zone,” all students within the development either walk to school or are driven, although part of the school population is bussed in from elsewhere in the school district. The number of children in the home is significant for all trips—walk and drive, and underscores the demand for travel that children represent.

Beyond providing insights into the factors that are relevant for the number of trips made, the results point to the value of measuring mode choice before, or concurrently with, trip generation. The traditional four-step model of travel demand has provided a useful common framework for extensive travel behavior study, while suffering from widely acknowledged shortcomings. The artificial separation and ordering of travel decisions into trip generation, distribution (destinations), mode choice, and route assignment gloss over the multiple feedback links and joint or iterative decisions that characterize the complex process of trip-making. By assuming that mode choice follows only after the decision to travel and selection of a destination, the traditional model fails to capture more nuanced processes, such as how household composition or location may affect travel.

Large regions that host various mixes of residential, commercial, and even light industrial uses may see substantial variation in travel behavior among neighborhoods. An approach that resolves trip generation for a finer-grained categorization of land uses, and accounts for modal options, distance, and the attractive power of destinations could yield more accurate predictions for number of trips.

The results show that walk and drive trips made for within-neighborhood utilitarian purposes respond differently to explanatory factors. Trip generation models that lump travel modes together may miss the mode-specific differences in sensitivity to a wide range of individual, household, and environmental factors that shape travel behavior.

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