TIME AND ACTIVITY CONSTRAINTS ON DIFFERENT TYPES OF PEOPLE

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ABSTRACT: *The concepts of time budgets and activity analysis drawn from sociological and geographical disciplines are reviewed for their relevance to transport issues and appraisal. The competition for travel time is shown as a function of stage in family life cycle, with the pressure on trip combination, destination substitution, and on other activities such as sleep and leisure. The different forms of time expenditures at different locations are related to different appraisal purposes, including environmental exposure. Data from over 14 countries, including Australia, show very similar trends in broad travel time budgets.*

Background Paper for
Session 5

TIME AND ACTIVITY CONSTRAINTS

INTRODUCTION

The appraisal of transport projects and proposals has developed quickly over the last 25 years from an essentially engineering assessment to a complex network of economic, social, environmental and engineering appraisals with a major input from the general community through consultation procedures.

For the last three years the ARRB has been systematically reviewing the different elements of the appraisal process. The initial segments covered were environmental impact (Lane 1977), family expenditure influences (Morris and Wigan 1977, 1978; Morris and Lane 1978), and social appraisal (King 1978a). These research investigations were all directed at fairly aggregated units of appraisal. The environmental impact review covered the different factors which could or should be considered in a transport assessment, and drew some conclusions from the intractability of the problems involved in putting numbers to the many different types of relevant factors: specifically, that each impact element should be presented separately without any great efforts being spent on providing an aggregated single measure of impact, worth, or severity. The social appraisal investigation was directed at finding homogeneous groupings of the population influenced by and making use of transport, using aggregated planning data based on residential districts (the Collector's Districts used in the Census of Population). This initial investigation showed the major importance of stage in the family life cycle as a key influence on the location and behaviour of groups. This lesson is being pursued at the micro-scale at a macroscale in a further ARRB project on residential location being carried out at Monash University (Young and Richardson 1978, Young, Morris and Ogden 1978). The Family Expenditure analyses treated the household as the basic unit, and emphasised transport demand rather than transport behaviour. The lessons from this line of work are that the stage in the family life cycle is critical, and that vehicle availability and ownership is the major complementary factor in producing travel from the needs of the household and the demands on the household budget.

In the family expenditure studies the competition between different needs constrains the behaviour of different households so tightly that in some cases the family moves into deficit funding over quite long periods of time by drawing upon capital to sustain housing, food, and movement needs. This shows up more with pensioner households, but the emergence of young families which are housing rich but financially stretched due to heavy purchase commitments in outlying areas (Morris and Lane 1978) indicates that similar situations can arise far earlier in the family life cycle.

The lines of investigation listed so far have been based on aggregated units of the populations involved in, or influenced by, transport factors: the individual too has his own views, priorities and needs within even the household. Accessibility to facilities and the intimate relationship

between accessibility, linked chains of the different activities which the individual wishes to pursue, and economic modelling of choice sets and evaluation of the consequences have been described in detail by Morris, Dumble and Wigan (1978) at the last ATRF meeting in Perth.

Almost all transport movement is a derived demand, as comparatively little movement is undertaken simply for its own sake. The activities of each end of - and in some cases, during - travel are the causal factors which determines the direction, intensity, pattern, timing, and demand for travel of different types.

The appraisal frameworks offered by accessibility and trip linkage concepts and complemented by the improved context for passenger transport expenditure assessment by using family expenditure data, will not be fully effective until time and activity duration and timing constraints are brought to the same level of development.

The constraints on indivuduals are apparent in each of these lines of work, and the values of time savings in travel are the result of priorities and choices available to the individual - at a price - to satisfy his or her activity needs. Not all activities are reflected in monetary outlays.

The common factor to all individuals is that each has only 24 hours in a day to spend on the activities in which he must be (or wishes to be) involved. Only in a few cases can this absolute constraint be 'bought out' by getting others to collect shopping, or do housework or childminding: sleep and eating are simply not possible to contract out at any price. An exactly similar situation applies in the movement of goods: goods must be received when there is some way of receiving them; the demand for goods is localised; and no amount of transhipment can alter the consumption point. The service of goods transport can be bought out, but the goods themselves cannot be used until they arrive, and activities based on their consumption cannot occur until they are in the same place as those who need them. In the case of both goods and personal movement a certain amount of cross-substitution is possible and gives rise to valuations of time savings and quality of service in both cases. The essential unit involved is time, and the allocation of activities and their physical location under the time constraints provided by the fixed 24 hour day is the basic process which gives rise to transport activity.

The basic unit for this kind of investigation is the individual: the subject of time budget allocations across activities of all kinds has been used by sociologists for many years, and has more recently been pursued by urban geographers as an effective device for elucidating spatial activity patterns. The information on transport usage and behaviour immured in these studies shows the same list of key factors which we have already listed from the appraisal of transport issues from social, household expenditure, and

accessibility factors involved. They are: stage in life cycle, role in the family, vehicle availability, and relative locations of home and work. However, from the standpoint of time budgets and activity patterns these factors are linked in a single framework for the assessment of competition between activities; their combination; and their distribution over different locations.

This paper develops the complementary nature of time and activity demands in the consumption of transport services principally for passenger needs. Consideration is given elsewhere to both modelling structures and commodity flows (see Wigan and Morris 1979).

CONCEPTUAL FRAMEWORK

The manner in which different activities win out in competition for the scarce resource of time is a key process in understanding travel behaviour. The linkage between activities which travel provides is conditioned and constrained by the time available for movement and time restrictions imposed by particular locations and activity centres on those wishing to undertake an activity at a given place at a given time.

In the case of both goods and passenger movement, there is a range of different qualities of travel service available at different prices. In passenger movement the concept of the value of time saving is given visible effect by the patronage of different modes, the different combinations of service level, cost, and travel time which they offer. Goods transport services charge for different levels of delivery service, and treat larger deliveries favourably as they save delivery time and permit greater use of the delivery vehicle in the limited time available. Postal and communications systems also structure their cost and service levels to match the time delays and activity constraints on their users.

Once this is recognised, the role of constraints on travel time takes on its true significance as the primary determinant of the quality of travel as a means of servicing activities. Passenger transport is in heavy demand during the morning and evening peak hours, and the constraints set by working hours interact with the need to get sufficient sleep, eat breakfast, and ensure children reach school. Goods transport efficiency is limited by the time constraints set by unions, by delivery time restrictions, and the need to 'waste' movement time during deliveries.

The manner in which these constraints influence people's activity and movements is pursued in this paper through several different closely related strands of development.

The first strand is the concept of a time budget: here the different forms of activity undertaken by a person over a day are examined in terms of the amount of time spent

on each activity. Durations must add up to 24 hours, and thus the term 'time budget'.

