derived in dollars. But we might ascertain how many citizens attended each of the concerts and what percent this was of the total in the area. Other meaningful relationships could be developed which would certainly be helpful in evaluating the benefits of the concert series. The same thing could be done with sociological and economic data.

In conclusion, several other works on highway sociology should be mentioned, including one by Black and Black (4) and another by Thiel (5). Highway location studies in several states have also explored economics and sociology to a considerable extent. These include the Inner Belt studies in Boston (6), the Westside Freeway studies in California (7), and freeway studies in Tallahassee, Fla. (8).

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Who Makes the Trips? Notes on an Exploratory Investigation
Of One-Worker Households in Chattanooga

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●THE ANALYSIS of urban travel has usually centered on the residential unit and the amount of travel its members can be expected to generate on an average weekday. Households may be stratified according to number of members, income classification, the number of cars owned or regularly used by members, residential densities, and various other criteria. Trip generation models are often designed to relate to trip modes and purposes.

The trip generation models are used to prepare estimates of future travel demands, based on projected numbers of persons and households, cars owned, jobs available, etc. Much significance attaches to the travel generated for work purposes because weekday peak-hour travel contains a higher proportion of these movements. One of the imponderables of traffic forecasting is the significance that should attach to changing work habits. There is much speculation heard these days about shorter working days

and/or shorter working weeks. How would such changes be likely to show up in future urban travel demands?

It was this question that led to the brief study reported here. The home-interview surveys record travel by working populations, as well as all others who make trips. With a little manipulation, the approximate length of each individual's working day can be computed from his trip reports. Does a short working day result in more or less travel by the worker? If a regularly employed person does not report to work on the day of interview, does this fact relate to his travel behavior on that day?

Data for Chattanooga, Tenn., were conveniently at hand. Travel reported in direct interviews in more than 7,000 households was tabulated according to length of working day, number of household members, number of cars owned, income class (five) and number of residents with steady employment. Travel performed by working members of the households was tabulated separately from trips by non-workers.

Households were classed according to number of working members into three groups: (a) households with no working member (approximately 630); (b) households with one working member (approximately 3,370); and (c) households with two or more working members (approximately 3,080). Thus, nearly half of all households in the survey were found to contain one employed person, whereas fewer than 10 percent had no working member. Two or more of the residents in each of the remaining households were employed, many of them in part-time occupations.

The sample of one-worker households has been examined in considerable detail. Although nearly as many households are represented by two or more workers, the study of them is complicated by the need to stratify households into classes or combinations of full-time and part-time workers. This reduces the number of samples in each population, thereby limiting the number of variables that can be examined simultaneously to produce meaningful results. But the study of multi-worker households should be quite illuminating, and the results may be much different from the behavior patterns found for one-worker households.

Trip generation in the one-worker households is clearly illustrated in Table 1 and Figure 1. Households without cars generate very few trips, with total trip production closely related to the size of household. One-car households account for nearly twice as many trips as no-car families of each size, and two-car families make still more trips.

The most interesting aspect of Figure 1, however, is the share of travel accounted for by the worker himself. In households without cars, the worker's travel changes very little with family size. This is not the case in car-owning households, where the worker himself makes an increasing number of trips as the members of his household increase in number. In fact, when households of two persons or more possess two cars, the worker makes more trips, at every family size, than does the worker in the one-car family. In the largest families (five persons or more), which generate the largest volumes of travel per household, the one working member of the household accounts for more than three-fifths of the total.

Speculation on the reasons for this pattern relate to the likelihood that the working member of a one-worker household uses his car to go to and from his place of employment (a 1959 study of St. Louis showed that about 75 percent of all cars owned by area residents were driven to and from work). In a one-car family, the worker and his car are called on to perform most of the errands associated with maintenance of the household. This does not explain the greater demand on the worker in two-car households, although it may be safe to assume that the worker now regards one of the cars as solely his responsibility, rather than a joint concern of all family members, and may choose to use the new freedom implied in making a variety of purely personal trips that he would not otherwise make. (Trip purposes have not been examined in this study— analysis along this line might help answer this question.) Psychological evaluation of the attitudes engendered among household members when a second (and third) car are made available for use might prove very interesting.

