

USE OF AN ACTIVITY DIARY SURVEY TO EXAMINE TRAVEL AND ACTIVITY
REPORTING IN A HOME INTERVIEW SURVEY

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ABSTRACT: *Research presented in this paper uses results from an activity diary survey to comment on the quality of data collected in a home interview travel survey. Evidence is presented to suggest that although a period of slightly more than three years separated the two surveys, the samples were reasonably similar with respect to their socio-demographic composition and real mobility levels. There was, however, a much higher level of travel and out-of-home activity reporting in the activity diary when compared to the home interview survey. Differences in reporting rates are examined in detail and areas of deficiency with the home interview survey are identified. The paper concludes with a short discussion of the possible implications of these deficiencies when home interview survey data is used to investigate a range of urban transport issues.*

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INTRODUCTION

In Australia the home interview travel survey has formed the most common means of collecting non-home activity information for use in transport planning and research. Since 1960 extensive home interview travel surveys have been conducted in conjunction with transport studies in every State capital city as well as in many provincial centres. Designers of these surveys have always placed much emphasis on the quantity of data collected in order to minimise sampling error. Less attention has been paid, however, to the quality of data collected.

Referring to the quality of data obtained in any survey, two principal sources of potential bias, other than sampling bias, can be identified (Wermuth 1983):

- non-response bias due to no contact or the refusal of some sampled individuals to supply information
- bias introduced by the deliberate or inadvertent supply of incorrect information by some sampled individuals.

It would appear that the potential for bias of the former type in Australian transport study home interview surveys (HISs) is low since response rates typically achieved are in the range 85-95 per cent (Dumble 1980). The degree of bias due to the supply of incorrect information is, however, more difficult to recognise and assess.

Of particular concern here, to the transport analyst, is that each person surveyed has supplied correct information on the extent and nature of travel undertaken. Normally, however, the sole sources of information available to assess travel reporting in a transport study HIS are results from screenline counts and 'on board' public transport surveys. These enable validation of HIS data to occur only at an aggregate level and for one or two modes.

An alternative method to detect travel misreporting in HIS travel data is to conduct a supplementary survey with emphasis on data quality rather than quantity and then compare results from the HIS with those from the supplementary survey. This paper describes application of such a method in an Australian context. The two surveys used in this exercise are the Metropolitan Adelaide Data Base Study (MADBS) HIS and the Adelaide Travel Demand and Time Allocation Study (ATDATAS) activity diary survey.

These surveys were conducted in March/April 1977 and October/November 1980, respectively. Ideally for the purposes of this exercise the two surveys should have been conducted at the same time. Considerable effort is therefore devoted to establishing that differences that arise between the two surveys can be attributed to misreporting of travel in the HIS. This is done in Section 3 of the paper by firstly establishing that the two survey samples are similar with respect to socio-economic and mobility characteristics and secondly that no major changes occurred in trip making within the spatial area of survey

coverage during the period March/April 1977 - October/November 1980. Section 4 contains results from analyses demonstrating differences in travel characteristics reported in the two surveys. The concentration of effort is on establishing substantial trip under-reporting in the home interview survey. These analyses are expanded in Section 5 to embrace non-travel activities. Preceding these Sections, Section 2 outlines ATDATAS. No description is provided of the 1977 MADBS HIS since it was fairly representative of this type of transport study survey and has been well documented elsewhere (Pak Poy and Associates 1978).

AN OUTLINE OF THE 1980 ADELAIDE ACTIVITY-TRAVEL DIARY SURVEY

The overall objective of ATDATAS was to collect a data set that would permit investigation of the travel decision making process. This translated into a number of specific aims. The primary mechanism for achieving the overall objective was to adopt the framework developed by human activity researchers in which travel is viewed explicitly as a derived demand. In practice this involved collecting complete activity-travel information from households for a weekly period. A secondary mechanism was to collect data on individual perceptions of the travel environment. Another important tangential aim of prime interest in the current paper was to collect data that would permit validation research to be conducted on the 1977 MADBS home interview survey and travel demand models.

