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Voyage of the S.S. Minivan: Women's Travel Behavior in Traditional and Suburban Neighborhoods

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ABSTRACT

There are numerous studies examining the interactions between travel behavior and neighborhood design. However, little thought is given specifically to gender differences. While sex is considered in most multivariate statistical analyses as a possible independent variable, there are few studies that focus *primarily* on "gendered" travel behavior, as influenced by neighborhood design. There are even fewer studies that examine the differences in travel behavior *among* women by neighborhood type. Naturally, women are not a homogenous group, and are characterized by a variety of preferences, needs, perceptions, and behaviors.

This study is based on a survey that collected considerable data on land use as well as travel behavior, including a wealth of information on both preferences for and perceptions of neighborhood characteristics. The main questions this study addresses are: Are there gender differences in travel behavior? If so, what are the causes and the effects? Are there differences among women by neighborhood type, life cycle stage, presence of children, etc? The findings point to some significant differences for and among women, particularly with respect to both the social and infrastructure aspects of safety, but also by neighborhood type (suburban versus traditional) and the presence of children.

INTRODUCTION

There is considerable interest in the question of how neighborhood design influences travel behavior. In particular, many researchers and planners are interested in whether neighborhood design and certain land uses can reduce driving, and/or increase walking. The questions are largely driven by concerns about air quality, climate change, traffic congestion, and public health. However, little thought is given specifically to gender differences. While sex is considered in most multivariate statistical analyses as a possible independent variable, there are few studies that focus primarily on "gendered" travel behavior as influenced by neighborhood design. There are even fewer studies that examine the differences in travel behavior *among* women by neighborhood design. Naturally, women are not a homogenous group, and are characterized by a variety of preferences, needs, perceptions, and behaviors.

Given that the same is true for men, it is natural to ask: Do men and women in fact have different travel needs and different travel behaviors? If so, what might be some of the causes of the travel behavior differences by gender? Does neighborhood design affect men and women in different ways? Also, since all women are not the same, are there differences in the travel behavior among women by neighborhood type or presence of children? Are these differences significantly different from those among men on these same dependent variables? And, perhaps most important: If there are differences, what can be done about it? If anything can be done, should it?

This study seeks to answer some of these questions in a systematic fashion. What makes this study particularly unique is the availability of survey data on land uses as well as travel behavior. This survey includes a wealth of information on both preferences for and perceptions of neighborhood characteristics. This is important because of the increasing volume of literature that demonstrates the importance of neighborhood characteristics in explaining travel behavior. In addition, there have been few studies that look at the influence of neighborhood characteristics on women in particular. This paper further explores some of these relationships, using the unique breadth and depth of the survey data discussed above.

PREVIOUS RESEARCH

Despite major changes in household structure over the last century, particularly since the Second World War, men and women still have different roles in and out of the home. Mackenzie (1988) identifies cultural shifts from household-based production of goods (pre-Industrial Revolution) to household-based reproduction of people (post-World War II suburban growth). She cites this as the basis for men's and women's roles diverging even more than in the past, particularly with relation to their environment. No longer were "cottage industries" or sustenance living the norm. Now workers were moving into assembly-line type work, with women being both employed out of the home, and responsible for a more separate home life.

Women's entrance into the workforce was the cause for major change in their travel behaviors. Michelson (1988) deals more quantitatively with the travel behavior of women, while being sensitive to the qualitative aspect. He points out that due to the "increased participation of women in paid employment outside the home . . . consequently, women's activity patterns seem to resemble what men do, but women's qualitative experience in the daily routine is actually quite different from that of men" (Michelson 1988, p. 88). Later, he says that "these differences between men and women in the nature and juxtaposition of daily activities carry serious implications for everyday travel" (Michelson 1988, p. 95).

