

Urban Activities, Travel, and Time: Relationships from National Time-Use Survey

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Results are presented on how people allocate time for their out-of-home activities, including related travel. The information is derived from analyses of the daily activity patterns of urban residents recorded in a 1975 national time-use survey. The analyses indicate a variety of relationships between out-of-home activity time, travel time, and household variables for weekdays and weekends. They also suggest broad out-of-home time budgets and travel-time budgets for households and persons. The detailed activity descriptions in the data base required considerable aggregation, the best results for which came from functional activity groupings rather than traditional land-use-based trip-purpose groupings. These functions were related to scheduling and planning characteristics of the activities as well as their potential for substitution of individual participants. The analyses do not substantiate the fixed daily work schedule assumed by some activity analyses. Rather, daily work time is quite variable, and this variability is a primary independent variable explaining allocation of time to other activities. The relationships between these activities and work time were strengthened by the inclusion of in-home work time, confirming that some in-home household activities will affect out-of-home behavior.

Some results on how people allocate time for their out-of-home activities, including related travel, are presented here. This information was obtained from analyses of the daily activity patterns of urban residents recorded in a 1975 national time-use survey. The analyses indicate a variety of relationships between out-of-home activities, their duration, and their associated travel times for some common household groupings. The analyses also provide information on personal and household travel-time budgets, out-of-home activity time budgets, and activity participation rates for both weekends and weekdays.

Previous studies of human activities and time allocation can be grouped broadly into two categories: (a) activity and time-space studies and (b) activity and time-budget studies. Many conceptual and empirical relationships dealing with human activities and time allocation have been developed in recent years, but only a limited number of these has focused primarily on understanding travel behavior.

Chapin (1) refers to human activity patterns as "the ways aggregates of residents in the metropolitan community go about their daily affairs; that is, how archetypical persons (statistical means) from key socioeconomic segments of this small society pursue their rounds of daily activity." He sees role and personal characteristics (preconditioning factors) and motivations and attitudes (predisposing factors) to explain variations in activity patterns among segments of society.

In sharp contrast to this work is that of Hägerstrand (2), with his space-time model of human activity. Hägerstrand's "prism" is in the feasible region of activities fixed in time and space. He identifies three types of constraint, namely, capability constraints due to biological factors and the capacity of physical tools, coupling constraints due to the need for persons to come together at certain locations for given periods of time, and authority constraints due to the limits and control of access to activity and travel facilities.

Time and its allocation have been studied by many, including the time-budget study by Szalai (3) for several

countries and by Robinson (4) for the United States. Descriptive empirical analyses representing time spent in various activities have been presented in these works.

Studies on travel time by Zahavi (5) indicate that the mean daily door-to-door travel time per traveler, including access time, tends to be stable both cross sectionally and over time, even when speeds increase significantly. A recent study by Hummon, Baker, and Zmotel (6) using the same data base that we used here provides extensive activity and travel information, particularly for trip chains or excursions.

While people's interest in activities and travel is growing, it is not yet understood how they allocate time for activities and travel. We therefore tried to determine from the time-use survey any empirical relationships that might exist between out-of-home activity time, travel time, and socioeconomic and household characteristics.

DATA BASE

The data used for this study were the first interviews from a national time-use survey (7) that reported on a sample of American adults 18 years of age or older, who were first interviewed in October-November 1975. The 1519 respondents and 887 spouses reported the details of a full day's activities by type, time of occurrence, and duration. The interviews obtained both daily time-use diaries and information on employment, income, personal and other resources, stock of technology available to the household, and mass-media coverage. Travel was specified by time of occurrence and duration but not by mode and was related to activity. In general, for multiple-activity trip chains, each individual trip was related to the next primary activity, whereas the final trip segment was related to the last activity.

SCOPE OF ANALYSES

The data base just described provides much detailed information, and the analyses were therefore constrained to make them manageable while allowing the necessary insights into time budgets and their interrelationships. Thus, the investigations attempted to make maximum use of the unique characteristics of the data and to provide reasonable comparisons with other more conventional travel-data sources.

With the latter objective in mind, the study was restricted to urban residents, and the household and person classes chosen for analysis were those that provided substantive contrasts and also allowed a sample size sufficient for meaningful results. Results were developed both for weekdays and for weekends.