The second strand is the concept of time occupancy of a given location. Much transport gives rise to external nuisances such as noise, dirt, fumes, and vibration and these all affect the activities undertaken adjacent to transport corridors in a manner well illustrated by the patterns of nuisance levels over the day matched to the occupancy probabilities of the site concerned. Such exposures may be in terms of people as occupants of a house or flat, as pedestrians, as shoppers, or at their place of work, but the time profiles of occupancies at a given spatial location are also constrained to cover a 24 hour period every day, and as many activities are location-linked (e.g. sleeping at home) the constraints on time utilisation at a given location are a direct influence on the activity patterns served at a specific location.

The third strand is that of land use linkage: in most 'Transportation Studies' land use designations are taken to be synonymous with the activities undertaken on those land uses. This misleading misrepresentation is encouraged by the aggregation of activity units of different scale within each such land use (e.g. 'commerce' = shops from corner stall to department store), thereby disguising the lack of correspondence between land use and activity level. The quality factor in transport (referred to earlier) is therefore complemented by a quality factor in activity type which differentiates the attractiveness and efficiency of the common land use. Nevertheless, the patterns of movement between different land use designations are an effective descriptive tool when matching transport services and needs. In the case of goods transport the levels of service offered to such linkages are closely related to the widely varying vehicle types found most effective to carry different types of commodities between land uses.

The fourth strand is that of activity linkages: an invidious and recurrent problem in 'transport studies' is the need to determine if different travel movements reported over a 24-hour period are in some sense all part of the same journey. Questions such as the handling of 'non-home based trips', and the structure of journey linkages are far better understood (if not better handled) by noting and linking the activities which occur between each individual movement over the day. This is the precise equivalent of counting platoons of vehicles on a road or recording the length of the gaps between platoons, while the length of the gaps between them are used as the significant factor by traffic lights serving the platoon flow. If for platoons we read activities and for gap lengths we read trips, the analogy becomes evident.

The last two strands correspond to the concepts of 'timing space' and 'spacing time' discussed by Parkes and Thrift (1975) In most of these strands the importance of roles within different family structures and stages in the

life cycle of the family is clear: as mentioned previously the importance of these two variables in understanding travel demand and travel behaviour has recently become evident in studies of transport provision and consumption by different groups within the community. However, the relationships between family structure and stage of life cycle and activity linkages and time constraints are more easily recognised than the same structures viewed from the perspectives of transport expenditures in household budgets, the transport determinants and effects of location choice, and the intensity of travel demand by different groups in the community.

The four strands are essentially alternative ways of examining activity patterns and time constraints. They differ principally in terms of the level and basis of aggregation, as shown in Fig. 1.

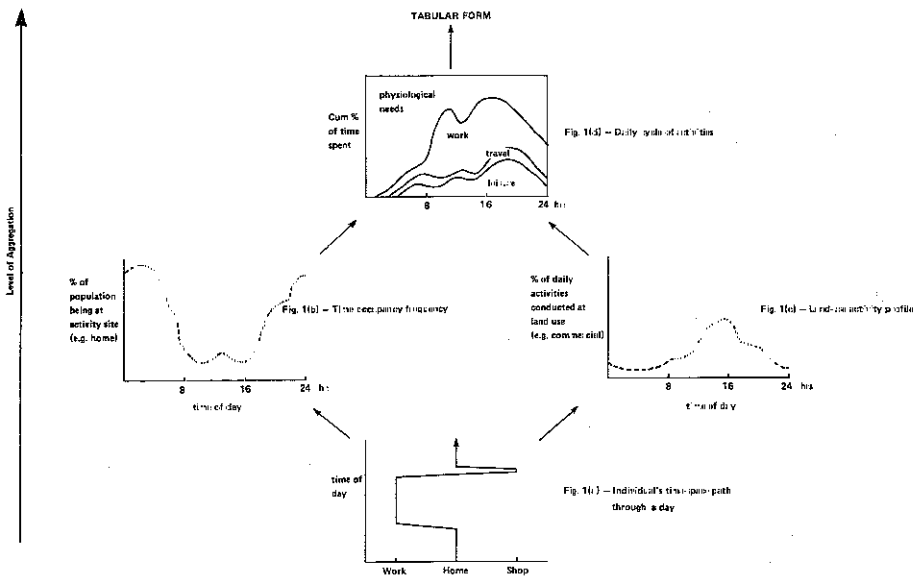


Fig. 1 - Alternative perspectives on time and activity constraints

At the lowest level of aggregation (Fig. 1a) individual movements in space and time can be represented by an unbroken path, employing the time-space language developed by Hagerstrand and his students at the University of Lund. To take a concrete example, consider the graphic diary shown in Fig. 2: an illustration used by Carlstein, Lenntorp and Martensson (1969) describing the daily program on a typical work day of a professional Swedish family of five. Every member (viz. two parents, two school children and one pre-school child) is represented by a path moving through a number of activity locations (or 'stations') during the course of the day.

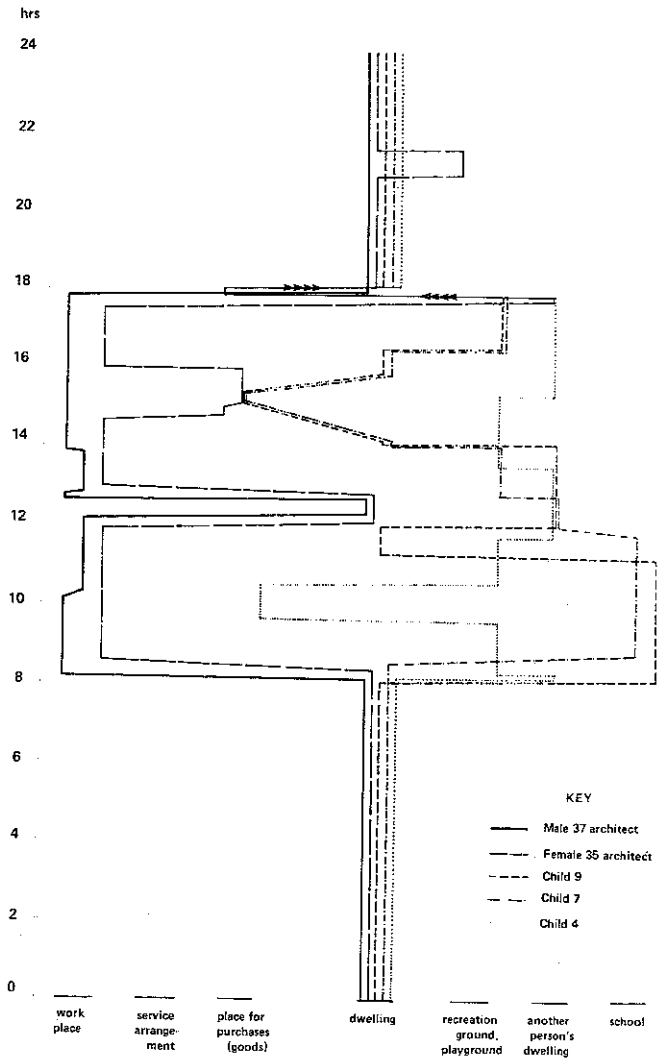


Fig. 2 - Graphic diary of a Swedish professional household

(Source: Carlstein, Lenntorp and Martensson 1969)

