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Women and Transport: A Characterisation of the Determinants of Women's Tendency to Interact Spatially in Akure, Nigeria

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Abstract: It is a truism that there is a remarkable gender difference in urban spatial interaction pattern. The tenor of this study is on the characterization of the variables that influence women's propensity to interact spatially in Akure, Nigeria. Spatial interaction was assessed using the frequency of all-purpose trips made by women in Akure, Nigeria. The factors that influenced the frequency of spatial interaction were identified for female commuters in Akure and the nature of their influence was analyzed using the multiple regression model. The study makes recommendations on how to enhance women's propensity to interact in the urban system in Akure. Ultimately, the study notes that economic empowerment is the elixir needed to address all the factors that either promoted or discouraged spatial interaction by women in Akure town and advocates a policy framework for women's self-actualisation and capacity-building.

Key words: Transport, characterisation, determinants, tendency, interact spatially

INTRODUCTION

Interest in gender and gendered pattern of spatial interaction in the urban system emerged about two decades ago, when feminist geographers began publishing critiques of the gender-blind approach to transportation research. It has been widely reported that women typically make shorter work-trips compared to their male counterparts (Law, 1999). The significant gender differences in trip purpose, trip distance, transport mode and other aspects of travel behviour have also been established (Fox, 1983). The factors that are responsible for this gender difference in trip characteristics are related to the sex roles of women e.g., child bearing, shopping and other domestic chores and responsibility (Tivers, 1985).

The difference in mobility behaviour of men and women has been attributed to fear by women of male sexual violence. Pain (1991) reports that some of the fears entertained by urban women include pervasive awareness of vulnerability to sexual assault. Consequent upon this, women have evolved some self-protection strategies and behavioural constraints such as travelling with an escort and avoiding certain place at certain times. These self-imposed precautionary measures can limit mobility significantly and create a remarkable difference in the male and female mobility patterns.

Pickup (1988) opined that women's gender role is the primary reason for their low travel mobility and he identified three components of this role as: Family role-playing; gender-related tasks and the conditions under which women travel. Hamilton and Jenkins (1989) also noted that women's domestic role, their socialization history and their position in the labour market could influence their mobility pattern. Rosenbloom (1998) reports that the travel pattern of non-employed women such as housewives and older women exhibit marked gender bias in frequency, length and duration.

Morenikeji and Fadare (2001), in a study carried out in Minna, Nigeria, noted that there was gender bias in the trip rates of male and female commuters in the town and this difference was found to be statistically significantly at 1% critical limit. The factors that contributed to the statistical significance of the difference include level of education of female commuters and vehicle ownership. Studies have also indicated that women travel less frequently than men, rely more on public transport than men and travel shorter distances than men. This assertion has been supported by studies in Switzerland where it was reported that men use car for 54.00% of their trips and women do so only for 38.00% (Matthies *et al*., 2002).

Spatial interaction theory provides a basis for the understanding and analysis of transport flows in urban areas. Transport flows involve the movement of commuters, goods and services between places. Spatial interaction varies in direction, scale, speed, capacity and content depending on the methods of transport used. It includes such activities as traffic, travel and communications. The major units of spatial interaction in the transport sector are trips. Thus spatial interaction analysis follows two approaches namely, an examination of some of the determinants of the propensity to generate trips at the household, firm or individual level and the capacity of the various land uses to generate and attract trips.

This study follows the first approach, i.e., an examination of some of the determinants of the propensity of women in Akure, Nigeria, to generate all-purpose trips in the town. All-purpose trips is a concatenation or summation of all the typologies of trips made by the women that were covered in the sample during the period of the survey.

THE SPATIAL INTERACTION EPISTEMOLOGY

Spatial interaction analysis in the transport system is traceable to the American Geographer, Edward Ullman who, in the 1940s, propounded a theory of spatial interaction. His theory recognized the reciprocal relations between different places on the earth's surface and was predicated on the principles of complementarily, intervening opportunities and transferability (Ullman, 1959).

Complementarily implies areal differentiation and the existence of supply and demand in different areas. In other words, it is the degree to which two regions complement each other. In order for interaction to take place, the demand for a good or service at one place must be matched by the supply of the same good or service at another place.

Interviewing opportunities represent constraints as to the possibility of interaction taking place. The theory maintains that even when there is a supply in one area and a demand in another, interaction would only take place if there are no alternative sources of the same goods and services. Intervening opportunities continually appear and disappear so that spatial interaction is always in a constant state of flux. The third tripod in the schemata, transferability, relates to the ease with which such demands could be met and therefore, it is distance measured in real terms of travel time and cost.