These “implications” are manifest as very clear differences between men and women’s travel behavior. Women, even if employed full-time like their spouse, tend to still be responsible for the majority of household maintenance duties, such as grocery shopping, going to the post office, and shuttling children to and from school, sports, lessons, and friend’s homes. This leads to lot of what in travel behavior surveys are designated as “serve passenger trips.” As Rothblatt et al. (1979, p. 64) darkly but humorously remark, “this must be the Victorian era’s version of the harried housewife condemned, like the Flying Dutchman, to the eternity of her station wagon”(Rothblatt et al., 1979).

However, there is evidence that women may be further “harried” by the design of their environments. The articulation of the linkages between land use patterns and travel behavior are credited as early as 1954 to the researchers Mitchell and Rapkin (Handy et al., 2004). Many scholars expanded and deepened the research that exposed these connections. However, there is more recent evidence that shows that due to differing household roles, neighborhood design may affect women differently. As discussed by Rothblatt et al. (1979), the explosion of growth into the “suburbs” caused major shifts in transportation behaviors for everyone, but particularly for the modern woman. They look at the growth of the suburbs and ask whether “suburbia is adapting to the changing occupational, social, and interpersonal needs of contemporary women?” (p. 83). Given the observed and anecdotal evidence, many would conclude that it is not.

Neighborhood design has the capacity to make women’s travel easier, or more difficult. If women are responsible for many household-serving trips, including for children’s many needs, proximity and mix of services may facilitate easier access to these activities. Neighborhood design that allows pedestrian, bicycle, or transit access to these same facilities can reduce automobile dependence and increase the amount of environmentally friendly and physical beneficial walk and bike trips. Clifton and Livi (Clifton and Livi 2004) a survey of three Maryland neighborhoods which collected data on respondents' perceptions about the physical environment, attitudes about walking, and self-reported pedestrian behaviors. In their analysis, they found that women walked more, but shorter distances. Women walked more to church and the mall, but less to parking lots and work. Women also were significantly more affected by safety issues, both crime and traffic issues. They found that women seem much more sensitive to environmental factors related to crime and traffic, and may be helped by more destinations, safer lighting, and even education campaigns that encourage walking.

Safety is recurrently an issue for women much more than for their male counterparts. Loukaitou-Sideris (2004) found that women's perception of safety has little to do with actual risk, but rather with familiarity with situation and location, pre-conceived notions of situations and locations, and observation of behaviors within a situation and location. She stresses that women are more afraid of crime than men, and not just violent crime, but harassment, groping, intimidation, and other often unreported crimes. She uses a study of four neighborhoods in Los Angeles to observe and collect survey data on travel behavior. From this, she finds that even in the more affluent neighborhoods, women rarely walk or bike either alone or without a "clear purpose" - e.g. jogging, walking a dog, or going to the store.

Both transportation issues (e.g. gas prices, traffic congestion, inadequate parking supply) and public health issues (e.g. air quality, obesity from sedentary lifestyles) are driving the interest in reducing automobile travel and increasing physically active modes of travel. However, questions remain. Most studies consider gender, and some of the studies cited above specifically examine the relationship of gender with travel behavior and neighborhood design. The survey data utilized in this study builds on this research, with useful comparisons and suggestions from

the previous work for the research questions. However, this study has more land use and neighborhood design data than is characteristically found in this type of research. Furthermore, the analysis looks in depth at the differentials between men and women and also differences among women in different situations (e.g. the presence of children). These contrasts have not been extensively studied before this, with such a breadth and depth of data on land use and neighborhood characteristics.

METHODOLOGY

Data

This paper uses data from a 2003 survey conducted by the University of California, Davis for a project funded by the California Department of Transportation (Caltrans). The survey sampled residents from eight California neighborhoods. The neighborhoods were chosen to represent four "traditional" neighborhoods and four "suburban" neighborhoods. This designation was made with qualitative and quantitative evaluations of the neighborhood age, the street network, age and design of houses, and the location and type of commercial centers (Handy et al. 2004). The neighborhoods chosen as "traditional" included Mountain View, Sacramento (Midtown), Santa Rosa (Junior College area), and Modesto (Central). The neighborhoods chosen as suburban were Sunnyvale, Sacramento (Natomas area), Santa Rosa (Rincon Valley area), and Modesto (suburban area).