Another question that is particularly important in any attempt to forecast future travel in urban areas has to do with the social environment that might induce other household members to travel as much as the worker (or that might induce the worker

TABLE 1
ONE-WORKER HOUSEHOLDS

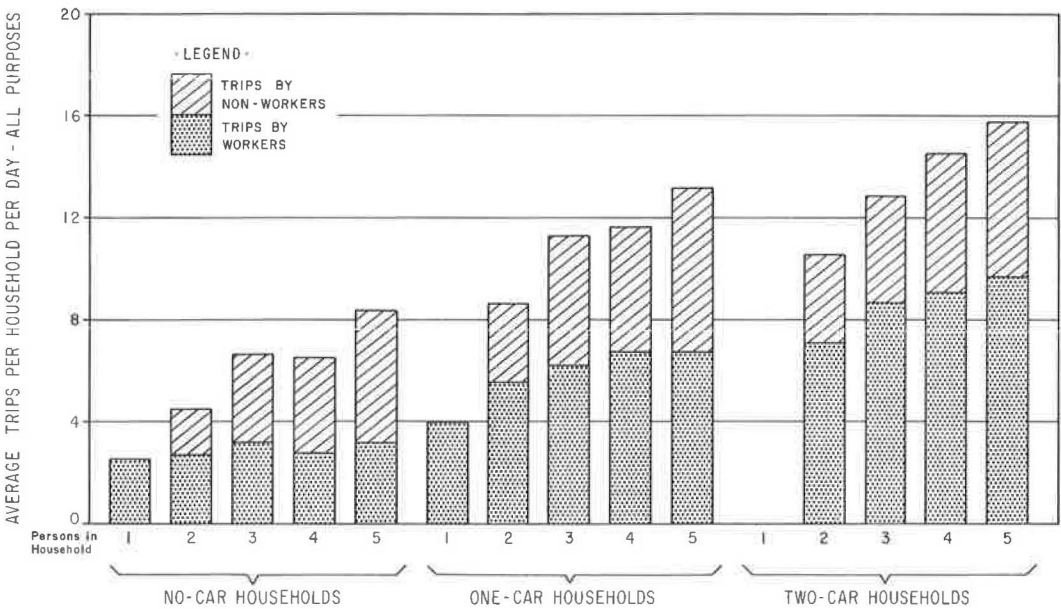| No. in Household	No. Cars Owned	Daily Trips Generated in Household by			
		Workers	Nonworkers	Total	% by Worker
1	0	2.54	—	2.54	100.0
	1	3.95	—	3.95	100.0
	2	—	—	—	—
2	0	2.69	1.77	4.46	60.3
	1	5.55	3.04	8.59	64.7
	2	7.15	3.40	10.55	67.7
3	0	3.07	3.55	6.62	46.4
	1	6.15	5.11	11.26	54.7
	2	8.62	4.18	12.80	67.3
4	0	2.75	3.67	6.42	42.9
	1	6.70	4.87	11.57	57.9
	2	9.05	5.47	14.52	62.3
5	0	3.07	5.27	8.32	36.9
	1	6.70	6.40	13.10	51.2
	2	9.65	6.11	15.76	61.2

Figure 1. Worker and non-worker trips, all members of one-worker household by all modes.

to travel less). Perhaps in-depth analysis of data already available can be used to indicate the answers to this question. It is an important query, whether or not additional travel is regarded as a "good thing" for the individual. If all, or a portion, of the household members who perform little travel today were to develop radically new travel habits over the next decade or two and produced trips in substantially the same proportions as the workers, estimates of future travel demand would be far different from those developed using the conventional generation models, based largely on analogy with today's generalized trip characteristics. What might trigger such a change? Would a cheap, automatically controlled vehicle encourage more travel by more household members? Will eventual automation of more household chores leave the housewife free to make more trips, and will she use the time to travel or for other activities?