Spatial interaction is usually analysed using the sequential forecasting models, made up of the trip generation model; trip distribution models; modal split models and trip assignment models. Trip generation models normally describe reasons why trips are made and the relationship between land use and trip-making. A trip is regarded as a single journey made by an individual between two points-origin and destination and for a specific purpose and by a specific mode of transport (Salter, 1983).

Trip distribution model calculates the proportion of trips from zone i which will be attracted to zone j and constitute a proportion of total trips attracted to zone j (Ogunsanya, 1986). If the trip volumes 0_i for trip origins and D_j for the trip destinations are obtained, the function of the trip distribution model is to determine how this trip volume will be distributed amongst zones in the city. If in zone i for instance, 0_i trips are generated and in zone j Dj trips are attracted, the trip distribution model determines the volume of trips (Xij) which will go from zone i to j (Ayeni, 1994).

Trip modal split determines the type of modes used by trip makers. This is based on the assumption that urban travelers have alternative modes or means of transport to choose from. The modal split model therefore represents the transportation version of the general model of human choice that explains how people select between competing alternatives (Kanafani, 1983).

Trip assignment models are concerned with the route-choice behaviour of commuters. Commuters travelling in the urban centers from zones of origin i, to zones of destination j are normally expected to be rational in their route-choice behaviour and ipso facto are expected to choose the route with the least impedance vis-a-vis other competing or alternative routes (Ogunsanya, 1986).

The tenor of this research is on gendered trip generation and a brief low down on trip generation is therefore inevitable. Trip generation modeling is the analytical process that provides the relationship between urban activity and travel. Trip generation model forecasts the number of person-trip that will begin from or end in each traffic analysis zone within the town for a stated period of time. Trip generation equations have as their dependent variable the number of trips generated per person or per household for different trip purposes, while the independent variables are the land-use and socio-economic factors that are considered to affect trip-making.

Landuse is a major factor in the generation of trips because in residential areas, the density of development and the type of housing are major determinants of the number of trips generated. Similarly, in areas where commercial or industrial landuse is of importance, the type of activity and the number of workers employed per unit area will influence trip generation.

The main aim of trip generation modeling is to establish a functional relationship between travel, land use and socio-economic characteristics of an area. The rate of trip making within an area depends primarily on landuse and therefore the function of trip generation analysis is to establish meaningful relationships between landuse and trip making activities so that changes in landuse can be used to predict subsequent changes in transportation demand.

The major characteristics of landuse that have been found to relate closely to trip generation are the intensity, character and location of landuse activities. Intensity of landuse is usually expressed in such terms as dwelling units per acre or employee's per acre. Character of landuse has reference to the social and economic makeup of the users of the land and includes measures such as average family income and car ownership per capita. Location within an urban area has been found to be a variable that can express the combined effect of such variables as family size, stage in family life cycle, age, sex, level of education of the household head etc.

The relationship between trip ends, land use and socio-economic factors can be obtained easily using the lest squares regression analysis (Ayeni, 1979). The least squares regression model could be linear or non-linear on one hand and simple or multiple on the other hand. The multiple linear regression model is usually stated as:

$$Y = a + \sum_{i=1}^{n} bixi + error \qquad (1)$$

Where:

Y = The criterion or dependent variable.
a = The intercept value on the regression hyperplane.
bi-bn = The partial regression coefficients.
xi-xn = The predictor variables.

This model (Eq. 1) assists in assessing the contributions of the predictor variables to trip making and before it is applied for predictive purposes, it has to be calibrated to determine the value of the parameters involved. One major problem with the least squares regression technique of estimating trip generation rate is the inability of transportation planners to come out with a single global regression equation that is capable of predicting both present and future trip rates. The category analysis was developed to take care of some of the inadequacies of the regression model.

The major utility of category analysis over regression analysis is that it deals with homogeneous zones and it concentrates on households rather than traffic zones as the trip-making unit (Burton, 1985). Category analysis identifies homogenous zones and then it cross-classifies basic dwelling-unit data into these homogeneous zones. It sees the household as the basic unit of trip making and posits that trips generated by households depend on the socio-economic characteristics of the household and its location relative to workplace, shopping and other trip attractors.

