Some Contrary Indications for the Use of Household Structure in Trip-Generation Analysis

KATHIE G. McDONALD AND PETER R. STOPHER

The variables used to predict household trip-generation rates have long been an area of concern for transportation planners; these variables included household size, number of vehicles owned, and income. However, a recent NCHRP study that used linear regression analysis has proposed that a household-structure variable would correlate more strongly with trip rates than almost any other variable, except vehicle ownership. In particular, this should improve the model significantly where it is combined with vehicle ownership and used as a substitute for household size. The results of a trip-generation analysis performed on data from the Midwest by using multiple classification analysis (MCA) in contrast to linear regression are described. The household-structure variable was tested by using both analysis of variance and MCA to determine how well the variable performs in various model structures when compared with other variables. The other variables tested were number of cars or vehicles available to the household, household size, housing type, total number of employed persons, household income, and total number of licensed drivers. It was concluded that the household-structure variable did not perform significantly better than the other variables tested.

With the increasing acceptance into practice of behavioral models for travel forecasting, recent research by the NCHRP has focused on enriching travel-forecasting models with theories and procedures from the behavioral sciences. [Note that these research results are from work done at Boston College for NCHRP Project 8-14 (New Approaches to Understanding Travel Behavior); the report is available on request from NCHRP.] One of the first potential directions examined for translation into practice is the incorporation of behavioral concepts in trip-generation modeling at the household level. As part of this research, Charles River Associates (CRA) proposed that a household-structure variable would significantly improve the performance of such a model (1).

This proposal was based on the premise that households with differing structures, in terms of adults, children, and personal roles, would have differing activity requirements, mobility constraints, and opportunities for trade-offs with other household members or for trip chaining. Thus proposed changes in household structure, such as an increasing percentage of single and single-parent households as well as adult households with no children, as is expected within the next decade, would have a significant effect on trip-generation rates within a population. It is argued that such a variable should add behavioral content that is lacking from traditional trip-generation models, which generally have included such variables as household size, number of vehicles owned, and income to predict household trip rates. Furthermore, a household-structure variable would be more significant in capturing changes in the future than many of the more traditional variables used.

The household-structure categories proposed were based on the age, gender, marital status, and last names of each household member. These variables determined the presence or absence of dependents within the household, the number and type of adults present, and the relationships among and of household members.

The results of an application of this household-structure variable in trip-generation analysis in a Midwest study area are described. The value of this variable is compared with other variables that were tested at this time by using multiple classification analysis (MCA) (see paper by Stopher and McDonald elsewhere in this Record). MCA is an extension of analysis of variance (ANOVA) that, for a set of classified data, expresses group means as deviations from the grand mean.

HOUSEHOLD-STRUCTURE CONCEPT

The household-structure variable defined by CRA comprises eight household categories: male and female single-person households, single-parent households, couples, nuclear families, adult families with children, adult families without children, and unrelated individuals. Age 20 was used as the cutoff to distinguish between children and adults. These categories were determined by using the method shown in Figure 1.

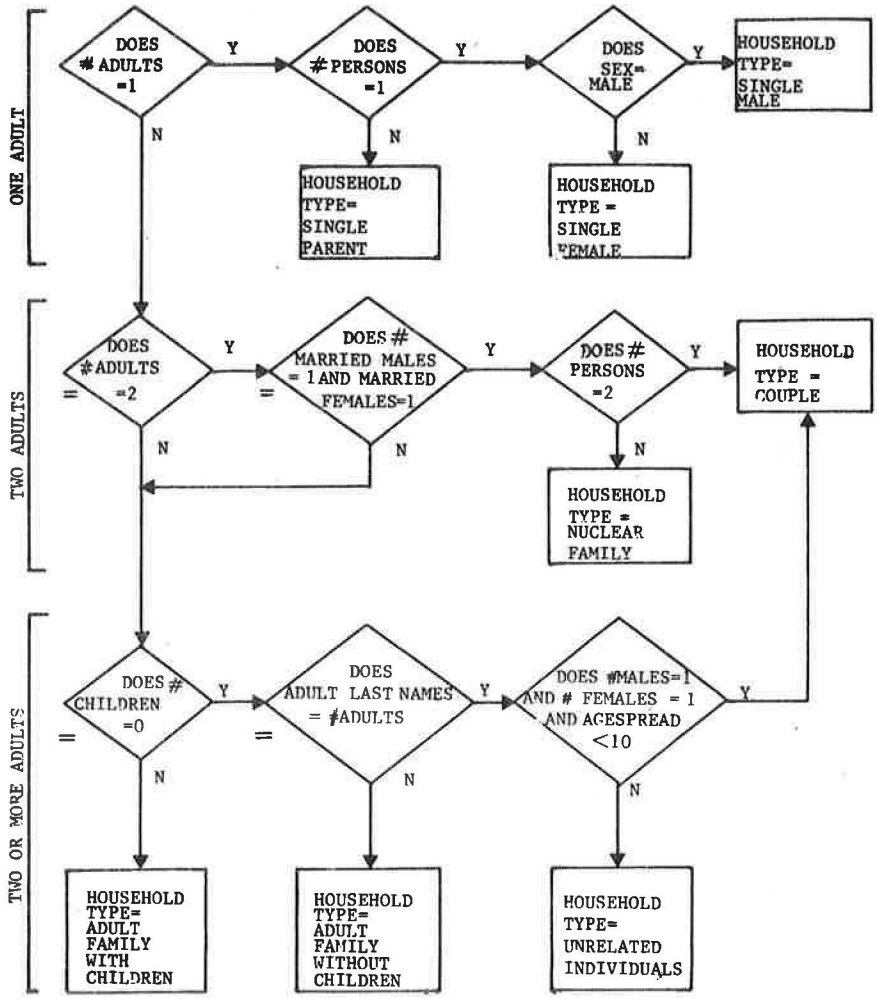
It was expected that these categories would have varying effects on trip rates. Adults living alone would be less mobility constrained than those adults living with children; but they would have none of the opportunities for trip coordination produced by living with other adult members. Single-parent families would have both increased mobility constraints as well as no opportunities for trip coordination, whereas couples would have the advantages of the opposite of both of these. An adult family would have further increased opportunities for trip coordination, but would perhaps differ from an adult household of unrelated individuals where individual activities would possibly be less influenced by other household members.