These aims suggested a two part survey design. The first part consisted of selected households recording all that they did over the course of a week in activity diaries. In the middle of the recording period interviewers were instructed to contact households (normally by telephone) to discuss any problems that may have occurred. At the end of the period diaries were collected and the household interviewed for about 45 minutes concerning their socio-economic characteristics and perceptions of travel for certain activities.

The sample selection procedure was directed at satisfying the validation objective as well as assisting in closely examining changes in travel behaviour over time. It involved returning to dwellings within the eastern and north-eastern suburbs of Adelaide that in 1977 contained households that had participated in the MADBS HIS. This sampling method resulted in a substantial pool of households participating in both surveys, but also a minority of households, who had moved into these dwellings since 1977, only participating in the 1980 survey. On the debit side some bias was undoubtedly introduced into the 1980 survey as a result of this procedure because non-respondents from the 1977 survey were automatically excluded from the 1980 survey. It is likely, however, that this source of bias is of a minor nature (non-response in the 1977 survey for the study area was 13.5 per cent) and in any case will not affect the comparative analyses presented in this paper, only more general uses of the 1980 data set.

Socio-economic and perceptual information gathered in the 1980 survey is only sparingly used in this paper. Details of

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these questionnaire forms can be found in Barnard 1981. The bulk of analyses presented here use the activity diary records. An example activity diary is shown in Fig 1. The final format of the diary was the result of extensive pilot testing. The dimensions of the diary (200mm x 140mm) were chosen to encourage the respondent to carry it and record activities as they occurred. The address and sample number of the household was inscribed inside the front cover, as well as a means of identifying the respondent (normally christian name) and the interviewer's and project leader's names and telephone numbers. Also inside the front cover was the day the respondent was to commence recording his/her activities. This information was repeated on the first blank diary page (to be filled in by the respondent). Pages 2 and 3 contained some 'commonly asked questions' about the survey, complete with answers. These related to the aims of the survey, reasons why certain items of information were needed and confidentiality. For example, answers were supplied on why information on activities was wanted for an entire week, the usefulness of information on in-home activities and how to record activities 'I regard as private'. These questions were considered crucial in alleviating doubts some respondents may have had in supplying, possibly sensitive, information. Following these questions were three pages of instructions, an example diary, and immediately before the blank diary pages, a page containing nothing except, in bold black type, three reminder points; namely, to record all travel - even minor trips, to record each shop or building visited at non-home destinations, and to carefully read the example diary.

Blank diary pages were divided into two parts. The lower half was designed to facilitate personal documentation of the nature, time and (if non-travel) place of each activity episode. In addition information on the regularity of participation for each activity, expenditure on the activity and whether a child under 12 years old was present with the respondent was requested. The upper half was designed to allow the respondent to provide further information on each trip undertaken (i.e. travel activity). In content this trip information represented a subset of data items typically included in a conventional travel survey. For all trips, method of travel was to be recorded. Mode specific information requested included direct trip costs (fare for public transport and parking cost for car travel), access and egress walk times (for public transport and car), wait time and number of transfers (for public transport) and parking type and number of occupants (for car).

Response rates for the survey are shown in Table 1. The original sample consisted of 534 private dwellings. Households in 49 (9 per cent) of these dwellings could not be contacted. Another 68 (i.e. 14 per cent of 485) households refused to supply any information, except whether they were resident there in 1977. Of the remaining 417 households, 179 were fully participating while 238 supplied partial information.* These response rates seem to be fairly consistent with those found in

Footnote: The lower response rates associated with activity diary surveys when compared to home interview surveys can probably be primarily attributed to the more intrusive nature of the survey instrument and heavier reporting burden.