Category analysis requires the classification of household types according to a set of categories that are highly correlated with trip making. Trip production are estimated as functions of household characteristics and trip attractions as functions of economic activity. This modeling technique relies on a substantial empirical input (data) from a large survey and constancy of trip making rates within a number of household groups (Ortuzar and Willumsen, 1990; Oyesiku, 1995; Okoko, 2006). The model according to Wilson (1974) is stated as:

$$O_i^n = \sum_{h \in H(n)} a_i(h)T(h) \qquad (2)$$

Where:

O_i^n = The number of trip productions in zone i by persons of type n.
n = A person type index.
h = Household type index.
t (h) = The average number of trips (for a particular trip purpose and time period) by a household of type h.
ai(h) = The number of households in zone i in household category h.
ai (h)T(h) = The number of trip productions made by households of category h in zone i.
H (n) = The set of households h, containing persons of type n.
h ∈ H (n) = Membership of this set.
Σ h ∈ H (n) = The sum of households containing members of type n.

MATERIALS AND METHODS

The research reported here was done in Akure, a medium-size Yoruba town in southwestern Nigeria. The population of the town in 1991 was 239,124 (National Population Commission, 1991). For the recruitment of the sample, 807 female respondents were systematically selected from Akure town. The technique of data analysis was that of multiple regression model (Eq. 1). The criterion variable in the model was the all-purpose trips per week (represented by the summation of all typologies of trips covered in the research i.e work trips, shopping trips, recreational trips, social, religious, schools, hospital and other trips). About twenty predictor variables were fed into the stepwise multiple regression model and out of this, eight were selected on stepwise basis. The eight significant variables are:

- Shifting in work place (SHIFTS).
- Household size of respondents (HOUSES).

- Residential density type (RESIDEN).
- Number of cars in the family (NUMCAR).
- Travel time from home to work place (TRATIM).
- Mode of travel to work (TRAMOD).
- Annual rent of commuters (ANRENT).
- Departure time from home to work (DEPART).

In trip generation analysis, the multiple regression model is often used. The method of calibration is the stepwise technique because it has the ability to accommodate only the significant variables in the model. The multiple regression model aims at encapsulating $n(n\geq2)$ number of predictor variables in a single model. It then predicts variations in y (criterion) variable as x variates vary (Eq. 1).

The regression model assists in assessing the contributions of the explanatory variables to trip making and before it is applied to predictive purposes, it has to be calibrated to determine the values of the parameters involved. Each term of the equation can be interpreted as the contribution of the corresponding independent variables to the magnitude of the dependent variable. That is, a unit change in an independent variable is seen to result in a change in the dependent variable, which equals the magnitude of the coefficient of the independent variable (Papacostas, 1987).

RESULTS AND DISCUSSION

A predictive trip rate model was developed for this study to predict the rate of all-purpose trips made by women in Akure. Certain socio-economic variables were found to significantly influence the propensity of women in Akure to interact in the urban system. The study reveals that women's propensity to interact in Akure is influenced largely by 8 predictor variables. These variables have been coded as: SHIFTS; HOUSES; RESDEN: NUMCAR: TRATIM: TRAMOD: ANRET; DEPART.

The degree of independence of these independent variables was assessed using Pearson's product moment correlation coefficients. The pair-wise relationship between the variables is shown in the zero-order correlation coefficient matrix in Table 1. The correlation matrix reveals some cases of pair-wise collinearity but they were tolerated and accommodated in the model after passing the Durbin-Watson test.

The zero-order matrix in Table 1 reveals that there is a strong and direct linear relationship between the number of all-purpose trips (Y) made by women in the study area and the predictor variables used in the analysis. The strongest and most direct pair-wise linear relationship is the one between the dependent variable (Y) and the household size of respondents (HOUSES). The Pearson's product-moment correlation coefficient for the relationship between all-purpose trips (Y) and household size (HOUSES) is +0.972. This coefficient is very high and direct, meaning that a unit increase in the number of household size will bring about a corresponding increase in the number of all-purpose trips made by women in the study area. The exact rate of increase in Y vis-à-vis a unit increase in HOUSES, could be determined using the trip-rate model in Eq. 3.

Another predictor variable that exhibited a high and direct linear relationship with the independent variable (Y) is travel time (TRATIM). However, TRATIM exhibited a high collinearity coefficient with the number of cars (NUMCAR) in the family of female commuters. The collinearity tolerance statistics for these two variables shows a lower value for NUMCAR (0.118, Table 1). Consequently, NUMCAR is used here as a substitute for TRATIM to explain the relationship between Y and TRATIM (Note that in Eq. 3, NUMCAR also has a higher predictive coefficient (0.444) than TRATIM with a coefficient value of 0.019).