The distances between the activity locations are not drawn to scale, but the length of the (vertical) segments parallel to the time axis is proportional to the length of time the individual spends at a given place. This particular household is highly mobile, having two cars and four bicycles at its disposal; it is very largely this high level of mobility which enables the household members to participate in a variety of different activities despite the dominating influence of work and school. The flexibility of the employed wife's profession

enables her to do some shopping in mid-afternoon. During part of this shopping expedition she is accompanied by her two older children, who then return home and subsequently visit a recreation ground, ultimately to be met again by their mother (this time after she has collected the youngest child on her way home from work).

This graphic diary clearly shows up the variety of constraints operating on the household unit. These may be imposed by social needs (schooling); by mutual agreement (the parents' common lunch at home; and the evening meal for the whole family); by urgent needs (such as a visit to the doctor); by general household needs (household shopping); or by physiological needs (sleeping, personal care, etc). The net result is a complex set of interactions through the course of the day, and the activities undertaken by individual household members serve to constrain the activities undertaken by other members to a greater or lesser degree. The male parent has the simplest path: apart from a lunch break taken at home and several visits to alternate work locations, his working day represents a virtually uninterrupted stretch from 8 a.m. to 6 p.m. By contrast, there is a pronounced tendency among all other household members to mould a variety of activities into their daily program. For them it is unusual to go home directly after an activity, so that the home is almost empty for most of the working or school day.

These daily activity patterns of individuals and households may be aggregated to produce time-occupancy profiles (Fig. 1b), such as that shown in Fig. 3. This is taken from the multi-national comparative time-budget study launched in 1965-66 (Szalai 1972), and illustrates the proportion of employed men at home at various times during a typical weekday in several countries. As a general rule, the more affluent the country the lower the proportion of time spent at home by employed males. France, however, is a notable exception with some 70 per cent being home at mid-day for lunch. The Frenchmen's love of food is also clearly evident in Fig. 4, which illustrates a further level of aggregation (Fig. 1d). The distribution of occupancies of different specific locations is an essential component of environmental appraisal: an environmental nuisance of a time or location with scant occupancy is not making much of a direct impact on people. Transport planning models can produce estimates of pollutant levels but products with location-specific occupancy profiles are needed for the assessment stage (Wigan 1976). The cumulative distribution of activities over *all* sites illustrates the relative importance or dominance of various activities at different times of the day. Such daily cycles of activities could also be derived from land-use activity profiles (Fig. 1c), illustrating the frequency (or even range) of activities conducted over the 24 hours of the day at a given land use classification (including residential). Though not illustrated in detail here, this corresponds to the third strand referred to earlier.

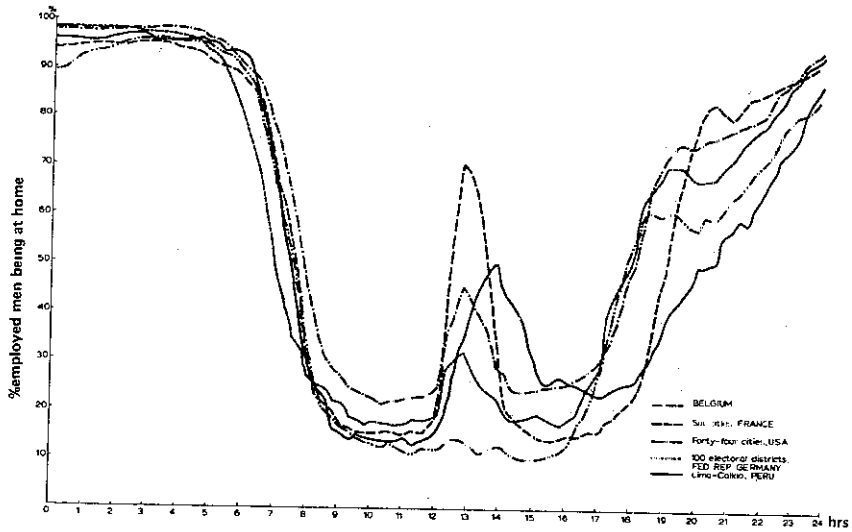


Fig. 3 — Percentage of employed men being at home across the 24 hours of a typical weekday in selected countries, 1965-66
(Source: Szalai 1972 p. 736)

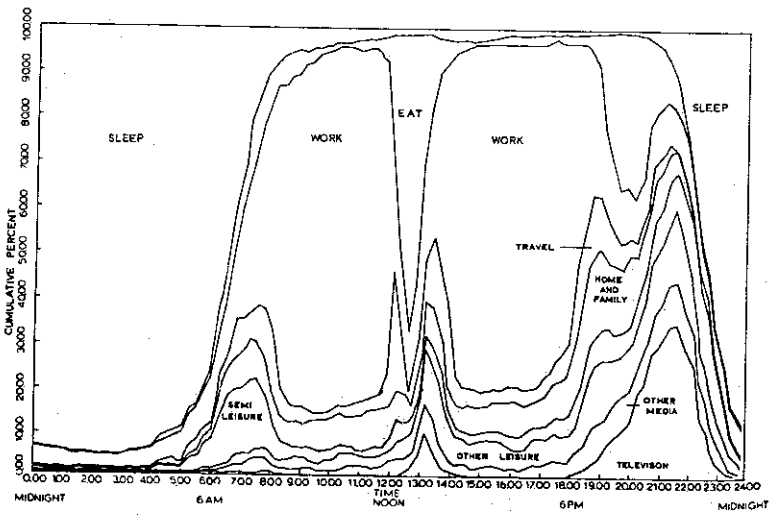


Fig 4 — Cumulative percentages of employed men engaged in different activities across the 24 hours of a typical weekday in France 1965-66
(Source: Szalai 1972, p. 722)

Finally, the activity patterns may be collapsed into a total time budget, by aggregating the time spent by individuals at all locations at all times of the day and night. As with other levels of aggregation, these may be derived for subsets of the population, in different places (and even for selected parts of the day). This is the usual form in which data is presented in tables, and it should be noted that a distinction must be drawn between the time budgets of those people who participate in the activities, and - more accurately - the time budgets presented for the time spent by the whole population involved, whether or not individuals were involved in any particular activity during the diary period. Each level of aggregation entails some loss of information. However, even the coarsest level of aggregation yields valuable insights for transport planning purposes.