More specifically, when trip-generation rates are analyzed by purpose groups, differences between the trip-generation rates of these household categories would be expected. Those households with children would be expected to have a greater proportion of school trips and trips serving passengers than those households without children, whereas the latter would probably have a greater proportion of social-recreation trips.

CRA examined this household-structure concept by using Baltimore survey data with regression analysis, where the dependent variables were trip-generation rates by purpose mode, and the independent variables tested included, in addition to household structure, vehicles owned, income, number of persons older than 12, age structure of household, housing type, number of preschoolers present, number of gradeschoolers present, employment status, race, population per residential acre, a city limit classification, and length of residence at that address. The trip-purpose groups defined as the dependent variables were as follows: total home-based trips, home-based work trips, home-based shopping trips, home-based personal business trips, home-based entertainment and community trips, home-based visit and social trips, and home-based service and accompany-traveler trips.

CRA concluded that the household-structure variable was significant in predicting trip frequency. It should be noted, however, that the regressions were constrained to use all independent variables to permit comparability, even though varying numbers of independent variables were highly insignificant. Potentially, intercorrelations among variables could have masked some of the true underlying relation-

Figure 1. CRA flowchart of household typology.



SOURCE: Charles River Associates, 1980.

ships. CRA concluded that, of two commonly used trip-generation variables--number of vehicles owned and income--only number of vehicles owned out-performed the household-structure variable.

CASE STUDY

The analysis of travel data collected in the Midwest examined the household-structure concept. The data were collected from a stratified random sample of the population in seven counties (2). The principal purposes of the survey were to provide

1. The means to update trip-generation rates and modal-split models,
2. Attitudes of the population toward transportation and energy,
3. Attitudes toward possible changes in the transit system, and
4. Preferred methods of obtaining information on carpooling.

The data were collected by using an in-home interview and a 24-hr travel diary and included the variables age, gender, possession of a driver's license, employment status, and income of household members, all of which were available for use in trip-generation analysis.

The final data set consisted of 2,446 households. Of these households, the average household size was 2.9 persons per household, where less than 50 percent (1,656) of all households had two or less persons; 60 percent (1,483) had no children; and 53 percent (1,300) were two adult person households. In addition, almost 80 percent (1,952) of all households had at least one car available for use, and 30 percent (734) had more than one; 80 percent (1,875) occupied single-family dwellings; and 87 percent (2,124) of all households had at least one licensed driver. Seventy percent (1,724) of all households had at least one person employed, 63 percent (1,537) had at least one person employed full-time, and 60 percent (1,468) of all households had 1980 incomes greater than $15,000, with 14 percent (341) greater than $35,000.

The household-structure variable defined by CRA was derived from the data by the method shown in Figure 2. This differs slightly from the CRA flowchart because of the definition of the variables within the Southeastern Michigan Transportation Authority (SEMTA) data set. These differences include the following: (a) the cut-off age between children and adults is 18 years instead of 20, and (b) relationship codes were used to distinguish between adult families without children and households of unrelated adults; the last name of each person was not ascertained in the survey.

Figure 2. Flowchart of household typology used in analyzing SEMTA data.