In Table 2 and Figure 2, the amount of time that the worker spends in travel each day is related to number of persons in his household and the number of cars at the family's disposal. Trip-time has been compiled from the times of departure and arrival reported for each trip in the home interviews and represents "portal-to-portal" time. Because Chattanooga is a quite compact city, very few reported trips exceeded 30 minutes. Median trip-time was about 8 minutes for all reported auto driver trips. Mean trip length was a little less than 4 miles.

Figure 1 shows that the worker performs more trips when he has a car than when he does not. Figure 2 shows that he also spends more time in travel when the household has a car, and still more when it has two. Time spent in travel seems to relate directly to car ownership and is indifferent to increase in family size. The worker in a two-member household spends but slightly less time in travel each day than the worker in a five-member household; although workers in two-car households spend more time in travel than those in one-car families, the difference between two-member and five-member families is, again, relatively small. In both situations, the number of trips shows proportionately greater increase than the time spent in travel. This inconsistency is not explained in the data at hand but may relate to the purposes of travel, the geographic distribution of households (large, car-owning households may be more highly concentrated in suburban areas, resulting in longer work trips), or other characteristics which further study could identify. It is conceivable that the worker, generally, recognizes a "travel-time budget" and his trip frequency is high or low, depending on the average amount of time required for his trips. But this relationship, if true, would appear to be modified by social or psychological factors associated with the number of cars available to the household.

In Table 3 and Figure 3, the travel mode by the worker has been examined in relation to the length of working day. Workers have been separated into three groups: (a) persons who worked less than 8 hours, (b) persons who worked more than 8 hours, and (c) employed persons who did not work on day of interview. Data for each group of

TABLE 2

TIME SPENT IN TRAVEL EACH DAY BY WORKING MEMBER OF HOUSEHOLD[a]

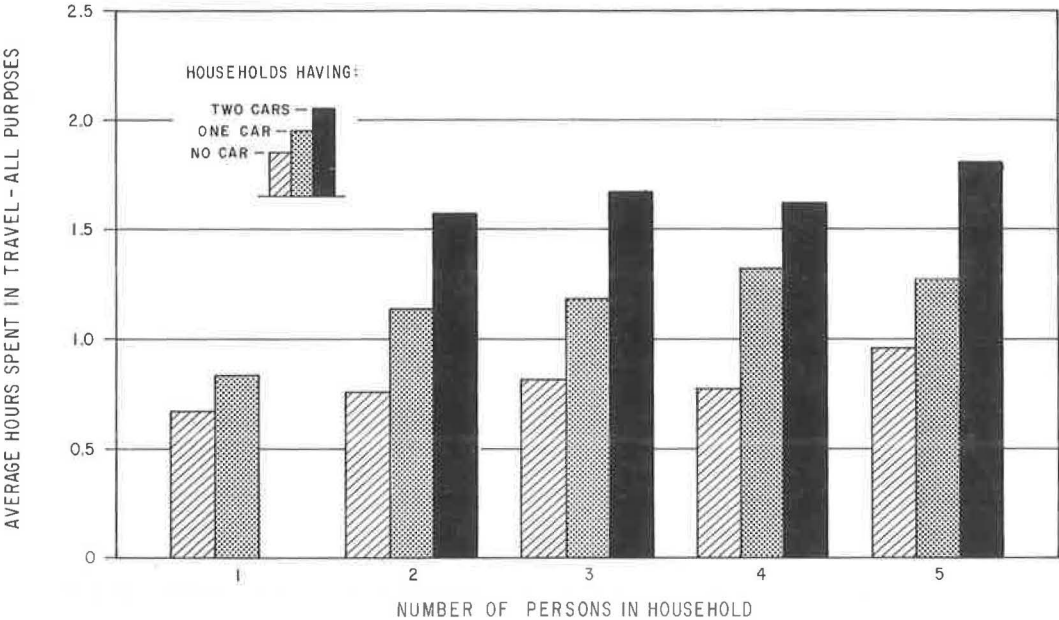| No. in Household	No Car		One Car		Two Cars	
	Household (no.)	Avg Hr (no.)	Household (no.)	Avg Hr (no.)	Household (no.)	Avg Hr (no.)
1	134	0.67	141	0.83	-	-
2	156	0.76	546	1.14	135	1.57
3	78	0.82	501	1.18	162	1.66
4	55	0.77	485	1.32	201	1.62
5	116	0.95	491	1.27	169	1.80
Total	539	-	2,164	-	667	-

[a]One-worker households.