The researchers designed a household survey using previous travel behavior surveys, and pre-tested the survey on UC Davis students and staff. The survey was refined, and then tested on a "convenience sample" of Davis residents (Handy et al. 2004). The survey was then administered to the eight California neighborhoods. The survey had a 24.9% response rate, for a total of 1682 complete responses. The survey questions are divided into five major sections: residence and neighborhood characteristics, including preferences and perceptions; daily travel behavior, including work and non-work travel, and driving, transit, bike and walk modes; household vehicles; travel preferences; and socio-demographics.

Variables

The dependent variables are the travel behaviors of the survey respondents. Respondents were asked the miles they drive in a particular week. They were also asked how many times in a week they typically stop on the way home from work. Respondents were asked to indicate their approximate frequency of driving and walking to selected destinations in a typical month with good weather. In addition, walking was measured by the number of times residents walked to the store in the previous 30 days, and the number of times respondents strolled around the neighborhood in the last 30 days.

The explanatory variables were grouped into five categories: socio-demographics, perceived neighborhood characteristics, neighborhood preferences, objective neighborhood characteristics, and travel attitudes. The remainder of this section will present these five groups of variables.

Socio-demographics

The survey contained a list of socio-demographic variables. These variables include gender, age, employment status, educational background, household income, household size, the number of children in the household, mobility constraints, residential tenure, and so on. It is important to note that survey respondents were more likely to be female than the general population, and that there was a lower occurrence of households with children than in the general population. This was not intentional. However, although these univariate distributions may not be representative, we expect conditional relationships (e.g. travel behaviors given female, or given children in the household) to be reasonably well estimated. Race/ethnicity characteristics were *not* collected.

Perceived neighborhood characteristics and neighborhood preferences

Respondents were asked to indicate how true 34 characteristics are for their neighborhood, on a four-point scale from 1 ("not at all true") to 4 ("entirely true"). The characteristics of these neighborhoods as perceived by survey respondents reflect fundamental differences in neighborhood design. Further, the importance of these items to respondents when/if they were looking for a new place to live were measured on a four-point scale from 1 ("not at all important") to 4 ("extremely important"). The comparison of individuals' perceived neighborhood characteristics for their current residence and their preferences for the same characteristics indicates how well their current neighborhoods meet their preferences. A factor analysis on perceptions and preferences of neighborhood characteristics (some items were dropped) reduced these items to six factors: accessibility, physical activity options, safety, socializing, attractiveness, and outdoor spaciousness.

Objective Neighborhood Characteristics

Following the survey, objective measures of land use mix and accessibility were estimated for each respondent, based on distance along the street network from home to a variety of destinations classified as institutional (bank, church, library, and post office), maintenance (grocery store and pharmacy), eating-out (bakery, pizza, ice cream, and take-out), and leisure (health club, bookstore, bar, theater, and video rental). Land use mix refers to the relative proximity of different land uses, such as homes, stores, offices, parks, and other uses, within a given area (Handy et al., 2004). In this study, land use mix indicators were measured as the number of different types of businesses within specified distances and the distance to the nearest establishment of each type. Accessibility indicators used here were simplified to the number of establishments (opportunities) of each business type within specified distances. Commercial establishments were identified using on-line yellow pages, and ArcGIS was used to calculate network distances between addresses for survey respondents and commercial establishments. Commute distance, a measure of proximity of employment and residential locations, was also measured in the survey. In contrast to most non-work activities, the commute is a necessary and spatially constrained trip for workers.

Travel attitude

To measure attitudes regarding travel, the survey asked respondents whether they agreed or disagreed with a series of 32 statements on a 5-point scale from 1 ("strongly disagree") to 5 ("strongly agree"). Factor analysis was then used to extract the fundamental dimensions spanned by these 32 items. Six underlying attitudes were identified: pro-bike/walk, pro-transit, pro-travel, travel minimizing, car dependent, and safety of car.