The person classes used for the analyses included married working males; married females, working and nonworking; and single working persons. For the weekend, the samples were divided according to whether the person who normally worked during the week did or did not work that day. Data for single males and females

were sometimes combined to allow a sample of sufficient size.

The household classes used included married couples with both spouses working, married couples with only the male working, and single working persons. Samples did not correspond exactly to the person-class samples described above, since the household analyses included only those households where records for both spouses were available. In many instances, the household samples for weekends were too small to permit much analysis.

Although the data base included 87 activity classifications, travel information was available only for the following 9 aggregate activity groupings: work and income production, household, child care, goods and services, personal needs and care, education and professional training, organizational, entertainment and social, and sports and leisure. For these activity groups, the time spent on the activity and the time spent in related travel were analyzed and, although some reasonable correlations did exist, particularly between activity duration and its associated travel time, the extreme variability of the data required aggregation of the activity groups.

The activity groups were analyzed in two ways. One is the simple and traditional division into (a) work and (b) nonwork activities and travel. The other, which was more thoroughly analyzed, is a grouping of the above activities functionally into the following three groups of activities:

1. Work and organizational
 - a. Work,
 - b. Education and professional training, and
 - c. Organizational activities;
2. Personal and household maintenance
 - a. Household,
 - b. Child care,
 - c. Goods and services, and
 - d. Personal needs and care; and
3. Leisure
 - a. Entertainment and social and
 - b. Sports and leisure.

Group 1 represents those activities that are probably always scheduled in advance and that, in the short run at least, occur on a regular basis. These activities are usually particular to the individual, and other persons cannot substitute.

Group 2 represents the immediate needs of the household and the persons in it. While the activities are required on a regular basis, rigorous planning and scheduling are not always needed. For many of these activities, substitution of individuals is possible.

The final set of activities, in group 3, represents discretionary time, which will be some measure of the quality of life of the individual and household. These activities allow for little substitution of individuals.

Our study is concerned with out-of-home activity and related travel. In the analysis of work, however, several relationships were strengthened by including work in the home. Although the correlations between work activity and work travel were weakened slightly, nonworking female spouses were an exception to this effect, since most of their work is in the nature of looking for work and it appears that in-home work of this type leads to subsequent travel. Most other relationships remained stable or were strengthened by the inclusion of in-home work, indicating that, for a full understanding of out-of-home activities and time budgets, a purely out-of-home activity and travel survey may have some deficiencies.

DAILY TIME BUDGETS

The daily time budgets for the activity groups 1-3 for persons and households are presented in Tables 1-4. For the weekday shown in Table 1, only those workers who actually worked that day are included. The married male worker with a nonworking spouse (B) spends about 11.5 h out of the home, with 1.5 h of this devoted to travel. The married female worker with a working spouse (C) spends just over 9 h out of the home and about 1.2 h in travel. The lower travel time for females can be seen readily in Table 1, but the activity breakdown shows that this is primarily for work travel, which could be associated with the lower average work duration for working women.

There was an indication of a similar difference in average travel time for single men and women (E) but, overall, single working persons spend about the same amount of time out of the home as do married working males. This suggests perhaps an out-of-home time threshold that applies regardless of household responsibilities.

As expected, nonworking wives (D) have a higher participation rate for household support activities than do working spouses of either sex. The total time budgets for household support and its associated travel are similar for households whether the wife is working or not, as indicated by Table 2. The detailed breakdown in Table 1 shows that for the household with only the male working (D), the wife provides the majority of the household support, whereas for the two-worker household (A), the husband does more of this activity. Household support activity for a single person (E) has a relatively high participation rate, but the duration is at a lower level than that of a husband with nonworking wife (B) or a working wife (A).

Leisure activity shows a remarkably constant travel time for all person classes, although the nonworking wife (D) and single persons (E) show greater participation rates and greater activity durations.

Weekend time budgets for persons who did and persons who did not work that day are shown in Table 3. For those persons who work, the weekend time budget is very similar to the weekday time budget. Activity time tends to be somewhat lower, but travel time remains constant. Among the activity groups, work duration is less and leisure time is greater.