TIME BUDGET ALLOCATIONS: TIME 'DEFICIT' AND 'SURPLUS' GROUPS

The notions of 'deficit' and 'surplus' have no formal place in total time budgets, since every individual has the same amount of time per day at his disposal. Nevertheless the amount of competition for, or the demands upon, the scarce resource of people's time varies markedly from one individual to another. Moreover the perception of time may vary among individuals and with time of day. We may be 'short' of time, or we may have 'plenty' of time. We may 'save' time, 'waste' time or even 'kill' time. It is also possible to 'purchase' other people's time for some activities, and this may be regarded as coverage of a deficit.

Total leisure or 'free' time available each day is a crude indicator of time deficit or surplus. On this basis, long-distance commuters and wage-earning married women emerge as two distinct time-deficit groups. Evidence on time-surplus groups is scarce, although some limited evidence exists for retired people.

Long-distance commuters

The impact of commuting time on daily activity patterns is illustrated by an outlying factory in Budapest employing many long distance commuters (Szalai 1966a). Commuting time varied from half to five and a half hours a day. Longer commuting times in this otherwise homogeneous population compressed certain other activities, notably recreation and leisure, but the allocation of sleep was unaffected. Szalai (1972) suggests that such 'compressibility choices' identify social groups.

Not surprisingly, commuting times vary with the size of city and with relative location within cities. The average commuting times in the medium-sized city of Albury-Wodonga (Cities Commission 1975) were only 50-60 per cent of those in metropolitan Melbourne (Table I). This was the first major time budget study conducted in Australia, and was designed as

TABLE I

TIME (IN HOURS) SPENT IN DIFFERENT ACTIVITIES ON WEEKDAYS IN TWO AUSTRALIAN CITIES*, 1974

ACTIVITIES	Employed Males		Employed Females		Housewives	
	Melb	A/W	Melb	A/W	Melb	A/W
WORK RELATED	9.22	8.73	6 41	5.51	-	-
. Productive Work (incl. overtime and breaks during work)	(8 18)†	(8.13)	(5.61)	(5.08)	-	-
. Trips to and from work	(1 04)	(0 60)	(0.80)	(0 43)	-	-
HOUSEWORK	0.76	0 74	2 61	3.11	5 31	5 58
CARE OF CHILDREN	0 26	0.20	0.45	0.50	1.46	1.02
. Child Care	(0.21)	(0.18)	(0.37)	(0.43)	(1 23)	(0 92)
Associated travel	(0.05)	(0 02)	(0 08)	(0.07)	(0.23)	(0.10)
PURCHASE OF GOODS AND SERVICES	0 32	0.39	0.77	0.79	1.13	1 09
. Purchasing activities	(0.18)	(0.29)	(0.55)	(0.60)	(0.75)	(0.82)
Associated travel	(0.14)	(0.10)	(0 22)	(0 19)	(0.38)	(0.27)
PHYSIOLOGICAL NEEDS	9 54	9.81	10.06	10.23	11 07	11.03
Personal care at home	(0.68)	(0 65)	(0 85)	(0.81)	(0.76)	(0 73)
Eating	(1 04)	(0 97)	(1 09)	(1 12)	(1 67)	(1 61)
Sleeping	(7 82)	(8.19)	(8.12)	(8 30)	(8 64)	(8 69)
FREE TIME	3 89	4 18	3.69	3.79	5 03	5.17
. Discretionary activities	(3.60)	(3.87)	(3.41)	(3.58)	(4.75)	(4 85)
Associated travel	(0 29)	(0 31)	(0.28)	(0.21)	(0 28)	(0 32)
TOTAL	24 00	24.00	24.00	24 00	24.00	24 00
Total daily travel	1 52	1 03	1 38	0.90	0.89	0 69

Source: Australia. Cities Commission (1975)

* viz, Melbourne and Albury-Wodonga

† indicates component totals

a companion study to the 1965-66 multi-national[(1)] comparative time budget study (although Melbourne with some 2.6 million is clearly outside the size range adopted for the 'parent' study). The shorter work travel times in Albury-Wodonga are matched by greater free time and slightly more sleep. Travel time in connection with child care and purchase of goods and services is smaller in Albury-Wodonga than in Melbourne. The reverse applies for travel associated with discretionary activities.

These differences in travel time allocations reflect differences in the accessibility characteristics and the spatial structure of the two cities. For instance, only 28 per cent of wage-earners in Melbourne live within three miles of their workplace, compared with 74 per cent in Albury-Wodonga. Moreover, although car usage is higher in Albury-Wodonga, so too is the use of non-mechanised modes. Interestingly, significant minorities in Albury-Wodonga (36 per cent of males

[1] The Multi-National Comparative Time Budget study of the 1965-66 survey reported by Szalai (Ed) (1972) will subsequently be referred to as the 'MCTB' study.

43 per cent of females) said they would walk to work if their primary mode was not available (compared with only 13 per cent of males and 16 per cent of females in Melbourne).

Variations in accessibility also give rise to corresponding variations in work journeys within cities, with longer commuting comes usually applying to workers living at greater distances from the city centre. Table II confirms this trend for all but a few (usually smaller) cities surveyed in the MCTB study. Once again the time occupied by work journeys tends to reduce the free time of the employed. The general average of free time in Belgium is 3.5 hours, but the average free time of people living in central areas varies between 3.8 and 4.2 hours (Szalai 1966b).

Table II also suggests a strong trend towards a constant average time allocation for work journeys, in these cities as a whole (see also Zahavi 1976). In most countries the average journey to and from work commits less than an hour a day for the average worker, 50 minutes being the short common value. The average duration of work journeys made by the different modes are roughly equal. Clearly the duration of commuting depends less than might be expected on the level of industrial development and the existence of individual means of transport. Szalai (1966b) suggests that such homogeneity implies that longer commuting distances depend less on better transport facilities than on the time available for the journey.

Some evidence of a constant travel time budget within cities has also been identified by Goodwin (1976). When walk and other miscellaneous modes are included the time spent travelling in connection with all activities tends to be fairly constant for groups of people in different locations (Fig. 5) Mitchell and Town (1976) have identified essentially similar distributions of self-reported travel times for different trip purposes and for different socio-economic groups, despite differences in mode usage. The existence of travel time budgets has important implications for the concept of travel time savings which forms the foundation of most transportation models. Improvements in transportation do not necessarily give rise to a reduction in travel, rather the travel time 'saving' is reallocated to travel for other (or higher quality) activities.