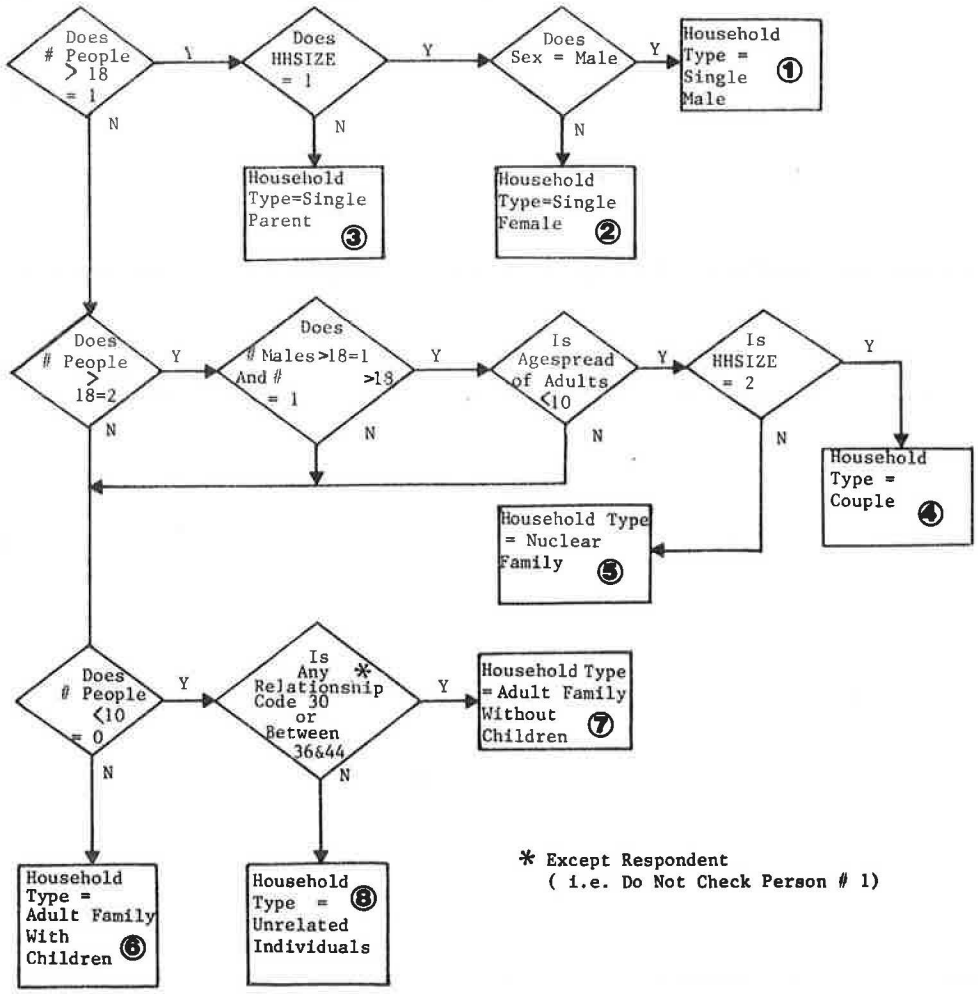


Table 1. Household-structure characteristics of SEMTA data.

Household-Structure Category	No. of Households	Percentage of Households
Single male	200	8.3
Single female	254	10.5
Single parent	150	6.2
Couple	502	20.8
Nuclear family	483	20.0
Adults with children	347	14.4
Adults with no children	420	17.4
Unrelated individuals	56	2.3
Missing	34	--
Total	2,446	

The final breakdown of the data into these household categories is given in Table 1. Almost 19 percent are single-person households, with slightly more single females than single males (2 percent). Single-parent households comprise only 6 percent, whereas couples and nuclear families comprise 21 and 20 percent, respectively. Adults with children make up slightly fewer households than those without children (14 percent compared with 17 percent), but households of unrelated individuals form the smallest category--2 percent of all households. Thirty-four households could not be classified. These included 17 single-person households where the person was younger than 18 years old.

To analyze the role of the household-structure variable in trip-generation analysis, this variable and seven other variables that were also thought to play a significant role in trip-generation rates were selected from the data set. The other variables selected were car ownership, household size, housing type, licensed drivers, household income, and total number of employed persons in the household (see Table 2). These eight variables were first analyzed by using one-way ANOVAs to determine how well they performed against the household-structure variable. Subsequently, the variables were analyzed by using one-way ANOVAs to determine the effects of varying grouping strategies on the categories within each variable.

The household-structure variable was grouped in three ways. The least-aggregate grouping combined the single-male and single-female categories because it was believed that there would be no significant difference between the overall tripmaking characteristics by gender, although there might be small differences for specific trip purposes. The least-aggregate grouping also combined nuclear families with adult families with children, based on the theory that additional adult members in the household would not significantly change the pattern of tripmaking. The second grouping strategy further combines all adult households, except single persons and couples. This assumes that adult households that consist of related persons will have little difference in tripmaking characteristics than those

Table 2. Variable grouping strategies used in SEMTA trip-generation analysis.