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IF YOU TRAVELLED TODAY

(Fill in for each trip)

TIME TRIP STARTED	TIME TRIP FINISHED	METHOD OF TRAVEL (Tick One)								TIME SPENT WALKING TO AND FROM CAR OR PUBLIC TRANSPORT (MINUTES)	IF PUBLIC TRANSPORT USED			IF CAR OR MOTORCYCLE USED				
		CAR DRIVER	CAR PASSENGER	CAR POOL	MOTORCYCLE	TAXI	TRAIN	BUS	BICYCLE		WALK	FARE (CENTS)	NUMBER OF TRANSFERS	WAITING TIME (MINUTES)	NUMBER OF PEOPLE (INCL DRIVER)	PARKING (Tick 1)		
															STREET PARKING	OFF STREET PARKING	HOME OFF STREET	
7.55	8.27							✓		8	40¢	-	2					
1.00	1.03							✓										
1.05	1.08							✓										
5.00	5.23	✓								4				2		✓		
5.35	5.40	✓								1				2			✓	
7.20	7.35	✓												2			✓	
9.45	10.02	✓												2			✓	

GENERAL ACTIVITIES

TODAY IS Thursday

TIME ACTIVITY STARTED	TIME ACTIVITY FINISHED	WHAT WERE YOU DOING	WAS A CHILD UNDER 12 WITH YOU AT THE TIME		HOW OFTEN DO YOU DO THIS (Tick One)				IF DAILY OR WEEKLY ACTIVITY Do you usually do this at about this time? (Tick One)			WHERE WERE YOU?	MONEY SPENT ON ACTIVITY	
			YES	NO	ABOUT DAILY	ABOUT WEEKLY	IRREGULARLY	NONE OF THESE	YES	NO	Ver		B	C
Midnight	6.45	sleeping	✓	✓					✓			home		
6.45	7.05	breakfast	✓	✓					✓			"		
7.05	7.35	housework	✓	✓					✓			"		
7.35	7.55	dressing	✓	✓					✓			"		
7.55	8.27	bus to work	✓	✓					✓					
8.27	1.00	Worked	✓	✓					✓			University of Adelaide North Terrace		
1.00	1.03	walked to deli	✓			✓						Snack Bar Rundle Mall near Rundle St.	1	56
1.03	1.05	bought lunch	✓			✓								
1.05	1.08	back to office	✓			✓								
1.08	1.50	lunch	✓	✓					✓			workplace		
1.50	5.00	Worked	✓	✓					✓			"		
5.00	5.23	travelled to shops	✓			✓								
5.23	5.35	grocery + chemist shopping	✓			✓						Colles + Village Pharmacy Burnside Shopping Centre	6	20
5.35	5.40	travelled home	✓											
5.40	6.10	prepared meal	✓	✓					✓					
6.10	7.05	dinner	✓	✓					✓					
7.05	7.20	cleaned up	✓	✓					✓					
7.20	7.35	travelled to friends	✓			✓								
7.35	9.45	socialising	✓	✓						✓		Finniss St, North Adelaide		
9.45	10.02	travelled home	✓	✓					✓					
10.02	12.00	bed	✓	✓					✓					

Fig 1 - Example diary page

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TABLE 1

HOUSEHOLD CATEGORISED RESPONSES TO 1980
ADELAIDE ACTIVITY DIARY SURVEY

Response Category	Number of Households
Fully participating households	179
Households with partial returns	238
Total refusals	68
No contact	49
Total	534

the Oxford surveys on activity patterns. Sixty three per cent of contacted households had participated in the MADBS HIS, with the remaining 32 per cent moving in since 1977. Finally it should be noted that although only a relatively small number of households supplied information, because so much data was collected from each person, even after the application of certain restrictions (see below), the total number of person/days available for analysis amounted to 2,461 and the number of trips to 13,847.