Employed Women

While men spend longer commuting (by virtue of their greater time spent in 'productive' work, and greater distances travelled), both working and non working women have most of their time pre-empted by heavy cumulative commitments. The employed women are apparent in every time budget as having less time for discretionary activities, shopping and sleep, by comparison with their non-wage-earning counterparts (refer to Table I). Employed women have the lowest 'free time' allocation of all groups. The constraints on shopping time apply to comparison shopping rather than shopping for food and other consumables (Girard 1958). Employed women spent

TABLE II

AVERAGE DURATION OF TIME SPENT TRAVELLING TO AND FROM WORK, BY MODE OF TRANSPORTATION AND DISTANCE TO CITY CENTRE: MULTINATIONAL SURVEY SITES, 1965-66

[in minutes per day weighted to ensure equality of days of the week and eligible respondent]

	Belgium	Kazanlik, Bulgaria	Olomouc, Czechoslovakia	Six cities France	100 electoral districts, Fed. Rep. Germany.	Osnabruck, Fed. Rep. Germany	Hoyerswerda, German Dem.Rep	Gyor, Hungary	Lima-Callao Peru	Torun, Poland	Forty-four cities, USA	Jackson USA	Pskov, USSR	Kragujevac, Yugoslavia	Maribor, Yugoslavia
Employed men and women: workdays only															
Distance to city centre:															
under 2 km	67	50	56	53	NA	43	62	41	87	58	36	33	40	53	41
2 - 5 km	66	62	63	51	NA	48	-	48	99	63	46	39	55	62	48
5 - 10 km	67	102	78	45	NA	61*	-	82*	89	76*	51	37	65	-	78
10 - 20 km	71	116	55	-	NA	-	-	89	97*	-	54	40	66	-	95
over 20 km	70	-	-	-	NA	-	-	135	-	-	53	44	-	113**	-
All transport: all distances	66	57	59	50	40	47	62	64	89	60	50	38		51	51
public transport	98	93	73	82	NA	71	82	104	103	71	81	-	67	70	71
walking	52	47	46	44	NA	46	30	40	48	41	30*	34*	32	47	40
automobile	55	73	62	46	NA	41	66*	48*	93	50	46	39	-	53	44
Size of survey Centres ('000 persons)	26.0 to 250.0	45.6	75.3	60.0 to 175.0	NA	138.0	90.0	72.0	NA	112.7	≥50.0	72.0	115.0	52.8	96.0

* indicates N between 10 and 29
** indicates N between 4 and 9
\- indicates N less than 4
NA indicates data not available for this variable

Source: Robinson, Converse and Szalai (1972) p. 122.

less time sleeping than housewives in every one of the twelve survey sites covered by the MCTB study, and in about half of these, employed women displayed less time allocated to sleep than employed men. This contrasts strongly with the 'compressibility choices' exhibited by the Budapest long distance commuters. 1973 Reading data (Bullock *et al.* 1974) repeated the pattern of least leisure time for employed women, but in this case only leisure time suffered, and sleep did not. Increasing numbers of children have similar effects on sleep and leisure time as employment. Fig. 6 indicates that the amount of domestic work increases more or less directly with the number of children, although the effects of three or more children indicate a lowering of standards or some economies of scale. The first child has the greatest impact on the domestic workload for both categories of women, but especially those in paid employment. It can be seen that the reduction in time spent in paid employment by married women after the arrival of a first child is *more* than offset by the increase in domestic work load, but for further children a straight shift from paid employment to domestic time is evident. Not only does paid working time decrease with increasing numbers of children, but so too does the rate of work force participation (Girard 1958, Klein 1970).

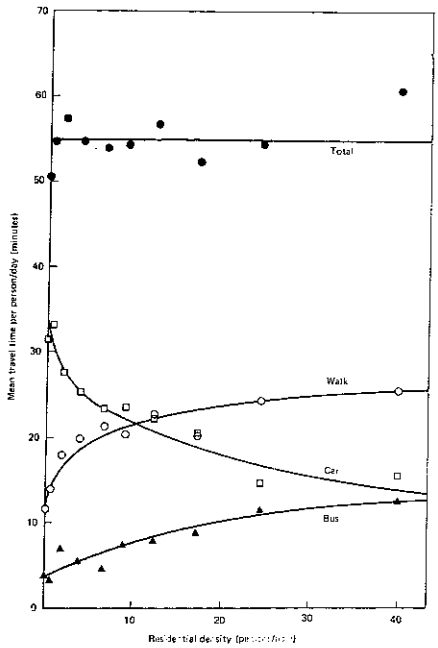


Fig. 5 — Daily travel time per person in U.K. 1972-73 National Travel Survey (Source: Goodwin 1976)

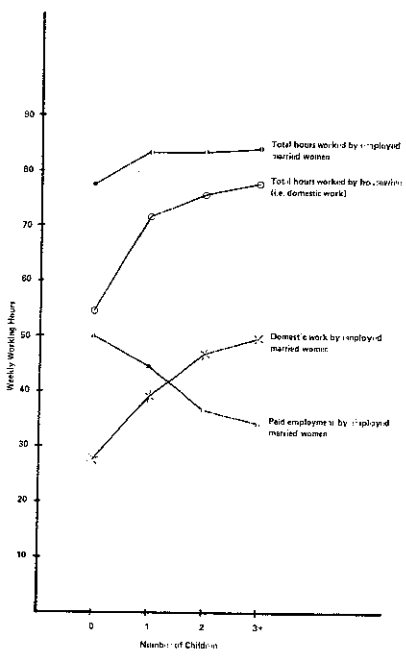


Fig. 6 — Weekly working hours of married women with and without paid employment, French urban centres, 1958 (After Girard 1958)

The domestic workload for urban women has not decreased appreciably over time, in spite of technological advances (Girard 1958, Szalai 1975). While modest time savings have been made in some types of domestic work, others (including shopping) seem to demand more time than before (Table III). This stability has its parallels in total transport time allocations, which have also remained fairly constant across wide ranges of technological development. Both working women and housewives spend more time at home than men both during the week and on weekends (Table IV).

Housewives seem to choose to stay in or around the house even during their 'free time' (Szalai 1975). The latter is clearly illustrated in Table I, where housewives in both Melbourne and Albury-Wodonga have more free time during the week than wage-earners of either sex, but their discretionary travel time is roughly identical. Vehicle availability information must be added before such a response can be labelled as a preference or a constraint.

This tendency has important implications for assessing the distributional effects of transport policies as women will be over-represented among those severely affected during the day by negative externalities, (such as noise, fumes and dust) peculiar to the location of their homes.