Variable Name	Grouping	No.	Categories Used in Grouping
LIFE I (household structure)	1-6	1	Single persons
		2	Single parents
		3	Couples
		4	Families with children
		5	Adult families without children
		6	Unrelated individuals
LIFE II (household structure)	1-5	1	Single persons
		2	Single parents
		3	Couples
		4	Families with children
		5	Other adult households with no children
LIFE III (household structure)	1-3	1	Single persons
		2	Families with children
		3	Households with no children
NUMCAR (number of cars available to household)	0-2	0	No cars available
		1	One car available
		2	Two or more cars available
HHSIZ I (household size)	1-5	1	One-person household
		2	Two-person household
		3	Three-person household
		4	Four-person household
		5	Five or more person household
HHSIZ II (household size)	1-4	1	One-person household
		2	Two- and three-person household
		3	Four-person household
		4	Five or more person household
HOUSTYP (housing type)	0-1	0	Multifamily
		1	Single family
TOTEMP (total number of employed persons)	0-2	0	No employed persons
		1	One employed person
		2	Two or more employed persons
INC80 (1980 household income)	1-3	1	$0-$14,999
		2	$15,000-$34,999
		3	>$35,000
TOTLIC (total number of licensed drivers)	0-2	0	No licensed drivers
		1	One licensed driver
		2	Two or more licensed drivers

households that consist of unrelated individuals. Thus the theory of a coordination of tripmaking decisions between related household members was examined. The most severe grouping strategy separates households with children from households without children, identifying this characteristic as the most important in trip decision making. Only single-person households are further distinguished to reflect unique trip-generation characteristics.

Other variable groupings are also given in Table 2. The model II household size grouping, which combines two- and three-person households, was examined after initial analysis indicated little difference in trip rates of these households. Income was grouped into high-, medium-, and low-income categories.

Finally, MCA (3, and paper by Stopher and McDonald elsewhere in this Record) was used to compare different combinations of these grouped variables in trip-generation analysis. MCA derives trip rates within a standard trip-generation matrix by using deviations from the grand mean of the data set. Thus it improves on the traditional method of computing individual cell means because it permits estimation of trip rates for cells that contain no data. In addition, MCA, by using version 6, 7, or 8 of the Statistical Package for the Social Sciences (SPSS) (3), is able to take into account the interactive effects between independent variables where these variables have nonzero correlations with each other. This corrects for the overestimation of adjustments from the grand mean when these correlations are ignored. This use of MCA and the cross-classification structure is different from the CRA approach, which was to use least-squares regression analysis to predict the trip-generation measures. The effects of household structure were analyzed both in terms of the additional level of variance explained by the household-structure variable as well as the level of variance explained when substituting household structure for another variable.

The models examined in trip-generation analysis are given in Table 3. It can be seen that the number of vehicles (NUMVEH) available to the household was substituted for number of cars in some models because this variable performed significantly better across all purpose groups.

Table 3. MCA models used in SEMTA trip-generation analysis.

Trip Purpose	No.	MCA Models
Home-based work, home-based shopping, home-based social-recreation, home-based other, and non-home-based trips	1	NUMCAR, HHSIZ I, HOUSTYP
	2	NUMVEH, HHSIZ I, HOUSTYP
	3	NUMCAR, LIFE II, HOUSTYP
Home-based work, home-based shopping, home-based other, and non-home-based trips	1	NUMVEH, HHSIZ II
	2	NUMVEH, HHSIZ II, LIFE II
	3	NUMVEH, HHSIZ II, HOUSTYP
	4	NUMVEH, HHSIZ II, TOTEMP
	5	NUMVEH, HHSIZ II, INC80

In all three types of analysis previously discussed, trip-generation models were examined for motorized trips by specific trip purpose. Initial analysis distinguished social-recreation trips, but the final trip-purpose categories examined were home-based work, home-based shopping, home-based school, home-based other, and non-home-based trips. These final trip-purpose categories differ from the categories used by CRA that (a) do not examine non-home-based trips, and (b) break down the other category into more specific purpose groups.

DESCRIPTION OF RESULTS

The results of the ANOVA for ungrouped variables are given in Table 4; the results indicate that across all purpose groups the number of cars available to the household explains more variation than any other variable. This result is consistent with results obtained by CRA. Household size and housing type are the next most significant variables across all purpose groups; and whereas the number of employees in the household explains the most variation for home-based work trips, it does not perform well for all other purpose groups. Household structure and income appear to be of equal strength, although they perform better on different purpose groups. Income is most effective in explaining the total number of non-home-based trips, whereas household structure is most effective in explaining the number of home-based school trips. The licensed-driver variable ranks no better than third in explained variation for any purpose group.

The ANOVA results of the grouping strategies performed on the household-structure variable are given in Table 5. The most effective grouping is the model II grouping: single-person households, single-parent households, couples, other families with children, and other adult households. There appears to be little difference between the travel considerations of adult families that consist of related individuals and those that consist of unrelated individuals, because there is a large increase in the F-ratio across all purpose groups when these are combined, whereas the change in the within-group

Table 4. ANOVA results for ungrouped variables.