Analysis

The data were analyzed using both bivariate and multivariate techniques. The questions in Table 1 were analyzed using crosstabulation and independent samples t-tests using SPSS. In addition, multivariate models were created for Vehicle Miles Driven (VMD), frequency of walking to the store, and frequency of strolling trips. Different techniques were used to account for the non-normal distributions of these variables: VMD was transformed using the natural log and then modeled using ordinary least squares (OLS) regression in SPSS, and negative binomial regression was employed for the walking variables using the Limdep program. Separate models were created for women, for men, and for the entire sample. In each case, socio-demographic variables were entered into the model first and significant ones retained, followed by travel attitudes and neighborhood preferences, followed by perceived and objective measures of neighborhood characteristics.

RESULTS

Gender Differences

As noted above, both anecdotal and empirical evidence show that gender roles still play a part in travel behavior, preferences, and perceptions. Our findings also point to gender differences, although not always as much as expected. The two main travel behavior differences between genders is that a) as expected from previous research and gender roles, women stop on the way home significantly more than men, and b) men report driving significantly more miles than women. Men also tend to work more days per week, and have longer temporal and spatial commutes (Table 1).

TABLE 1 Travel Behavior by Gender

	Men	Women	p-value	Number of cases (men)	Number of cases (women)
Days per week stop on the way home from work	1.66	2.07	0.000	617	637
Vehicle Miles Driven (VMD) in a typical week	183.79	140.98	0.000	744	803
Days per week go to work	4.88	4.70	0.002	628	645
Minutes to work	21.08	18.94	0.055	627	644
Miles to work	13.44	11.47	0.077	623	638

These differences could be driven by differences in travel attitudes and preferences for neighborhood characteristics. Preferences and attitudes show definite differences by gender in the t-test analysis. Men have a stronger preference for physical activity options and outdoor spaciousness as neighborhood characteristics, and more positive responses with respect to pro-bike/walk, pro-transit, and safety of car attitudes. Women, however, have a stronger preference for safety as a neighborhood characteristic, and more positive pro-travel and travel-minimizing attitudes. These results support the findings of previous research and anecdotal evidence. The factor score means are presented in Table 2.

TABLE 2 Travel Attitudes and Neighborhood Design Preferences by Gender

Variable	Men	Women	p-value	Number of cases (men)	Number of cases (women)
Pro_bike/walk travel attitude	0.15	-0.13	0.000	769	823
Pro-travel travel attitude	-0.08	0.07	0.003	769	823
Travel minimizer travel attitude	-0.15	0.14	0.000	769	823
Pro-transit travel attitude	0.05	-0.04	0.049	769	823
Physical activity options preference	-0.36	-0.38	0.009	768	845
Safety preference	0.35	0.44	0.020	768	845
Outdoor spaciousness preference	0.03	-0.14	0.000	768	845

However, there were only two significant differences in the perceptions of their neighborhoods. Women felt their neighborhoods had higher accessibility and socializing than did men (Table 3). These differences suggest that women may find their neighborhoods more conducive to walking than do men.

TABLE 3 Neighborhood Design Perceptions by Gender

Variable	Men	Women	p-value	Number of cases (men)	Number of cases (women)
Perception of accessibility	0.40	0.54	0.001	770	849
Perception of socializing	0.22	0.31	0.029	770	849

Neighborhood Type

Neighborhood type shows a strong correlation with women's travel behaviors, particularly regarding distance to work and non-motorized modes (Table 4). Women in traditional neighborhoods report an average of 9.78 miles to work, versus 13.76 miles for suburban women. Traditional women have an average commute of 17.41 minutes, versus 21.00 minutes for suburban women. This represents approximately 20-30% longer (temporally and spatially) commutes for suburban women, a non-trivial result. In addition, exacerbating this is the choice

of mode to work. Suburban women show significantly more single-occupancy-vehicle (SOV) use than their traditional neighborhood counterparts. The combination of longer distance and time to/from work, with greater use of single occupancy vehicles, has serious ramifications for air quality, physical activity, time at home/with family, and basic quality of life.