TABLE III

TIME DEVOTED TO HOUSEHOLD WORK BY URBAN WOMEN
(Hours average all days of week)

	Housewives			Employed Wives	
	1926-27	1952	1967-68	1952	1967-68
USA[1]					
Shopping time	0 4(hrs)	0 5	1 0	0 3	0 8
Total housework	6 1	6 3	6 2	3 8	4 5

	1924	1959	1965
USSR[2]			
Shopping (and queueing)	0 2	0 65	0 5
Total housework	4 47	3 87	3 6

Sources: [1] Walker (1969)
[2] Szalai (1972)

TABLE IV

PERCENTAGE OF DAY SPENT AT HOME

LONDON REGION 1970:[1] (married people aged 30-49 yrs)	Weekday (%)	Saturday(%)	Sunday (%)
Employed men	55	66	76
Employed women	71	75	83
Housewives	87	82	87

MELBOURNE 1974:[2] (adults aged 18-69 yrs)	Weekday (%)	Weekend (%)
Employed men	54	74
Employed women	61	75
Housewives	86	84

ALBURY/WODONGA 1974:[2] (adults aged 18-69 yrs)		
Employed men	55	66
Employed women	58	72
Housewives	87	84

Sources: [1] Young and Willmott (1973)
[2] Australia Cities Commission (1975) Appendix A p 16

Elderly People

Many elderly people lead quite active lives (see Table V) although they have lower work commitments. Hanson (1977) shows that variations in overall travel patterns between the elderly and the rest of the population are almost completely explained by reduced travel to work, and the relaxed constraints on timing. Uppsala data suggests that the elderly participate in most activities as frequently as younger people with the exceptions of work and recreation.

The average distances travelled to each activity by every mode are very similar both for the elderly and others, but the elderly tend to use different modes and travel at different times to younger people. The contrasts in travel behaviour between week days and weekends in Table V are marked, and are not usually picked up in transportation surveys.

The shifts in mode usage by the elderly are by now fairly well documents, and reflect their lower car availability, but the data on the alterations in the timing and association of activities provide a fresh perspective.

TABLE V

AVERAGE TIME SPENT ON FREE-TIME ACTIVITIES ON WEEKDAYS AND WEEKENDS BY SELECTED POPULATION GROUPS: AUSTRALIAN CITIES, 1974.

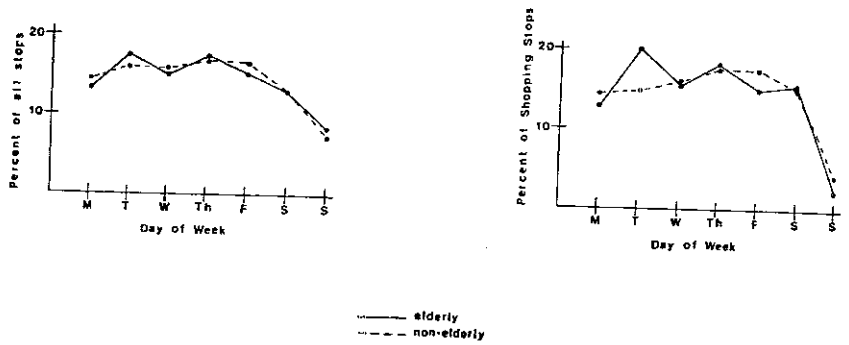
	Weekdays				Weekends			
	Employed Males	Employed Females	Housewives	Persons aged 60+	Employed Males	Employed Females	Housewives	Persons aged 60+
MELBOURNE								
Travel connected with free time	0 29	0 28	0 28	0 39	0 65	0 98	0 82	0 76
TOTAL FREE TIME*	3 89	3 69	5 03	6 13	7 75	7 39	6 74	8 22
ALBURY/WODONGA								
Travel connected with free time	0 31	0 21	0 32	0 18	1 13	0 68	0 68	0 58
TOTAL FREE TIME*	4 18	3 79	5 17	5 00	8 07	6 16	6 93	7 59

*Total free time excludes travel connected with free time

Source: Australian Cities Commission (1975) p 35 Appendix A p 15

The travel patterns of the elderly have further similarities to the rest of the population as weekday travel is more frequent than weekend travel (Fig. 7), but at any finer level of disaggregation there are substantial differences. Social and recreational trips are less concentrated on the weekend than they are for the non elderly. The elderly also tend to shop earlier in the week: this could be due to either special incentives (as are often offered by food stores), or a desire to avoid congestion. Whatever the reasons, the reduced work involvements give the elderly the flexibility to respond. A similar response is shown in the timing of activities across the day: the elderly tend to shop earlier or later than peak times, and do their shopping, recreation and personal business earlier than younger people.

by day of week:



by time of day:

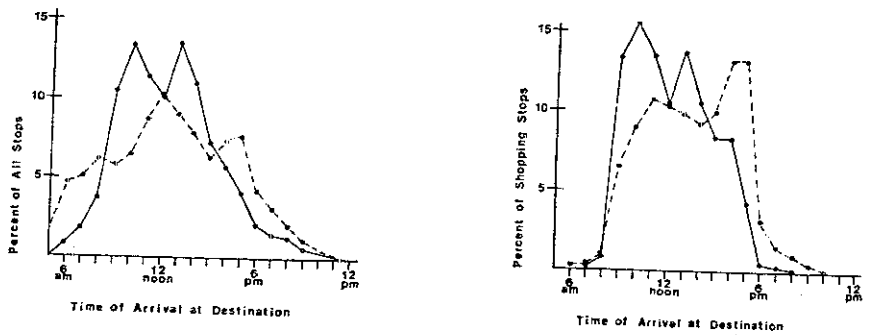


Fig. 7 — Time of travel for all purposes and shopping by the elderly and the non-elderly in Uppsala (Source: Hanson 1977)

Employed people by contrast tend to squeeze in such activities as part of the return trip from work. This reflects the great pressure on employed people to meet their needs during the limited times that they have access to the places of business concerned, due to the coincidence of working and opening hours as much as the shortage of available time.

When working hours are divorced from a strict relationship with opening hours (e.g. Flexitime) there are similar effects evident with younger populations. University students have been found to devote considerably more time to spare-fixed rather than time-fixed activities, despite closely similar total time and travel budgets across the diverse timing constraints inherent in tertiary institutions (Tomlinson *et al.* 1973).

These findings emphasise the need to pay attention not only to the overall aggregation level typified by a Time Budget (Fig. 1), but also to the frequency, sequence, synchronisation, and substitutability of activities. The time-space relationships and personal mobility inherent in a particular social environment also constrain the use of time and participation in activities.