The zero-order correlation coefficient matrix thus reveals that as the number of cars (NUMCAR) in the female-headed families increases, there is also bound to be an increase in the number of all-purpose trips made by women in the sample. The correlation coefficient is very high and direct with a value of +0.908, thereby attesting to a direct linear relationship between all-purpose trips and the number of cars per family.

Table 1: Zero-order correlation coefficient matrix for female commuters in Akure

	Y	Shifts	Houses	Resden	Numcar	Tratim	Tramod	Anrent	Depart
Y	1.00	0.709	0.972	0.530	0.908	0.966	0.873	0.490	0.535
Shifts		1.00	0.636	0.212	0.685	0.761	0.539	0.183	0.567
Houses			1.00	0.622	0.886	0.925	0.834	0.458	0.496
Resden				1.00	0.590	0.486	0.325	0.000	0.000
Numcar					1.00	0.926	0.709	0.361	0.427
Tratim						1.00	0.821	0.461	0.544
Tramod							1.00	0.705	0.600
Anrent								1.00	0.593
Depart									1.00

Collinearity tolerance statistic: NUMCAR = 0.118; TRATIM = 0.145; TRAMOD = 0.288

One other variable that was accommodated in the model is the Travel Mode (TAMOD) of female commuters. The correlation coefficient was also found to be very high and direct (+0.873), meaning that a change from public mode to private mode of transport will bring about an increase in the frequency of all-purpose trips by commuters in the sample. There was collinearity between this variable and the household size of commuters, but the collinearity coefficient of 0.288 was tolerated after passing the Durbin-Watson collinearity test.

It is also noticeable that Shifting (SHIFTS), Residential Density (RESDEN) and Departure Time from home (DEPART) also had high and positive correlation coefficients (+0.709, +0.580 and +0.535) with all-purpose trips (Y) made by female commuters. This means that a unit increase in the value of any of these variables will result in a corresponding increase in the frequency of all-purpose trips. The relationship between annual rent (ANRENT) and all-purpose trips (Y), though direct, was found to be weak and in the predictive trip-rate model (Eq. 3), the contribution made by the coefficient of this variable to explanations for variations in variable Y, was very minimal.

The actual magnitude of the influence of each of these variables on the frequency of all-purpose trips could be determined by calibrating the parameters in Eq. 3. The zero-order correlation coefficient matrix shows the direction and strength of the linear relationship between the dependent variable (Y) and the predictor variables. The actual rate of increase of Y (all-purpose trips) given a unit increase in the value of the predictor variables, while holding the values of all the other parameters constant, could be determined using the predictive trip-rate model in Eq. 3. The predictive trip-rate model that was developed for this study is given in Eq. 3:

$$Y = 3.118 + 0.992\,(HOUSES) + 0.109\,(TRATIM) + 0.940\,(TRAMOD) + 0.659\,(SHIFTS) - 0.175\,(DEPART) + 0.444\,(NUMCAR) - 1.237\,(RESDEN) - 6.9E{-}02\,(ANRENT) \quad (3)$$

The model (Eq. 3) shows that most of the coefficients of the variables have positive values and thus promote gendered spatial interaction by women in the urban system. The first variable in the model is the household size of the women covered in the study. With a regression coefficient value of 0.992, the model predicted that given a unit increase in the household size of the respondents, their ability to interact in the urban system will increase by almost 1 unit (0.992 unit), holding all the other coefficients and the intercept value on the regression hyper plane, constant. In common phraseology, this means that the larger the family size, the greater the propensity of women to interact in the urban system.

Another variable that significantly influenced the proclivity of women to interact in the town is the available mode of transport. The model predicted that those women who owned private cars interacted more in the urban system than those who did not have private means of transport. Specifically, the model predicted that a change from public mode to private mode of transport would create an increase in the rate of interaction by almost 1 trip (TRAMOD coefficient value is 0.940), holding all the other coefficient values constant. This is to be expected because private ownership of cars is believed to increase one's tendency to interact in the urban system.

The above observation was corroborated by the equally high partial regression coefficients for the number of cars per family of female commuters (NUMCAR). The regression coefficient showed that the number of cars in the family of female commuters had a tendency to increase their ability to interact in the urban system. As the number of cars is increased by a unit, the propensity to interact increases by almost half a trip (partial regression coefficient = 0.444), holding all other parameters constant. This is axiomatic because the more the number of cars in the family, the greater the number of trips generated.