The weekend time budgets for persons who did not work that day show that the total out-of-home time for workers drops from around 11 h for a working weekday to about 6 h for the nonworking weekend. Average travel time, however, remains at its previous levels, supporting the concept of a travel-time budget. For weekend travel, there is no apparent difference between married males and married females when both spouses are working. The time allocated to household support activities generally increases, as does time for leisure activities. For both activity groups, however, there is no marked change in the participation rates.

In summary, the daily out-of-home time budgets appear to indicate that there are consistencies in mean travel-time budgets and in mean out-of-home time budgets. They also give some preliminary insights into the trade-offs of activity allocations between persons within households. Although the previously reported travel-time differences between men and women are confirmed, these differences are not consistent, indicating that these may be activity based rather than travel based.

Table 1. Weekday daily time budgets per person class by activity group.

Person Class	Activity Group									Total		
	Group 1			Group 2			Group 3			Activity and Travel		
	Duration (min)	Travel (min)	Participation Rate (%)	Duration (min)	Travel (min)	Participation Rate (%)	Duration (min)	Travel (min)	Participation Rate (%)	Time (min)	Travel (min)	Participation Rate (%)
A	510	53	93.2	106	51	57.6	83	23	32.1	689	94	93.2
B	529	59	92.2	73	41	51.5	88	26	28.1	675	90	92.2
C	424	39	73.9	64	37	44.3	76	23	25.2	558	71	73.9
D	166	26	24.6	101	58	75.0	102	26	40.0	240	67	86.7
E	496	51	87.7	68	28	67.7	118	29	40.0	676	81	87.7

Note: A = married working male with working spouse; B = married working male with nonworking spouse; C = married working female with working spouse; D = married nonworking female with working spouse; E = single working person.

Table 2. Weekday daily time budgets per household class by activity group.

Household Class	Activity Group									Total		
	Group 1			Group 2			Group 3			Activity and Travel		
	Duration (min)	Travel (min)	Participation Rate (%)	Duration (min)	Travel (min)	Participation Rate (%)	Duration (min)	Travel (min)	Participation Rate (%)	Time (min)	Travel (min)	Participation Rate (%)
A	902	90	71.5	138	74	56.7	106	45	37.1	1206	173	71.5
B	577	64	88.9	141	79	78.6	120	28	51.3	906	149	88.9

Note: A = household with working male and working female; B = household with working male and nonworking female.

Table 3. Weekend daily time budgets per person class by activity group for those who worked that day and for those who did not work that day.

Person Class	Activity Group									Total		
	Group 1			Group 2			Group 3			Activity and Travel		
	Duration (min)	Travel (min)	Participation Rate (%)	Duration (min)	Travel (min)	Participation Rate (%)	Duration (min)	Travel (min)	Participation Rate (%)	Time (min)	Travel (min)	Participation Rate (%)
Persons Who Worked That Day												
A	431	36	26.7	133	43	24.5	120	30	8.8	660	79	26.7
B	332	40	38.3	97	43	23.9	173	54	16.7	525	87	38.3
C	343	32	25.6	73	44	20.9	114	20	13.9	477	77	25.6
D	-	-	0	-	-	0	-	-	0	-	-	-
E	378	39	22.6	69	53	19.3	95	24	12.9	545	93	22.6
Persons Who Did Not Work That Day												
A	190	108	13.3	101	50	53.3	270	67	42.2	376	98	68.9
B	169	25	20.8	187	32	37.5	257	62	27.0	388	67	54.1
C	179	75	16.2	139	59	58.1	194	65	37.2	362	100	69.7
D	112	17	38.7	130	40	53.0	198	48	42.8	318	58	75.5
E	76	26	19.3	177	58	67.7	211	81	61.3	489	122	70.9

Note: Person classes A-E are identified in Table 1.

TRAVEL TIME AND ACTIVITY DURATION

As is to be expected, for many individual activity classes there is a direct correlation between activity duration and the associated travel time. This is particularly true for activities carried out several times during the day. The correlations between activity duration and travel time for the activity groups discussed in this paper are given in Table 4. Generally, the personal and household maintenance group (group 2) shows the strongest relationships, particularly for married working persons (A-C). This suggests that these persons are more restricted in scheduling these activities. The nonworking wife (D), on the other hand, shows a lower correlation and represents a less-rigorous scheduling requirement.