COMPARABILITY OF THE TWO SURVEY SAMPLES

When comparing the activity diary survey with the MADBS HIS detailed attention was paid to minimising survey differences except those inherent in the methodological approaches used. Employer's business and work-work trips were excluded from the data sets pertaining to both surveys. In addition, for analysis purposes, certain other types of trips were excluded from the 1980 data, notably, trips for 'incidental' purposes (e.g. purchasing petrol) and 'walking for pleasure' trips. Further, the spatial coverage of the 1980 activity diary survey and that subset of MADBS HIS observations (totalling 1852 person/days information) used in the subsequent analyses is identical.

The temporal incidence of the two surveys was, however, unavoidably different. A period of slightly more than three years separated the two surveys and they were conducted at different times of the year. Also the response rate to the activity diary survey was comparatively low leading to the possibility that socio-economic and real mobility differences existed in the two survey samples. The objective of this section is to provide evidence that the survey samples are essentially similar with respect to their mix of socio-economic characteristics and the true mobility levels of respondents. This is done by, firstly, simply examining the socio-demographic representativeness of the 1980 sample using the 1977 sample as a base and, secondly, using independent comparable aggregate statistics on travel within the Adelaide region to demonstrate that no major changes occurred in trip making during the period March/April 1977 - October/November 1980.

Representativeness Checks

Basically representativeness checks of the 1980 data in relation to the 1977 sample fell into two categories. The first category comprised checks examining the socio-demographic representativeness of the final 1980 sample. In the second category were checks designed to detect mobility differences (as measured in 1977 survey) between those responding to the 1980 survey and those not responding.

An important initial test involved examining the possibility that 1977 survey participants were more likely to participate in the 1980 survey, resulting in the later survey being biased towards 'stayers' and away from 'movers'. This possibility is predicated on the presumption that there exists an 'anti-survey' element in the population, but those people who agree to one travel survey will not generally object to providing more information if required. A different line of reasoning would suggest that people, once they have participated in one survey, consider they have 'done their bit' for society and are therefore less likely to participate in further surveys, especially if on the same subject matter. Evidence from Table 2 does not support either hypothesis, with about equal proportions of movers and stayers amongst both refusals and participants in the 1980 survey. In all likelihood this result reflects the very different nature of the 1977 and 1980 surveys, causing those who supplied data in 1977 to review their participation. It is an important result in that movers and stayers probably have different travel characteristics and if bias was discovered, adjustments may need to be made.

TABLE 2

CROSSTABULATION OF RESIDENCE STATUS WITH 1980 ADELAIDE
ACTIVITY DIARY SURVEY PARTICIPATION STATUS

Residence Status	Participation Status		
	Full	Partial	Refusals
Stayers (i.e. 1977 survey participants)	112 (63%)	145 (62%)	35 (66%)
Movers-In (i.e. 1977 survey non-participants)	65 (37%)	89 (38%)	18 (34%)

- Notes: 1. Bracketed figures represent column percentages
2. Discrepancies in the number of households in each participation category between Tables 2 and 3 are due to uncertain 1977 survey participation status.