With the exception of driving to civic institutions (more trips by suburban women) and taking transit with no particular destination (more trips by traditional women), the only difference for women by neighborhood type is in the non-motorized modes. Interestingly, it is *all* types of walk/bike trips that differ for women by neighborhood type. Traditional women make significantly more walk/bike trips to every type of destination, including strolling around the neighborhood, and going out with no particular destination. However, suburban women showed significantly more times for children playing outside on average; this is not surprising given that 59% of women with children live in the suburbs. In the next section, presence of children under the legal driving age of 16 years is used as the independent variable.

TABLE 4 Women's Travel Behavior by Neighborhood Type

	Traditional	Suburban	p-value
Days/month work at home	2.03	1.00	0.006
Miles to work	9.78	13.76	0.007
Minutes to work	17.41	21.00	0.014
Drive alone to work from home (days/week)	4.43	4.69	0.010
Drive alone to home from work (days/week)	4.46	4.69	0.019
Number of autos	1.50	1.62	0.036
Vehicle Miles Driven (VMD per month)	132.37	151.89	0.056
Times stroll around the neighborhood in previous 30 days	10.66	8.45	0.023
Times walking to a store in previous 30 days	4.89	2.02	0.000
Times exercising in neighborhood in previous week	2.10	1.59	0.038
Times children played outside in neighborhood in previous week	0.77	1.13	0.025
Number of cases	450	350	

With respect to attitudes (table not shown for brevity), women in traditional neighborhoods scored higher on accessibility and attractiveness neighborhood preferences and pro-transit attitudes, while their suburban counterparts scored higher on safety preference and safety of car

attitude. When compared with men, the same relationships occurred, but in addition, traditional neighborhood males scored higher than their suburban counterparts on physical activity options and socializing preferences and on the travel minimizing attitude.

Presence of Children

The presence of children under 16 seems to be a strong predictor for automobile dependence. Households having women with children owned significantly more vehicles (1.84 cars on average) than those having women without children (0.81 cars). In addition, women with children under 16 were more likely to drive a light-duty truck, minivan, or SUV than a car. Examining the factor score preferences, women without children were more likely to favor physical activity options, while women with children were more concerned with safety. In addition, women with children specifically averaged much higher on the questions about wanting to "Own one more car" and "I need a car."

Women with children under 16 averaged more days a week for which they stopped on the way home from work. They were also far more likely to carpool to/from work with household members. Importantly, women with children under 16 had significantly higher VMD, with an average of 166 miles/week versus 134 miles/week for women without children. Perhaps reflecting the higher number of women with children in the suburbs, women with children averaged almost 15 miles to work, versus an average of 10 miles for women without children. Surprisingly, women with and without children under 16 did not report differences by specific destinations, except that women without children were slightly more likely to drive somewhere with no destination in mind, and to walk or bike somewhere to eat.

Whereas an eatery was the only destination that differed by non-motorized access for women with or without children under the legal driving age of 16 years, many more differences arose for women with children under the age of 5 years. Surprisingly, the utilization of non-motorized modes for some destinations was significantly higher for women *with* children under the age of 5. In particular, women with very young children walked or biked to church/civic institutions, eateries, and someplace to exercise significantly more often than their counterparts without young children. Even walk/bike trips to services were moderately significantly higher for women with young children. The only walking activity on which women without children under 5 scored higher with moderate significance was the exercising in their neighborhood question. Interesting, "times walking in neighborhood," "times walking to shop" and "times children playing outside" did not significantly differ because of very young children. The behaviors with significant differences are shown in Table 5.

When analyzing the same non-motorized travel behaviors for men, there were *no* significant differences between those with very young children and those without. This solidly reinforces the earlier discussion about women having primary caretaking responsibilities, particularly for younger children.