The work and organizational group (group 1) shows a strong relationship for the nonworking wife, indicating that the duration of such activities is closely related to

the amount of travel time one is prepared to give to it. While the correlations are modest for working persons, the analysis of variance is significant for married persons with both spouses working (A). In these cases, there is a clear nonlinear relationship. As working duration increases, travel time also increases, but a threshold is reached after which travel time decreases, indicating scheduling constraints influenced in part by a total out-of-home time budget.

Although the nonworking wife shows a low correlation for group 2 activities, there is a very strong relationship for group 1 activities. For group 3 activities, married men show a distinct difference from married women, suggesting that perhaps men have a more varied leisure structure from the viewpoint of duration.

Single persons show no significant patterns for travel time and activity duration. In a general sense, it seems that the relative allocations of travel time and out-of-home activity time must be influenced by household con-

Table 4. Correlations between duration of activity and travel time.

Person Class	Activity Group			Out-of-Home Work	Non-work
	1	2	3		
A	0.12 ^a	0.52 ^b	0.11	0.08	0.34 ^b
B	0.11	0.40 ^b	0.17	0.09	0.30 ^a
C	0.16 ^b	0.44 ^b	0.40	0.16 ^a	0.45 ^b
D	0.58 ^b	0.19	0.42	-	0.27 ^b
E	-0.17	0.10	0.02	-0.15	0.20

Note: Person classes A-E are identified in Table 1.

^aAnalysis of variance significant at 10 percent.

^bAnalysis of variance significant at 5 percent.

straints, and these are much more restrictive for married persons.

In the next section, relationships between different activity groups are examined. It is possible that some of the correlations between travel time and activity time just discussed may be the result of mutual relationships with other variables. To verify this possibility, partial correlations were derived with respect to socioeconomic variables (especially automobile ownership) and other activities. These revealed no significant changes in the relationships, although some of the higher correlations were somewhat reduced.

RELATIONSHIPS BETWEEN ACTIVITIES

The identification of relationships between activities should provide further insights into the structure of activity-time budgets and the activity participation process within the household. Successful empirical analyses in this area would be one step toward the establishment of causalities and the development of formal predictive models.

To establish any direct relationships between the main activity groupings, partial correlations were developed between the total out-of-home durations (including travel) for each of the three possible combinations of groups:

Person Class	Groups Correlated		
	1 and 2	2 and 3	1 and 3
A	-0.27	-0.13	-0.01
B	-0.59	-0.18	-0.51
C	-0.31	+0.08	+0.13
D	-0.09	+0.28	-0.25
E	+0.11	+0.61	-0.03

The results show a trade-off between work time and household time for married working persons, again representing the household constraints that affect time allocation. The strongest correlation is for the married male with a nonworking wife (B), and the daily time budget data have already shown that this class of person carries out the minimum household activity. The relationships suggest that they have a highly constrained out-of-home activity structure. Single persons (E) and nonworking wives (D) show little correlation, reflecting activity structures that are less constrained and require fewer trade-offs.

There is little correlation between household support and leisure for working married persons, whereas there is a positive correlation for single persons and nonworking wives. Thus, there is little trade-off or substitution between leisure activity and household activity. The positive correlations, particularly strong for single persons, probably reflect the organization of trips and tours.

The relationships between leisure activity and work

activity are not consistent. Mostly, there is little correlation but for the household of married persons in which only the male works (B), there is a trade-off, particularly for the male. This is another indication that the male in this instance is closely connected to the home, and this connection places added constraints on his out-of-home activity structure.

The results of the analyses of variance for the relationships between activity durations, travel times, and socioeconomic variables are presented in Table 5. Generally, the connection between activity time and its associated travel time, which has already been discussed, is apparent. Other relationships, however, do emerge. The socioeconomic variables used are as follows:

1. Work organizational activity duration,
2. Household support activity duration,
3. Leisure activity duration,
4. Household support travel time,
5. Hours worked per week,
6. Personal income,
7. Household income,
8. Age,
9. Presence of children,
10. Age of the youngest child,
11. Education, and
12. Automobile ownership.