Shifting (SHIFTS) also affected the rate of gendered spatial interaction positively in the study area. The model predicted that urban women involved in shifting work interacted more than their counterparts who were not involved in shifting work. The partial regression coefficient for this variable was found to be as high as 0.659. Two other variables were also found to have positive effects on women's propensity to interact in the study area. These variables are: travel time from origin points to destination points (TRATIM) and departure time from home (DEPART). The partial regression coefficients associated with these variables, however, had small values (0.109 and 0.175, respectively) and they expectedly exerted negligible effects on the penchant of women to interact spatially in the study area.

On the other hand, two variables in the model discouraged women from interacting maximally in the urban system. These variables are: the annual rent of female commuters (ANRENT = 6.9E-02) and high residential density (REDEN = -1.237). The model coefficients mean that high rents have a tendency to discourage women in urban areas from making intra-urban trips in Akure town. This prediction is axiomatic because women who spend a lot on rent will have little left to spend on travelling to acquire other needed urban services. The low and negative regression coefficient associated with high residential densities is due to the

Table 2: Analysis of Variance (ANOVA) for female commuters in akure

Model	Sum of squares	Degree of freedom	Mean square	F statistics	Sig.	R	R^2
Regression	27590.5	8	3448.813	5793.989	0.000	0.9914	0.983
Residual	475.001	798	0.596				
Total	28065.50	806					

fact that majority of the people in this density type are poor and thus are not adequately endowed financially to embark on incessant trips in the urban system.

The trip rate model was validated using the mean values of the significant variables in the predictive model (Eq. 3). The model correctly predicted the empirical mean trip rate of female commuters in Akure. The empirical female all-purpose trip rate was 14.0248 trips per week and this was correctly validated using Eq. 3. The proportion of the variance of all-purpose trips explained by the joint variance of all the predictor variables was measured using the coefficient of multiple determination (R^2). The coefficient of multiple correlation (R) was found to be very high and positive ($R = +0.9914$). This means that the relationship between interaction (variable y) and the socio-economic attributes of female commuters was direct and strong. The actual strength of this relationship was measured using the coefficient of multiple determination (R^2) and the computed value of R^2 was found to be 0.9830. This means that the eight significant variables in the model accounted for 98% of the factors that influence the propensity of women to interact in Akure town.

The rate of increase or decrease of trip-rates of female commuters vis-à-vis a unit increase or decrease in the values of these predictor variables is discernable in the predictive trip-rate model (Eq. 3). The test for the significance of the regression coefficients of all-purpose trips on the eight independent variables was tested using Snedecor's F-statistics (Analysis of variance). The computed F-value of 5793.989 was found to be significant at 1% confidence limit (Table 2). This means that all the eight predictor variables in the trip-rate model (Eq. 3) significantly influenced the frequency of all-purpose trips made by women in Akure town.

CONCLUSION

This study has identified some salient factors that influence gendered spatial interaction and hence the level of involvement of women in city life and activities in Akure. Some of these factors include the size of their families; the number of cars in the family; annual rent; availability of public transport and the residential density of the neighbourhood where the women reside. Some of these factors encouraged women's interaction in the urban system, while others discouraged their involvement in spatial interaction. Some of the prominent factors that encouraged interaction include ownership of private cars and the number of private cars in the family.

One of the variables that discouraged women from interacting spatially in the urban system is the high rent structure in Akure town. There is the need to enforce the rent edict and ensure a uniform rent structure in the town. Cutthroat rents charged by Shylock property owners, who practice petty-landlordism, should be discouraged. There is also the need to inaugurate rent tribunals and ensure that the rent edicts are enforced to the letter in Akure town. Aside from this, there should be an enabling environment to make house-ownership easy for women in Akure.

Policies on how to promote women's involvement in spatial interaction in Akure must, of a necessity, address those factors that either promote or discourage interaction. Ownership of private cars and the number of such private cars per family played significant roles in influencing the frequency of trips made by women in the study area. Large family sizes also promote interaction in the study area. This pre-supposes that there is a great demand for mobility by large non-car owing families. This paper therefore calls for a policy on the enthronement of a conducive atmosphere for the operation of public transport systems, especially mass-transit bus systems to cater for the transport needs of non-car owing families.