TABLE 5 Women's Travel Behaviors by Presence of Children under 16

	Without Children under the age of 16	With Children under the age of 16
Vehicle miles driven in average month	133.82	165.56
Miles to work	10.38	14.93
Days per week stop on way home from work	1.98	2.39
Days per week take carpool/vanpool with household members - Home-to-work	3.03	4.47
Days per week take carpool/vanpool with household members - Work-to-Home	2.97	4.23
Number of times in the last week children played outside in the neighborhood	0.17	2.80
Live on Cul-de-Sac (Yes = 1, No = 0)	0.22	0.30
Neighborhood type (Traditional = 1, Suburban = 0)	0.59	0.41
Number of cases	620	172

Multivariate Results

Vehicle Miles Driven (VMD)

Three models were developed for VMD, one for women (Table 6), one for men (Table 7), and a constrained model with both men and women, in which only the final significant variables from the segmented models were entered into the model (Table 8). Consistent with previous analysis (Handy et al. 2005) a "car dependent attitude" has the strongest effect on VMD in the model for all cases. It also appears in each segmented model as the largest coefficient. However, that is the *only* variable that appears in both segmented models. For men, the only other variables that proved to be significant were minimum distance to leisure destinations and perception of accessibility, which was only mildly significant at p=0.074.

For women, total income had the second largest standardized coefficient, with VMD increasing for increased income level. Almost as significant as income is the minimum distance to institutions such as church, the library, the post office, etc. As this minimum distance increases (an indication of lower density and greater segregation of uses) the VMD increases as well. Not surprisingly, the presence of children under legal driving age has at least a slightly significant impact on VMD. As perception of safety is stronger, VMD is less, often indicating more comfort using alternative modes. However, it is interesting to note that the only other

perception that is significant is that of socializing, an increase in which also reduces VMD. This reflects the possibility that socializing and neighborhood interaction as important components to perceived safety, a plausible, if speculative, connection. It could instead (or in addition), more straightforwardly, simply mean that those who find socializing in their neighborhood do not need to travel as much in order to meet a need for social interaction.

The goodness-of-fit of the women's model is relatively high for a model of individual travel behavior, with an R-square of 0.267, explaining 26.7% of the variability. The men's model had a much smaller adjusted R-square of only 0.101, or 10.1% explanatory power. This greater explanatory power of the women's model suggests that women's behavior shows less variance from the mean behavior, and/or that the variables analyzed are better predictors for women than men.

TABLE 6 Females only: Linear Regression Model for ln(VMD)

Variable	Coefficients	Standardized Coefficient	t-statistic	p-value
(Constant)	3.958		18.387	0.000
Current total income	0.000	0.136	3.732	0.000
Car dependent attitude	0.367	0.325	9.213	0.000
Safety perceived	-0.106	-0.090	-2.280	0.023
Socializing perceived	-0.104	-0.078	-2.034	0.042
Minimum distance to institutions (church, library, post office)	0.000	0.117	1.992	0.047
Presence of children under 16	0.176	0.065	1.819	0.069
N	710			
R-square	0.267			
Adjusted R-square	0.237			

TABLE 7 Males only: Linear Regression Model for ln(VMD)

Variable	Coefficients	Standardized Coefficient	t-statistic	p-value
(Constant)	4.909		21.735	0.000
Car dependent attitude	0.309	0.262	6.901	0.000
Minimum distance to leisure (bars, theater, bookstore, video)	0.000	-0.115	-1.974	0.049
Accessibility perceived	0.109	0.080	1.789	0.074
N	676			
R-square	0.101			
Adjusted R-square	0.076			

TABLE 8 All cases: Linear Regression Model for ln(VMD)

Variable	Coefficients	Standardized Coefficient	t-statistic	p-value
(Constant)	4.159		41.232	0.000
Current total income	0.000	0.136	5.344	0.000
Car dependent attitude	0.334	0.286	11.402	0.000
Minimum distance to institutions (church, library, post office)	0.000	0.086	3.034	0.002
Safety perceived	-0.074	-0.061	-2.322	0.020
Accessibility perceived	0.078	0.058	2.131	0.033
Socializing perceived	-0.072	-0.053	-1.992	0.047
N	1435			
R-square	0.135			
Adjusted R-square	0.130			