Variable	Original Category Values	Statistic	Purpose			
			HBWORK	HBSCHL	HBOTHR	NHB
LIF8	1,8	F	65.6	112.7	50.9	23.6
		SS	5,711.1	6,062.2	19,116.3	17,464.1
		df				
		Between group	7			
		Within group	2,402			
NUMCAR	0,4	F	179.0	24.1	68.5	54.0
		SS	5,296.5	7,809.3	19,902.0	17,265.3
		df				
		Between group	4			
		Within group	2,440			
HHSIZ	1,8	F	60.3	181.8	62.0	29.5
		SS	5,842.1	5,334.5	18,794.9	17,327.0
		df				
		Between group	7			
		Within group	2,438			
HOUSTYP	0,1	F	125.4	22.6	73.9	52.9
		SS	6,195.7	7,842.4	20,792.9	18,008.8
		df				
		Between group	1			
		Within group	2,321			
TOTEMP	0,8	F	205.6	12.7	24.6	30.8
		SS	4,551.3	7,873.5	20,878.2	17,472.1
		df				
		Between group	6			
		Within group	2,439			
TOTLIC	0,8	F	112.3	30.3	57.6	39.3
		SS	5,006.4	7,383.5	18,624.0	16,649.3
		df				
		Between group	8			
		Within group	2,437			
INC80	1,7	F	148.4	15.8	32.7	41.0
		SS	5,020.3	7,814.4	20,493.5	17,075.2
		df				
		Between group	6			
		Within group	2,439			

Note: F = F-score, SS = sum of squares, and df = degrees of freedom. HBWORK = home-based work, HBSCHL = home-based school, HBOTHR = home-based other, and NHB = non-home-based trips.

Table 5. ANOVA results for grouped variables.

Variable	Statistic	Purpose			
		HBWORK	HBSCHL	HBOTHR	NHB
LIFE I	F	85.5	148.8	69.1	30.3
	SS	5,745.0	6,150.0	19,195.0	17,557.7
	df				
	Between group	5			
	Within group	2,406			
LIFE II	F	110.2	186.0	86.2	37.6
	SS	5,748.9	6,150.0	19,200.0	17,564.8
	df				
	Between group	4			
	Within group	2,407			
LIFE III	F	128.4	354.4	135.6	61.8
	SS	6,146.4	6,221.0	19,730.9	17,752.0
	df				
	Between group	2			
	Within group	2,409			
NUMCAR	F	315.7	36.4	112.6	91.1
	SS	5,445.6	7,883.5	20,273.5	17,491.1
	df				
	Between group	2			
	Within group	2,443			
HHSIZ I	F	104.2	278.9	98.2	50.5
	SS	5,853.4	5,572.0	19,219.6	17,405.2
	df				
	Between group	7			
	Within group	2,438			
INC80	F	358.5	37.1	78.1	108.7
	SS	5,298.1	7,879.5	20,812.4	17,259.0
	df				
	Between group	2			
	Within group	2,443			

Note: Statistics and purposes are defined in Table 4.

variance is small. This contrasts with the model III grouping (single persons, families with children, and other families without children) where, although there is a large increase in the F-ratio across all purpose groups, and most particularly with home-based school trips, this is accompanied by a significant increase in the within-group variance.

The ANOVA results of the other grouped variables are also given in Table 5. It is clear that the number of cars available to the household remains the most significant variable in household trip-generation analysis. Once again, the F-scores are substantially greater across all purpose groups, even taking into account the difference in the degrees of freedom. Model II household size, which combines two- and three-person households, improves on model I household size by increasing substantially the F-ratio without increasing substantially the within-group variance. Household income (1980) is also effective in explaining trip-generation rates for all purpose groups except home-based school and home-based other, and thus may be useful when applied to specific trip-purpose models. The total number of licensed drivers, a variable that performed so poorly in earlier analyses, was not tested as a grouped variable.

The MCA results for the two sets of trip-purpose groups are given in Tables 6 and 7. From the first set of purpose groups (Table 6), the basic model consists of number of cars or vehicles available to the household and model I household size. Of the variables used as additions to this basic model, housing type clearly performs the best across all purpose groups. In addition, this model performs better than the model that uses number of cars, household structure, and housing type, where household structure is used as a substitute for household size, an alternative suggested by CRA (1). Further improvements are made by using number of vehicles available to the household instead of number of cars available.

The results of the models analyzed for the second set of trip purpose groups are given in Table 7. An initial examination of these MCA results gives the impression that the model that uses household structure, household size, and number of vehicles is the best model, particularly from an examination of the F-ratios. This is, however, a misleading impression. The F-ratio for an entire model is usually based on all main effects and interactions. If data are missing in some cells of the matrix that define the ANOVA problem, SPSS (3) is unable to calculate the interactions and computes an F-ratio on the main effects only. This F-ratio has substantially fewer degrees of freedom than one on the main effects and interactions, and therefore it must be a larger numeric value for the same significance level.

The household-structure model generated empty cells for some combinations of household structure, household size, and vehicle availability (e.g., the household structure of a couple can occur only for two-person households) and resulted in suppression of interactions in the ANOVA. The model that uses household structure is the only model in Table 7 for which this happened, and leads to an inflated F-ratio compared with all other models. When F-ratios are calculated on main effects only for the other models (as indicated by a footnote in Table 7), the F-ratios are almost all larger than those for the household-structure model. Thus the addition of household structure to the basic model of number of vehicles available to the household and household size does not improve its performance for any trip-purpose group.