Figure 2. One-worker households: time spent in travel each day by working member of household.

TABLE 3

ONE-WORKER HOUSEHOLDS: TRIPS BY WORKERS

| No. in House-hold	Hr Worked	No Car		One Car		Two Cars	
		House-hold (no.)	Avg Trips (no.)	House-hold (no.)	Avg Trips (no.)	House-hold (no.)	Avg Trips (no.)
1	<8	28	2.53	32	4.00	—	—
	>8	59	2.54	74	4.00	—	—
	0	47	2.55	36	3.80	—	—
2	<8	21	2.90	108	6.44	28	9.40
	>8	78	2.55	322	5.48	72	7.26
	0	57	2.54	115	4.82	35	5.43
3	<8	10	3.90	66	9.00	31	9.78
	>8	45	2.91	320	5.87	99	8.72
	0	23	3.00	115	5.27	32	7.16
4	<8	8	2.75	77	8.65	32	12.70
	>8	30	3.10	278	6.40	131	9.00
	0	17	2.11	130	6.15	38	6.05
5	<8	15	2.87	91	8.33	35	11.25
	>8	56	3.30	280	6.55	101	10.15
	0	45	2.84	120	5.73	33	6.27
Total		539	—	2,164	—	667	—
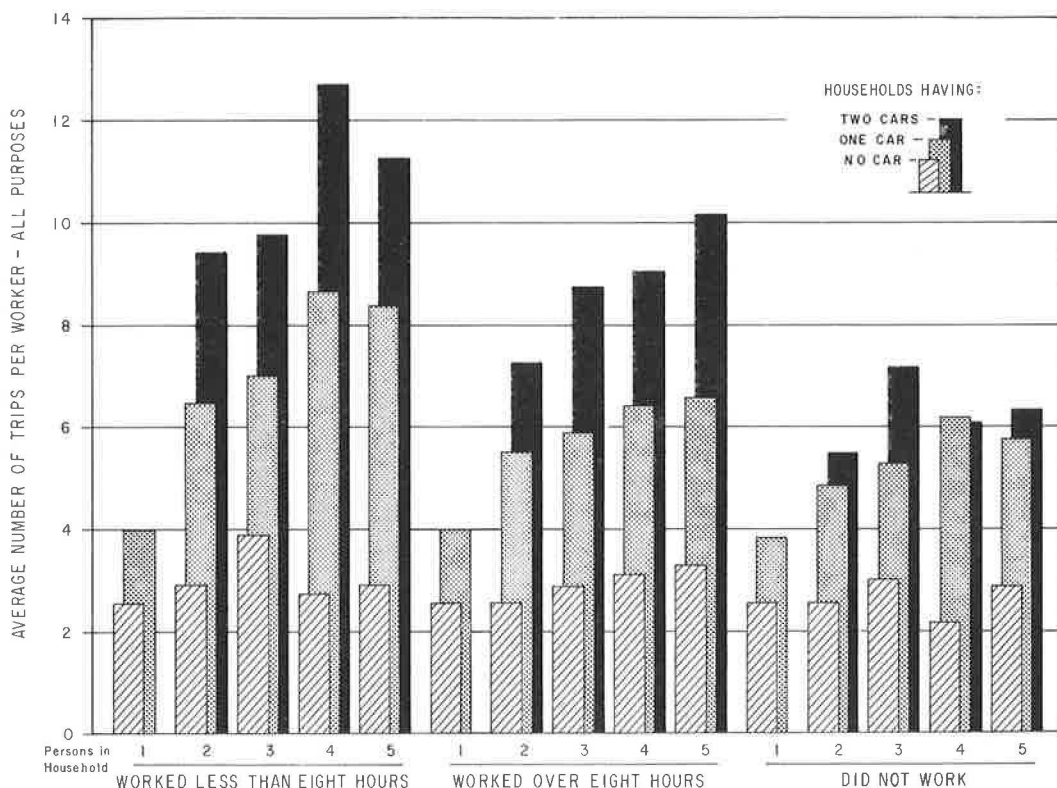
Figure 3. Daily trips by working member of one-worker households.