Walking to the Store

The final model developed for women's walking to the store contained few explanatory variables. Many of the variables that appeared in the early iterations (e.g. limits to walking, age, car-dependent attitude) disappeared when measures of the built environment were introduced. Even more interesting is the difference in this model from the one developed in the original Caltrans report (Handy et al., 2004) for all cases. That final model included the following significant explanatory variables: limits on walking, age, number of autos, worker, pro-alternative mode attitude, pro-transit attitude, safety of car attitude, physical activity options preference, safety preference, proximity of shopping, cul-de-sac preference, perception of safety,

perception of attractiveness, perception of accessible shopping, minimum distance to grocery store, and number of types of businesses within 800 meters (Handy et al., 2004).

The final model for only women respondents (Table 9) shared only five of these explanatory variables. Both preference for and perception of proximity of shopping increased the frequency of walking to shopping, which is an expected correlation. It does not answer the question, however, of whether these walking trips replaced driving trips, or were in addition to them. Pro-alternative mode and pro-transit attitudes both increase frequency of walking to shopping. As minimum distance to a grocery store increased, walking frequency decreased, although only slightly.

The men's only model for walking to the store (Table 10) shared some of the same variables with the women's, but not all. No socio-demographic variables remained in the final women's model, yet education level had at least some impact on men's walking to shopping; as men's education level increases, their walking frequency decreases. Men, as well as women, increased their walking with preference for proximity of shopping, and pro-bike/walk and pro-transit attitudes. However, none of those variables had as strong an influence in their individual model as did the women's variables in their model. Men's walking frequency also increased with a preference for physical activity options, but decreased with preferences for safety, attractiveness, and a safety of car attitude. As with women, the proximity of shopping was a strong predictor for walking to the store frequency. However, rather than minimum distance to a grocery store, men were influenced by the number of maintenance businesses and eateries within 400 meters and 800 meters, respectively. This may reflect a difference between women and men in the type of shopping they do most.

TABLE 9 Walking to the Store (Women's Model)

Negative Binomial Regression Model for Frequency of		
Variable	Coefficient	p-value
(Constant)	0.186	0.330
Preference for close shopping	0.257	0.000
Pro-walk/bike travel attitude	0.399	0.000
Pro-transit travel attitude	0.293	0.000
Perception of close shopping	0.245	0.000
Minimum distance to grocery shopping	-4.10E-04	0.000
N	784	

TABLE 10 Walking to the Store (Men's Model)

Negative Binomial Regression Model for Frequency of Walking to the Store		
Variable	Coefficient	p-value
(Constant)	-0.504	0.030
Education level	-0.075	0.045
Preference for close shopping	0.127	0.023
Physical activity options preference	0.181	0.002
Safety preference	-0.199	0.003
Attractiveness preference	-0.132	0.011
Pro-walk/bike travel attitude	0.234	0.000
Pro-transit travel attitude	0.280	0.000
Safety of car attitude	-0.187	0.001
Perception of close shopping	0.341	0.000
Number of maintenance businesses within 400m	0.205	0.002
Number of eateries within 800m	0.095	0.000
N	719	

CONCLUSIONS AND POLICY IMPLICATIONS

Many of the results in this analysis followed anecdotal evidence and previous gender-specific research. For women, safety issues arise again and again, affecting attitudes, perceptions, and travel behaviors. In addition, women are much more sensitive than men to socializing and neighborhood interaction, both of which can be encouraged through community-based programs. Women, however, do seem to be *less* sensitive than men to some of the infrastructure (e.g. accessibility and proximity of services) differences between suburban and traditional neighborhoods, perhaps since they are often more constrained by the duties and obligations of household maintenance.

It appears that it may be feasible to facilitate an increase in walking or biking trips by increasing safety and socialization, since both of these were significant in the model for women's VMD, whereas for men, they were not. Women will likely need to make as many trips as they do now, for household maintenance duties, but increasing safety and socialization may successfully encourage women to replace driving trips when possible. Women's casual strolling behavior is more sensitive to travel attitudes and perceptions of safety and socialization. However, women's active travel (i.e. walking to shopping) also includes a significant reliance on proximity to shopping, a question of infrastructure and neighborhood design.