Of the other variables examined as additions to the model, the total number of workers in the household improves the model for home-based work trips. Household income (1980) and the model II household-size variable are both improvements over the household-structure variable. Income is better in explaining home-based work trips and non-home-based trips, and housing type is better in explaining the other trips. Thus, unless a separate model is developed for home-based work trips by using the employment variable, the model of number of vehicles per household, household size, and housing type still remains the best approach. These conclusions support those found with the previous set of purpose groups, with the exception that the model II household size performs better than, and thus replaces, the model I household size.

CONCLUSIONS

In the trip-generation analysis of the case study data, the household-structure variable did not per-

Table 6. MCA results of set I models used in analyzing SEMTA data.

Model	Statistic	Purpose				
		HBWORK	HBSHOP	HBSOC	HBOTHR	NHB
NUMCAR, HHSIZ I, HOUSTYP	F	29.5	5.9	6.0	35.1	11.4
	df					
	Between group	29				
	Within group	2,292				
	SIG	0.000	0.000	0.000	0.000	0.000
	R^2	0.261	0.062	0.060	0.295	0.113
NUMVEH, HHSIZ I, HOUSTYP	F	29.1	5.6	5.0	35.5	11.5
	df					
	Between group	29				
	Within group	2,244				
	SIG	0.000	0.000	0.000	0.000	0.000
	R^2	0.261	0.060	0.053	0.298	0.116
NUMCAR, LIFE II, HOUSTYP	F	28.3	5.2	5.1	26.4	9.5
	df					
	Between group	29				
	Within group	2,259				
	SIG	0.000	0.000	0.000	0.000	0.000
	R^2	0.254	0.056	0.054	0.238	0.096

Note: SIG = significance, HBSHOP = home-based shopping, HBSOC = home-based social-recreation, and the rest are defined in Table 4.

Table 7. MCA results of set II models used in analyzing SEMTA data.

Model	Statistic	Purpose			
		HBWORK	HBSHOP	HBOTHR	NHB
NUMVEH, HHSIZ II	F	74.1	14.0	15.9	29.1
	df				
	Between group	11			
	Within group	2,434			
	SIG	0.000	0.000	0.000	0.000
	R^2	0.246	0.057	0.060	0.109
NUMVEH[a], HHSIZ II, LIFE II	F	94.1 94.1[b]	16.5 16.5[b]	21.0 21.0[b]	34.0 34.0[b]
	df				
	Between group	9			
	Within group	2,402			
	SIG	0.000	0.000	0.000	0.000
	R^2	0.261	0.058	0.073	0.113
NUMVEH, HHSIZ II, HOUSTYP	F	34.8 127.2[b]	7.0 24.9[b]	7.3 24.2[b]	13.9 47.3[b]
	df				
	Between group	23			
	Within group	2,299			
	SIG	0.000	0.000	0.000	0.000
	R^2	0.246	0.061	0.059	0.108
NUMVEH, HHSIZ II, TOTEMP	F	38.7 176.2[b]	5.0 19.2[b]	5.5 14.2[b]	9.7 38.6
	df				
	Between group	33			
	Within group	2,268			
	SIG	0.000	0.000	0.000	0.000
	R^2	0.348	0.057	0.055	0.105
NUMVEH, HHSIZ II, INC80	F	32.4 148.1[b]	5.2 21.1[b]	5.6 22.3[b]	10.4 44.3[b]
	df				
	Between group	33			
	Within group	2,412			
	SIG	0.000	0.000	0.000	0.000
	R^2	0.298	0.057	0.060	0.112

Note: Statistics and purposes defined in Tables 4 and 6.

[a]Interactions suppressed. [b]F-ratios calculated on main effects only.

form as well as was expected from the CRA analysis of Baltimore data. This may, however, be a result of the different methodologies that were used in the two analyses. The analysis reported in this paper applied traditional cross-classification models that used MCA to predict cell-by-cell trip rates. The final model consisted of number of vehicles, household size, and housing type. However, subsequent analysis not discussed in this paper has revealed that the use of an area-type variable instead of housing type may improve the models even further.