The amount of time allocated to household support activity is clearly related to work duration for married working persons (A-C), confirming the trade-offs suggested by the partial correlations. Otherwise, however, the relationships are scattered. Automobile ownership (12) and education (11) influence group 2 time of the nonworking wife (D) only, while that of the working wife (C) is related to weekly hours worked (5) and age (8). Income (7) is related to household activity for workers in a single-income household (B and E).

Leisure time shows no significance for nonworking wives and single persons. Work duration (1) influences leisure activity only for married working males who have working wives (A). It is of interest that the presence of children in the household (9) affects the leisure time of the working wife for a two-worker married couple and of the working husband for a one-worker married couple (B and C). It was observed earlier that these particular individuals carry the smaller load of household support activities.

Work travel time shows several relationships. For the working male with a nonworking wife (B), several socioeconomic variables affect his travel time but work duration (1) is not significant, whereas for the working male who has a working wife (A), the opposite is true. This again indicates a strong home connection for the former. Automobile ownership (12) is important for all workers except the male who has a working wife.

Household support travel time is related to automobile ownership for married working males who have working wives (A) or nonworking wives (D), the persons who carry out the larger share of household activity. Children in the home (9) are significant for married persons among whom the wife does not work (D). Leisure travel time shows very scattered relationships, which is in keeping with previous results.

These analyses indicate that one of the most consistent predictors of activity time and travel time is work duration. While many activity studies tend to use a fixed work time as a starting point, this analysis suggests otherwise. Daily work time shows an unexpected variability, which is reinforced by the very low correlation between daily work time and weekly work time reported by the survey respondents. This variability in

Table 5. Significance of variables.

Variable	Person Class				
	A	B	C	D	E
Group 1 Travel Time					
1	0.075		0.048	0.001	
5		0.015			
6		0.021			
8		0.004			
9			0.075	0.063	
10		0.047	0.090	0.010	
12		0.062	0.057		0.066
Group 2 Activity Duration					
1	0.002	0.008	0.130		
4	0.001	0.007	0.021	0.102	0.076
5			0.028		
7		0.019			0.013
8			0.042		
9					
11				0.009	
12				0.066	
Group 2 Travel Duration					
1	0.009	0.105			0.036
2	0.002	0.010	0.044		
6	0.082				
Group 3 Activity Duration					
1	0.068				
4			0.045		
5			0.029		
7		0.019			
9		0.082	0.061		
12					
Group 3 Travel Duration					
2			0.082		
3			0.136		
4					0.029
5	0.016	0.116			
6		0.038			
8				0.110	
12				0.041	

Notes: Person classes are identified in Table 1.

Variables: 1 = work organizational activity duration; 2 = household support activity duration; 3 = leisure activity duration; 4 = household support travel time; 5 = hours worked per week; 6 = personal income; 7 = household income; 8 = age; 9 = presence of children; 10 = age of the youngest child; 11 = education; and 12 = automobile ownership.

work time shows promise of being one of the main causal variables contributing to the daily out-of-home activity structure.

Most of the other variables are sporadic in their influence, but they do reinforce some earlier indications of household organization. These include the strong influence of the home on the out-of-home activity structure of the married working male who has a nonworking wife and the substitution of activities between the husband of the two-worker family and the wife of the one-worker family.

The influence of automobile ownership appears somewhat limited, but a more significant indicator is what does not appear in the above relationships. It seems that work travel time, most of which is commuting time, is not related to other out-of-home activity. At the present time, this is only a suggestion by default from this data set, but it does raise questions for the concept of the travel-time budget. It also suggests that the out-of-home activity structure may be relatively independent of land-use variables, particularly the household and work-location decisions.

CONCLUSIONS

This paper has presented some relationships between out-of-home activities and travel for urban households derived from a national time-use study. While the results are empirically derived, they provide some immediate implications for activity-based analyses.

1. The selection of activity groups is critical when one is analyzing time allocations to individual groups and the interactions between groups. This selection should be based on functional criteria related to the degree of need for the household, the planning horizon, and the characteristics of individual participation. The traditional land-use-based trip-purpose groupings may not be appropriate.

2. Many travel and activity studies take a fixed work time as a given starting point. We suggest that this assumption is invalid. Daily work time can and does vary

considerably for many individuals, and it is this variation that is the main force in out-of-home activity participation and time allocation. Thus, policies involving flextime, staggered work hours, the four-day workweek, or carpooling may have extremely complex impacts on out-of-home activity patterns and, hence, on travel.