workers have been related to car ownership and number of persons in the household. In each workday class, the relationships shown in Figure 1 are apparent in Figure 3. Worker trips increase dramatically with the introduction of a car into a household, under each condition of working hours, and increase still more when the second car appears. A relationship also appears between trip production and length of working day. For each family size, the number of trips generated is less for workdays in excess of 8 hours than for those less than 8 hours. Tentative studies (not shown) that break workdays under 8 hours into periods of less than 4 hours and over 4 hours appear to show that the shorter the workday, the more trips a worker can be expected to make.

Travel by workers who did not go to work seems contrary to this indication, unless one considers that employed people who did not go to work include some who are ill or otherwise incapacitated. In general, persons who did not work performed less travel than those who did, although the difference is not great, with family size and car owner-ship reflected in similar patterns of behavior.

Considering only those who worked, persons who work a short day very often take time off from scheduled work periods to perform special errands of a personal nature. To some extent, then, the increases in travel on short days do not necessarily reflect the travel patterns that would result if the conventional 8-hour workday were shortened. However, fewer hours at work mean more hours during the day for other (non-work) activities. Inevitably, additional activities imply some increase in travel. In future interview surveys, the significance of shorter working days might be better defined if information were obtained on the normal length of working day in each case. Behavior of those who took time off for special purposes could thus be isolated and the implica-tions of reduced working hours more clearly defined.

In Table 4 and Figure 4, the significance of family income levels has been explored, again related to car ownership and length of working day. The pattern of trip generation

TABLE 4

ONE-WORKER HOUSEHOLDS: TRIPS BY WORKER

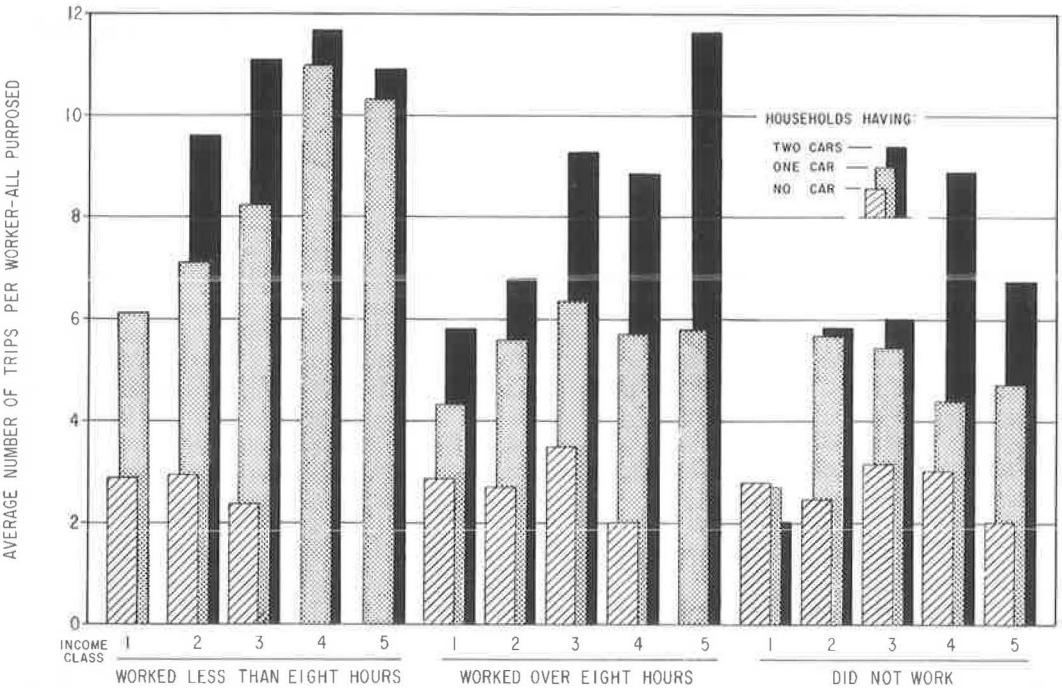| Hr Worked	No. Cars	Income 1		Income 2		Income 3		Income 4		Income 5	
		House-holds (no.)	Avg Trips (no.)	House-holds (no.)	Avg Trips (no.)	House-holds (no.)	Avg Trips (no.)	House-holds (no.)	Avg Trips (no.)	House-holds (no.)	Avg Trips (no.)
<8	0	20	2.90	53	2.94	8	2.38	-	-	-	-
>8	0	58	2.86	162	2.69	46	3.47	2	2.0	-	-
0	0	52	2.79	98	2.46	33	3.18	1	3.0	5	2.0
<8	1	18	6.11	140	7.14	193	8.25	7	11.0	6	10.33
>8	1	68	4.33	485	5.60	687	6.35	35	5.69	9	5.78
0	1	25	2.72	213	5.66	256	5.42	15	4.40	7	4.71
<8	2	-	-	20	9.60	84	11.05	12	11.66	10	10.90
>8	2	5	5.80	68	6.78	262	9.27	42	8.84	26	11.65
0	2	2	2.00	31	5.84	87	5.97	11	8.90	8	6.75
Total	-	248	-	1,270	-	1,656	-	125	-	71	-