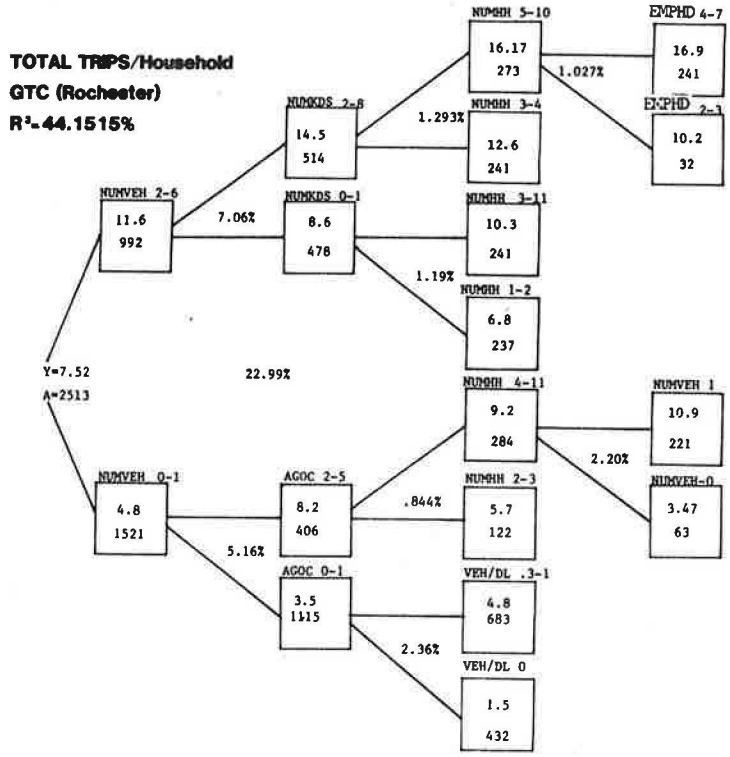
Figures 3 and 4 show the results of the automatic interaction detection (AID) analysis performed on 1973 Niagara Frontier Transportation Committee (Buffalo) and a 1974 Genesee transportation travel survey (Rochester) data for all trips and for home-based nonwork trips (4). The number of vehicles represents the first cluster. This supports both the conclusions drawn by CRA and by the authors. This is followed by number of children (usually a function of household size) and age of the oldest child. The final clusters are based on household size, vehicles per licensed driver (a function of both vehicles per household and household size), household employment status, and number of vehicles available to the household. Although the various age classifications may be a function of household structure, they may also be a function of other variables (for example, household size).

It is also pertinent to note that even had the household-structure variable performed satisfactorily in this trip-generation analysis, there would be problems implementing it in trip-generation models. When presented with a possible trip-generation design that used the household-structure variable, a metropolitan planning organization (MPO) was reluctant to implement it. Although CRA stated that the household-structure variable could be easily obtained from census data, the MPO expressed doubts that it could be. Forecasting at a zonal level, particularly to obtain distribution of households by household-structure category, appears fraught with problems. Possibly, forecasts could be made at the regional level of the constituent elements of household structure, but current analysis-zone forecasts in most metropolitan areas do not include these components and would possibly be difficult to add to current forecasts. In addition, household structure cannot be used as a policy variable, whereas other variables, particularly housing type, could be used. This also helped in the decision to exclude the household-structure variable from the SEMTA trip-generation models.

REFERENCES

1. P.M. Allaman, T.J. Tardiff, and F.C. Dunbar. New Approaches to Understanding Travel Behavior. NCHRP, Rept. 250, Sept. 1982, 147 pp.
2. R. Parvataneni, P. Stopher, and C. Brown. Origin-Destination Travel Survey for Southeast

Figure 3. AID analysis of Rochester survey data.



WHERE
NUMVEH = NUMBER OF VEHICLES AVAILABLE TO THE HOUSEHOLD
NUMKDS = NUMBER OF CHILDRED PER HOUSEHOLD
NUMHH = HOUSEHOLD SIZE
AGOC = AGE OF OLDEST CHILD
VEH/DL = VEHICLES PER LICENSED DRIVER
OCCUP = OCCUPATION
EMPHD = HOUSEHOLD EMPLOYMENT STATUS
LOC = LOCATION