SYNCHRONISATION AND ACTIVITY LINKAGE

The combination of activities (activity-linkage) is a natural result of the influence of time constraints. The degree to which such a response is possible is constrained by the times at which an individual can spare a few minutes and by the times at which the desired activities are offered. Hagerstrand (1973) refers to this as the 'timetable of environment'. For a working person there are on a weekday only three short 'windows' when this freedom to act is available. Briefly in the morning before work, during lunch-break (in competition with the need to eat) and again in the evening after work. Generally the lunchbreak and the first hour after work are used for personal business and shopping, due to business opening hours. Some services are very difficult for employed people to get to at all: banks being the classic example, leading to an Australian worker's right to be paid in cash if he so desires.

Similar regular constraints affect housewives: typically the need to get children off to school - and often the need to accompany them there (Hillman *et al.* 1976) - and to get them back again at lunchtime and at the end of the day. Other semi-scheduled tasks include paying household bills, organising repairs, receiving parcels, and accompanying children to medical and dental treatment: these also shrink the available discretionary time to be spent on shopping, housework and leisure. Klein (1970) argues that these timing factors are the main inhibitor to greater housewife employment rates, rather than any overall time shortage.

The ability of individuals to accommodate incidental activities into their daily program depends substantially on the spatial arrangement of activities, the mode of transport available, the length and frequencies of time-windows, and the time necessary to complete the activity. Time-space prisms are a useful concept for treating time-space accessibility and were developed by the Lund school of geography. A prism is the envelope defined by the continuous and connected set of time-space positions which constitute the physically accessible part of the environment. In other words the prism comprises the volume of space-time for which the probability of being included in the individual's time-space path is greater than zero (Lenntorp 1976). The daily program of one individual is presented as a series of prisms in Fig. 8

Fig. 8 illustrates the use of prisms to generalise the linked activity paths shown in Fig. 1a. Every spatial movement is represented by a prism, whose volume varies

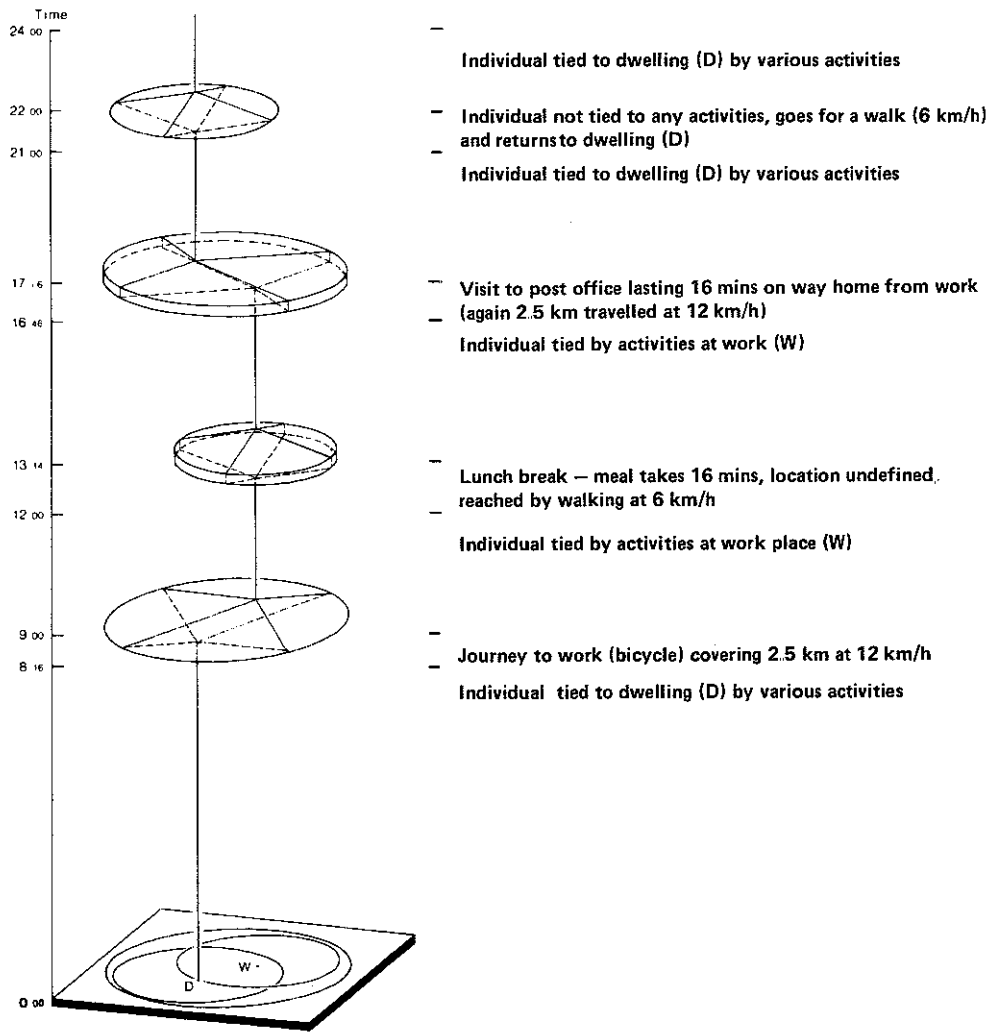


Fig. 8 — Prisms in an individual's daily program (Source: Lenntrop 1976)

directly with the speed of movement of the available transport, and inversely with the distance that can be covered: the prism is therefore a direct representation of the range of movement and location options available in a given time slot. The activity durations remain as single lines linking prisms. This type of representation is used by Lenntorp *et al.* (1976) in the PESASP models of activity linkage.

The influence of some of these factors can be seen in Table VI which illustrates utilisation patterns of specialised services by day of the week in Melbourne and Albury-Wodonga. The time allocations represent the actual time spent in buildings rendering private or public services. These services encompass a wide range, including medical and para-medical services, legal and financial services and welfare services. In Albury-Wodonga the total weekly amount of time spent by all groups in these activities is roughly constant, but the activities are distributed differently over the week. Employed men spend roughly the same amount of time on these activities on weekdays as they do on weekends, whereas the two groups of women, and especially housewives, fit most such visits into weekdays. Their ability to do so may reflect the shorter average ('productive') working hours of working women, and the less regimented work schedule of housewives.

Employed men in Melbourne not only devote more time to these activities on weekends than on weekdays but also transfer many such tasks to their wives: working women - especially housewives - spend more time overall on such activities. Employed men in the large conurbation find it more difficult to fit these activities into weekday lunch breaks and immediately after work than in the smaller city: the bulk of such activity is however completed during weekdays by Melbourne women.

Assuming that access to specialised services is just as important to wage-earners as to non-wage earners, the problems experienced by employees in getting to these services are an important issue in terms both of hours of operation and of location.