Another justification for a policy on mass transit urban system stems from the traffic management point of view. Increasing the number of cars by car-owning families to promote spatial interaction will inevitably pose both traffic management and environmental management problems. Traffic management problems will manifest in form of long platoons of cars at road intersections, with the attendant traffic congestion problems and road accident problems. Environmental problems are related to the emission of toxic gases into the ambient air, thereby causing environmental degradation. Toxic gases that usually emanate from the exhaust of motor cars include oxides of carbon i.e., carbon dioxide (CO_2), carbon monoxide (CO) and the oxides of Nitrogen.

A cursory look at the identified factors that influence women's propensity to interact spatially in Akure reveals that they could be addressed satisfactorily to a large extent through economic empowerment of women and proper physical planning. This stdy therefore calls for a policy framework for the growth and development of towns to ensure that work and activity places are located in close proximity to residential areas to ensure travel time and distance minimization. There is also the need for an immediate initiation of result-oriented programmes on women empowerment in Akure, Nigeria.

It is the contention of this study that economic empowerment is the elixir needed to promote spatial interaction in Akure. There is need for a policy instrument to give greater attention to women's self-actualization and capacity-building. Empowerment, self-actualization and capacity-building therefore constitute the fundamental triology to promote women's propensity to interact spatially in Akure town.

REFERENCES

Ayeni, B., 1979. Concepts and Techniques in Urban Analysis. London: Croom Helm.

Ayeni, B., 1994. Quantitative Methods for Geography Students. Ibadan: Research Support Services.

Burton, M.J., 1985. Introduction to Transportation Planning. 3rd Edn. London: Hutchinson.

Fox, M.B., 1983. Working Women and Travel: The Access of Women to Work and Community Facilities. J. Am. Planning Assoc., 49: 156-170.

Hamilton, K. and L. Jenkins, 1989. Why Women and Travel? In: Grieco, M., L. Pickup and R. Whipp (Eds.). Gender and Transport and Employment. The Impact of Travel Constraints Aldershot: Avesbury.

Kanafani, A., 1983. Transportation Demand Analysis. New York: McGraw-Hill.

Law, R., 1999. Beyond Women and Transport: Towards New Geographies of Gender and Daily Mobility. Progress in Human Geography, 23: 567-588.

Matthies, E., S. Kuhn and C.A. Klockner, 2002. Travel Mode Choice of Women: The Result of Limitation, Ecological Norm, or Weak Habit? Environ. Behav., 34: 163-177.

Morenikeji, W. and S.O. Fadare, 2001. Gender-Bias in Intra-Urban Trip Pattern in Niger State, Nigeria. Int. J. Transport. Stud., 1: 73- 85.

National Population Commission (NPC), 1991. Provisional Census Results. Lagos.

Ogunsanya, A.A., 1986. Some Remarks on the Use of the Conventional Modelling for Transportation Planning in Developing Countries. J. Nig. Instit. Town Planners, 6: 71-85.

Okoko, E., 2006. Urban Transportation Planning and Modelling. Akure: Millennium Publishers.

Ortuzar, J.D. and L.G. Willumsen, 1990. Modelling Transport. Chichester: John Wiley and Sons Ltd.

Oyesiku, K., 1995. An Analysis of the Demand for Inter-city Trip Generation Attributes of a Developing State in Nigeria. J. Transport Stud., 1: 17-28.

Papacostas, C.S., 1987. Fundamentals of Transportation Engineering. New Jersey: Prentice-Hall, Inc.

Pickup, L., 1988. Hard to Get Around: A Study of Women's Travel Mobility. In: Little, J., L. Peak and Richardson (Eds.). Women in Cities: Gender and the Urban Environment. London: Macmillan.

Rosenbloom, S., 1978. Women's Travel Pattern at Various Stages of their Lives. In: Katz, C. and J. Monk (Eds.). Full Circles: Geographies of Women Over the Life Course. New York: Rutledge.

Salter, R.J., 1983. Highway Traffic Analysis and Design. London: The Macmillian press Ltd.

Tivers, J., 1985. Women Attached: The Daily Lives of Women with Young Women. London: Croom-Helm.

Ullman, E.L., 1959. The Role of Transport as the Basis for Interaction. In: Thomas, W.L., (Ed.). Man's Role in Changing the Face of the Earth. Chicago: University of Chicago Press, pp: 862-880.

Whynne-Hammond, C., 1979. Elements of Human Geography. London: George Allen and Unwin.

Wilson, A.G., 1974. Urban and Regional Models in Geography and Planning. London: John Wiley and Sons.