Figure 4. Trips by worker in one-worker households.

shown in Figure 4 is much like that in Figure 3, although income level has been substituted for family size. Trip rates increase with increased levels of income, decrease as working hours become longer, and are lowest at each level of income on days when the worker did not report to his job. Again, the second car increases the worker's travel at every level of income and is clearly not the province of the upper-income group alone.

In Tables 2, 3 and 4, the number of households are given from which the averages have been computed. Statistical stability is reasonably good for the data plotted from Tables 2 and 3 but is less reliable for certain class intervals in Table 4. (Data for Table 1, containing only 14 classes, are all regarded as statistically stable.) The value of the picture shown in Figure 4 is enhanced, however, by the consistency of patterns plotted from very small amounts of information, indicating the basic regularity of the relationships shown. Interpretation of some of the more extreme variations in Figure 4 should take sample size into account, however.

CONCLUSIONS

As noted in the introductory statement, the brief study reported here is based on a very tentative analysis of trip data from a single, medium-sized city and may be regarded as "fallout" from the conventional analyses and transportation plans that the original study was designed to produce. The review of these data has revealed some interesting relationships and has suggested areas that might fruitfully bear further investigation.

Among the facts that emerge from the study are these:

1. Travel by the employed member of a household containing one working member increases, on the average, as the number of household members increase.

2. The worker's trips increase substantially when the household acquires one car, and increases again, by an almost equal amount, when the household acquires a second car.

3. The worker in one-worker households accounts for one-half to two-thirds of all trips generated in car and transit by all members of the household. In Chattanooga this was found to be true even in the largest category of two-car households.

4. The worker makes more trips on short working days (under 8 hours) than on longer working days. He makes the fewest trips on days when he does not report to work.

5. The size of his family is not as important as the fact of car ownership in determining the daily amount of time that the worker spends in travel for all purposes. In households of two or more persons, the amount of time spent in travel increases sharply with increases in car ownership. However, at each ownership level, time spent in travel is relatively constant for households of every size.

Several questions arise from the study which can only be answered in a satisfactory way by further investigation, using larger samples of data from a number of sources:

1. Why does the frequency of worker trips increase as households become larger? Why does travel time show less variation than number of trips?

2. Is trip-making by non-workers increasing? If so, is the increase more or less rapid than travel by workers? What would cause non-workers to spend as much time in travel as the workers?

3. Do shorter working hours result in more travel, or is the increase indicated here merely a reflection of special activities that inspired the worker to take time off for the purpose of travel? Would a shorter standard workday lead to more travel? For what purposes?

4. What are the social-psychological considerations responsible for the added travel by workers in households that add a second car? How can these be identified and measured?