3. Out-of-home activity patterns for individuals and households are dependent on in-home activity structures. In particular, in-home work time should be included in the analysis of out-of-home activities. If in-home work is viewed as out of home in a functional sense if not in a physical sense, such an inclusion is realistic. Surveys that include only travel behavior will be incomplete data bases, therefore, for activity analyses.

4. We did not find that out-of-home activity patterns were related in any way to work travel time, which is spatially related and reasonably invariant. Significant activity analyses can therefore be carried out without consideration of spatial variables. There is also a suggestion that individual daily travel-time budgets may be a function of commuting time.

5. Certain insights into household structure are provided. There is repeated confirmation that the husband who has a nonworking wife is highly connected to the home with a highly constrained out-of-home activity structure.

6. Several studies have looked at the structure of trip chaining or excursions, particularly that by Hummon, Baker, and Zmotel (6). Although the full understanding of travel will require the analysis of excursions, an essential precursor will be a clear determination of activity participation and time allocation.

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Theory of Destination Choice-Set Formation Under Informational Constraint

Robert Meyer

A theoretical framework for the behavioral analysis of destination-choice set formation is proposed that consists of a set of postulates that purport to explain how individuals' previous experiences with respect to destinations influence patterns of search behavior in the formation of choice sets. The theory yields predictions concerning (a) how destination choices are made by individuals who have limited information concerning the set of alternative destinations and (b) the likely nature of choice sets within differing sets of alternatives. Models describing the behavior of groups deduced from this theory are described.

Disaggregate behavioral models of destination choices are based on a rather simple and well-known behavioral postulate: When an individual makes a choice from among a set of destinations, there initially exists a subset of alternatives that are actively considered. The individual then assigns a utility value to each of these alternatives and chooses that destination for which utility is the highest. Current choice models represent an extension of this postulate to the study of group or repeated choice behavior; in this case, the utility function of a representative consumer is used to assign utility values to destinations under study. Assumptions made about the distribution of utilities within the population are then employed to yield expressions for the frequency or probability with which individuals in the population will choose each destination (1).

A major obstacle to the direct application of this approach in the study of destination choice, however, is that current models tend to be insensitive to one major aspect of the above behavioral postulate—the initial identification of sets of relevant or actively considered alternatives (2, 3). In other words, while we have developed analytic tools to model the behavior of individuals faced with a set of alternatives, we have few tools for identifying what those alternatives are.

From a modeling standpoint, the problem is as follows: It is quite likely that in a given study area many individuals consider different sets of alternatives when making destination choices. Without a means for assessing these sets a priori, the researcher is forced either to make the simplifying assumption that all in-

dividuals actively consider all destinations or to advance hypotheses about what the choice sets are likely to be for various segments of the population (3, 4). It is quite possible, of course, that such assumptions or hypotheses may prove untenable in practice. This would particularly be the case, for example, when the behavior of a group of individuals who vary greatly in their knowledge of potential destinations (owing to varying lengths of residency) is to be modeled or when some alternatives exist that completely dominate others in terms of their qualities (5-7). Because of this, model parameters that describe the relationship between predicted utilities and observed choices may be influenced as much by variations in choice sets among individuals (which are not fully accounted for in the model) as by variations in preferences (which are accounted for). Because changes in the nature of destinations may affect both choice sets and preferences to differing degrees, this potential confusion is likely to cause model parameters to be intransferable over time and space. In other words, forecasts of behavior may be prone to error (6, 8).

Although considerable discussion has been devoted to the choice-set problem, its solution has so far eluded researchers in the field (3, 8). One impediment seems to be simply that we have little theory related to choice-set formation to guide the work. For example, a number of authors have suggested that choice sets are largely determined by how individuals learn about spatial opportunities within time and space budgetary constraints (5, 6, 9, 10). Theories of spatial learning that might be used to predict choice sets, however, have not been forthcoming.

It is my purpose to suggest such a theory of learning. In particular, the theory is one that purports to explain how individuals make destination choices over time, given increasing levels of information with respect to the set of opportunities. The theory postulates that information gained over time as a result of feedback from choices is used to update beliefs about the structure of the available opportunity set. These beliefs determine the composition of a choice set; that is, they are the set