Sometimes it seems that research only leads to more questions. However, through this effort and the efforts that it draws upon, trends are emerging, and the relationships (and their directional impacts) of neighborhood design and transportation behavior are becoming more clear. Gender-specific approaches are enjoying a renewed and expanded interest. And the emergence of a nexus between public health and transportation is bringing new perspectives, approaches, and resources to the discussion.

The majority of previous research, current efforts, and this specific analysis point to the necessity for a holistic approach to these questions of why, how, and how best to improve women's travel behavior, particularly reducing the need for automobile travel and/or increasing active travel and walking behaviors. Some currently popular planning terms are "collaborative," "community-based," and "context-sensitive." These approaches can be used to educate planning professionals and inform a planning process that incorporates infrastructure and programs that reflect the needs and desires of women, as found through gender-specific research and outreach. As Andrew says, we must have a "commitment to develop methods sensitive to women and to ensure that findings reach those engaged in policy and practice can be characterized as a concern to do research *for* women rather than *about* them, to learn *with* women, not *from* them" (Andrew 1988). Beyond the desire to bring equity to planning and transportation, improving circumstances for women can only benefit the population as a whole.

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REFERENCES

ANDREW, C. A. B. M. M. (1988). GENDER-SPECIFIC APPROACHES TO THEORY AND METHOD. LIFE SPACES: GENDER, HOUSEHOLD, EMPLOYMENT. C. A. B. M. M. ANDREW. VANCOUVER, UNIVERSITY OF BRITISH COLUMBIA PRESS: 176-186.

CLIFTON, K. J. A. A. D. L. (2004). GENDER DIFFERENCES IN WALKING BEHAVIOR, ATTITUDES ABOUT WALKING AND PERCEPTIONS OF THE ENVIRONMENT IN THREE MARYLAND COMMUNITIES. WOMEN'S ISSUES IN TRANSPORTATION, CHICAGO, IL.

HANDY, S. L. (2004). CRITICAL ASSESSMENT OF THE LITERATURE ON THE RELATIONSHIPS AMONG TRANSPORTATION, LAND USE, AND PHYSICAL ACTIVITY. WASHINGTON, DC, TRANSPORTATION RESEARCH BOARD AND THE INSTITUTE OF MEDICINE COMMITTEE ON PHYSICAL ACTIVITY, HEALTH, TRANSPORTATION, AND LAND USE: 72.

HANDY, S. L., PATRICIA L. MOKHTARIAN, THEODORE J. BUEHLER AND XINYU CAO (2004). RESIDENTIAL LOCATION CHOICE AND TRAVEL BEHAVIOR: IMPLICATIONS FOR AIR QUALITY. DAVIS, CA, UNIVERSITY OF CALIFORNIA, DAVIS - CALTRANS AIR QUALITY PROJECT: 54.

HANDY, S. L., XINYU CAO AND PATRICIA L. MOKHTARIAN (2005). "DOES SELF-SELECTION EXPLAIN THE RELATIONSHIP BETWEEN BUILT ENVIRONMENT AND WALKING BEHAVIOR? EMPIRICAL EVIDENCE FROM NORTHERN CALIFORNIA." AMERICAN PLANNING ASSOCIATION.

MICHELSON, W. (1988). DIVERGENT CONVERGENCE: THE DAILY ROUTINES OF EMPLOYED SPOUSES AS A PUBLIC AFFAIRS AGENDA. LIFE SPACES: GENDER, HOUSEHOLD, EMPLOYMENT. C. A. B. M. M. ANDREW. VANCOUVER, UNIVERSITY OF BRITISH COLUMBIA PRESS. 1: 81-101.

ROTHBLATT, D. N., DANIEL J. GARR, JO SPRAGUE (1979). THE SUBURBAN ENVIRONMENT AND WOMEN. NEW YORK, PRAEGER PUBLISHERS.

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