United Kingdom data suggests that the incidence of activity linkage varies with the length of the time-window. Hillman *et al.* (1976) found that about one third of women who go out to work combine this work trip with shopping. However, women who work part-time are twice as likely to shop frequently as those employed full-time due mainly to the fact that shop opening hours overlap the work journeys of part-timers, thus enabling them to combine their work trip with shopping. Given this opportunity, such trip linkage is substantial (see Table VII). Commonly made trips - to shops and schools - were reported by many women as being combined with another trip purpose (including shops with schools).

The ability to combine trips on foot or by public transport is partly a function of land use, being easier where a number of facilities are in close proximity, or involve only a minimal diversion from the path of commonly made journeys. King's (1978c) analysis of microscale accessibility suggests that the housewife has few opportunities for combining shopping trips and school trips in Melbourne unless she is prepared for a lot of walking or else has use of a car. This is not the first evidence of the disregard shown for public transport users in the location of public facilities (e.g. Hodgson and Doyle 1978). While spatial agglomerations of activities all

benefit the car-user, multi-purpose trips can be made by car to different destinations due to the car's flexibility (unlike public transport) and speed (unlike walking). While the advantages of car travel in combining trips to different destinations are clearly evident, women (including those in paid employment) are less likely than men to have the optional use of the car (Hillman *et al.* 1976, Black 1978).

TABLE VI

AVERAGE TIME (IN HOURS) SPENT IN BUILDINGS OFFERING PRIVATE OR PUBLIC SERVICES, BY EMPLOYMENT AND DAY OF THE WEEK

	Wage-earning Men		Wage-earning Women		Non Wage-earning Women (Housewives)	
	week-day	week-end	week-day	week-end	week-day	week-end
Melbourne	0.43	0.65 1.08	0.87	0.40 1.27	0.93	0.41 1.34
Albury-Wodonga	0.60	0.56 1.16	0.67	0.45 1.12	0.99	0.22 1.21

Source: Australia: Cities Commission (1975) p 66.

TABLE VII

COMBINING TRIPS ON THE JOURNEY TO SHOPS, SCHOOL AND PRE-SCHOOL IN THE UNITED KINGDOM

	Town Centre	Usual Village shops	Shopping Urban Parade	Area Corner Shop	School	Pre-School
	%	%	%	%	%	%
Women sometimes combining trips	71	64	57	25	64	69
n (women)	144	72	110	24	86	74

Source: Hillman *et al.* (1976) p 96

Substitution effects

A further way of reducing the amount of travel is by using various methods of trip substitution. These include delegation of shopping to someone else, home deliveries, the use of a household freezer, or the use of the telephone. Hillman *et al.* (1976) found that roughly 25 per cent of women used each of the first three methods, the effect of which was to reduce the frequency of their trips. For instance 64 per cent of the women for whom someone else goes shopping make three or less trips per week, compared with 44 per cent who have no such help.

Use of telephone as a substitute for movement shows up clearly in Carlstein *et al's* (1969) detailed analysis of daily movements in thirteen case study households. Once again, Australian evidence suggests that this may be related to scale (see Table VIII). Some initial attention has been paid to the cross-substitution of telecommunications and transport by consultants to Telecom Australia (Encel *et al*. 1976).

TABLE VIII

OWNERSHIP AND USE OF TELEPHONES IN TWO AUSTRALIAN CITIES, 1974

	Melbourne	Albury-Wodonga
% of households with telephone	79	54
% of households phoning a:		
. relative once per day	22	9
. friend once per day	19	6
. relative at least once per week	67	44
. friend at least once per week	70	37

Source: Australia Cities Commission (1975)

STABILITY OF TIME ALLOCATION

The broad stability of time allocation to transport purposes has been picked up and used (e.g. by Zahavi, 1976) as a basis for transport analysis without a great deal of attention being paid to the competing activities, or indeed the appropriate groups with homogeneous characteristics for these purposes. Zahavi's analysis is the transport equivalent of the Lund model, and is as such an effective summary descriptive tool from the limited stance of transport demand. Langdon and Mitchell (1978) have drawn attention to the similarity between the cumulative time distributions for different travel purposes across different cities and populations, and in the same group the analyses of the stability of *total* trips made in a day over ten years showed that the numbers of trips made had remained stable in the city of Reading through major changes in the transport environment of the city, as long as walk trips were included in the total: the major difference being the shift from walking to cars over the decade concerned.

These latter findings strongly suggest that an activity and time budget approach to travel demand and time utilisation will, if reassured from a transportation viewpoint, lead to a coherent set of planning relationships between the activities for which we must plan, and the travel time and trip demands resulting from the limitations on the supply of time in the face of activity competition and the supply of travel imposed by the activities which travel is generated to serve.

Presently the different strands of analysis are essentially descriptive, and are heavily slanted towards the aims of the disciplines previously involved. It is suggested that time budget elasticity models with quality factors included in the spatial distribution of locations at which

activities take place would be an effective and useful device for improving the appraisal and understanding of planning issues in and connected with transport. It is worth noting that the time spent on telephone communication shows up quite clearly in the time budget data from many countries, and the potential and actual substitutability of telecommunications for transport would also be the better informed by investigations on these lines. The apparent stability of travel time budgets for certain groups across many countries and conditions raises fresh queries on the utility of travel time savings for assessment purposes, although these would not apply to freight movement activities.

CONCLUSIONS

The comparative homogeneity of the structure of time budgets across many countries, in spite of wide variations in technology, state of development, transport accessibility and social attitudes, is true not only for the travel time component alone (which has been discussed by Zahavi 1976), but also for other broad activies.

The segmentation of the adult population into employed male, employed female, and unemployed female shows marked differences in activity pattern and time budget allocations which in their turn show a degree of broad stability across countries.

The timing constraints in individual activities and the response to net time deficits, are essentially a function of the stage in the family life cycle - given a prior segmentation into the three population groups already distinguished by employment characteristics. The influence of social environment appears from international comparisons to be less than dominant, and the propensity to maintain time budgets at a broad level of comparability disguises wide variations in accessibility and quality of access to opportunities within each category as a result.

It would be of considerable practical interest to examine the activity structure and time budgets of - say - the isolated Pilbara population for comparison with the densely populated areas of the East typified by Albury-Wodonga and Melbourne: the role and function of transport and infrasturcture provision and use would be considerably illuminated thereby.

It should be realised that the stability of travel time budgets to which we refer is only an approximate finding: a detailed analysis of a range of French Cities (Godard 1978) shows that travel time budget variations of up to 20 per cent are to be found in practise, however, the activity and time budget approach to transport and communications demands and needs clearly holds the possibility of a major revision of our approach to transport analysis and appraisal.

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