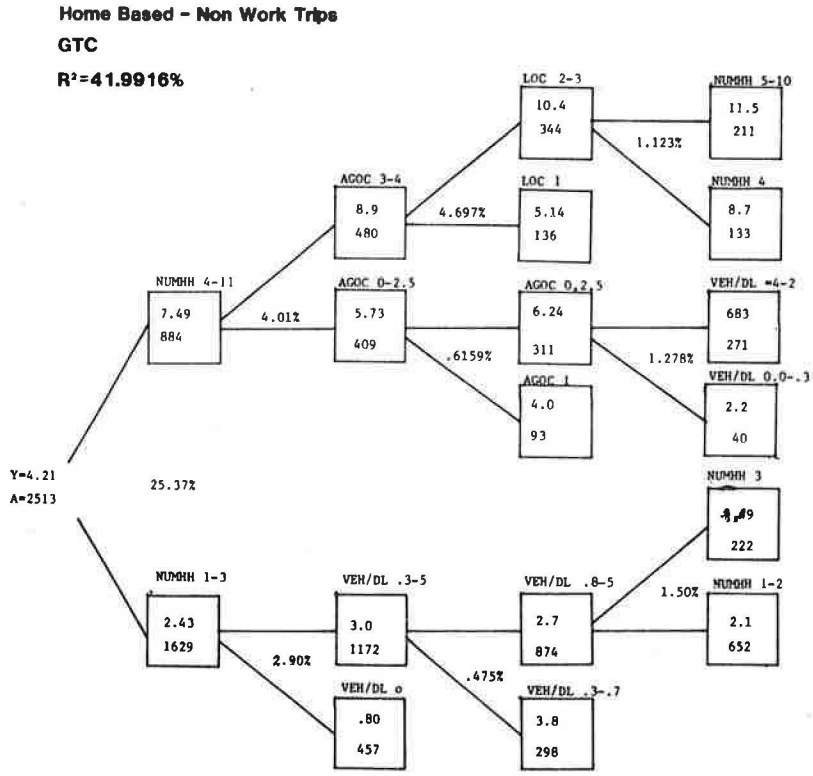
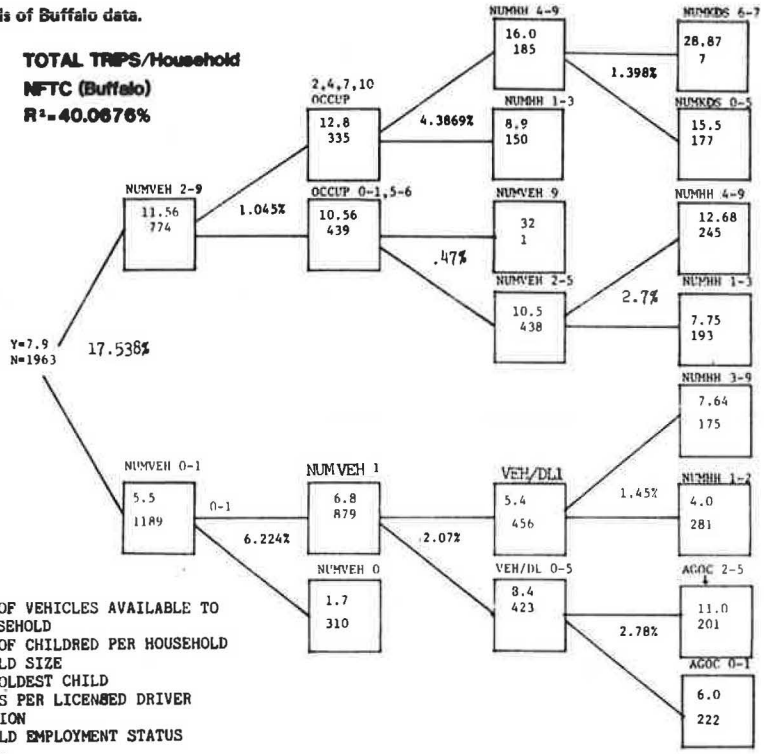
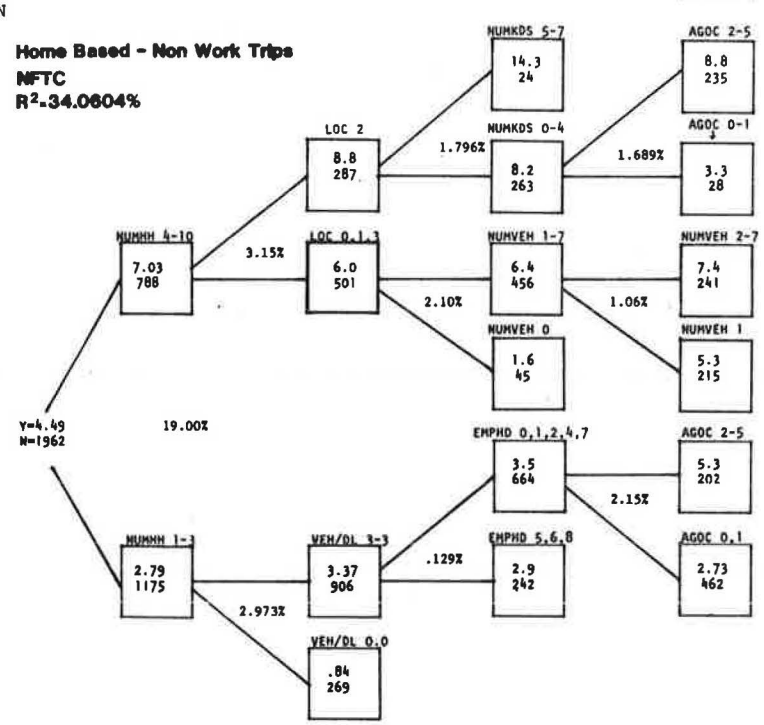


Figure 4. AID analysis of Buffalo data.



WHERE
NUMVEH = NUMBER OF VEHICLES AVAILABLE TO THE HOUSEHOLD
NUMKDS = NUMBER OF CHILDRED PER HOUSEHOLD
NUMHH = HOUSEHOLD SIZE
AGOC = AGE OF OLDEST CHILD
VEH/DL = VEHICLES PER LICENSED DRIVER
OCCUP = OCCUPATION
EMPHD = HOUSEHOLD EMPLOYMENT STATUS
LOC = LOCATION



Michigan. TRB, Transportation Research Record 886, 1982, pp. 1-8.

3. N.H. Nie, C.H. Hull, J.G. Jenkins, K. Steinbrenner, and D.H. Bent. Statistical Package for the Social Sciences, 2nd ed. McGraw-Hill, New York, 1975.
4. J. Chicoine. The Life Cycle Concept: A Practical Application to Transportation Planning. New York State Department of Transportation, Albany, Draft Paper, Aug. 1982.

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