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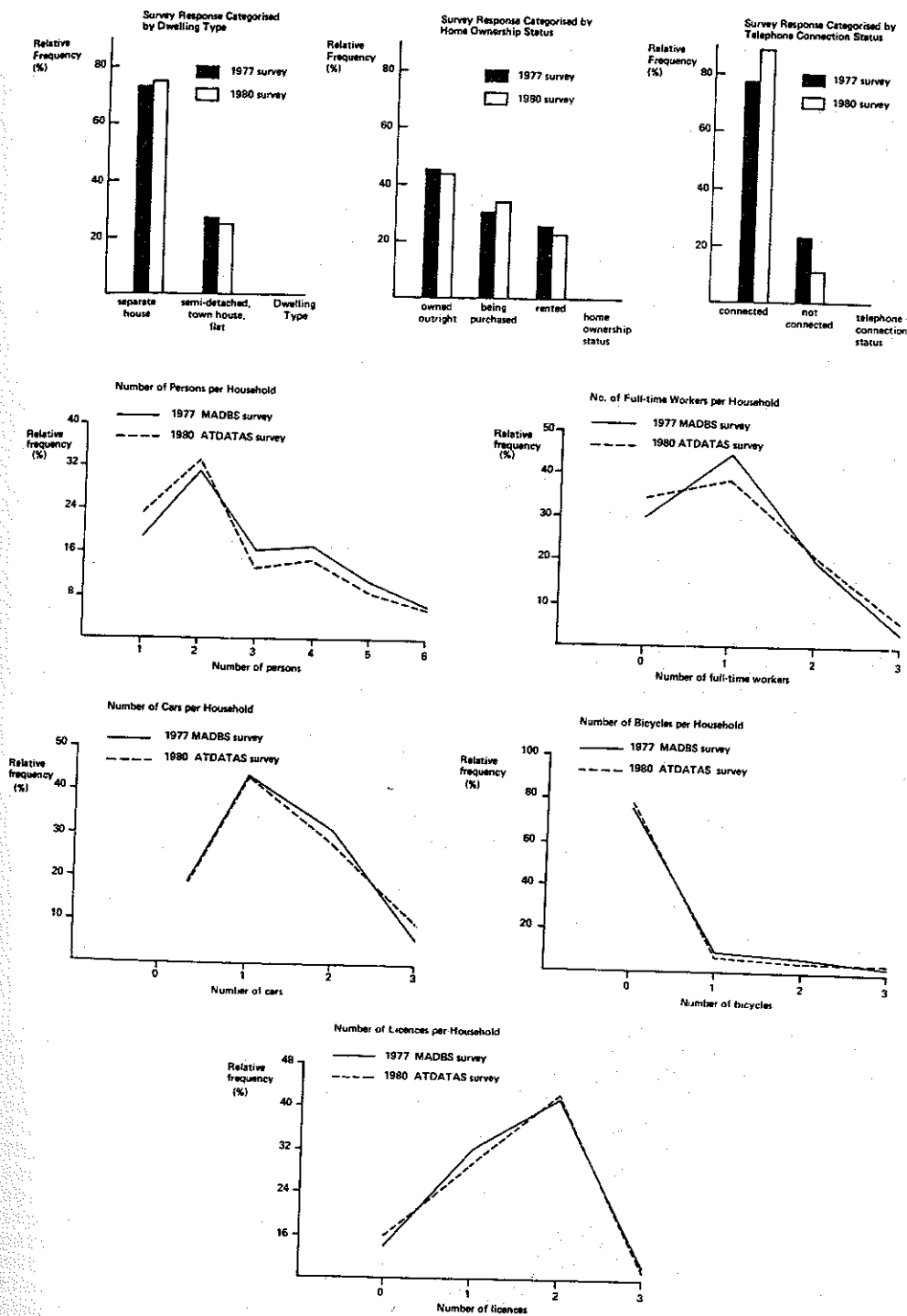


Fig 2 — Analysis of survey response by household characteristics

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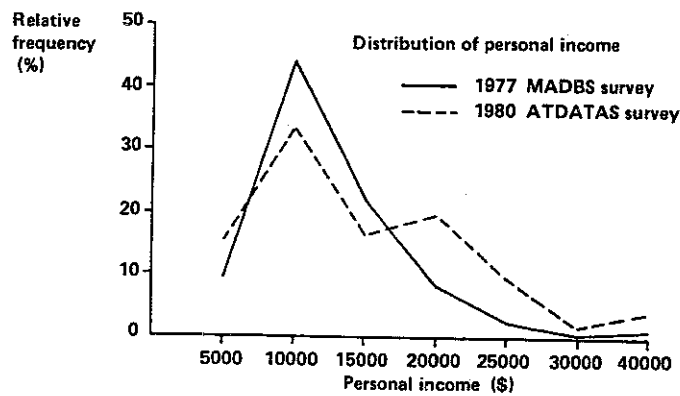
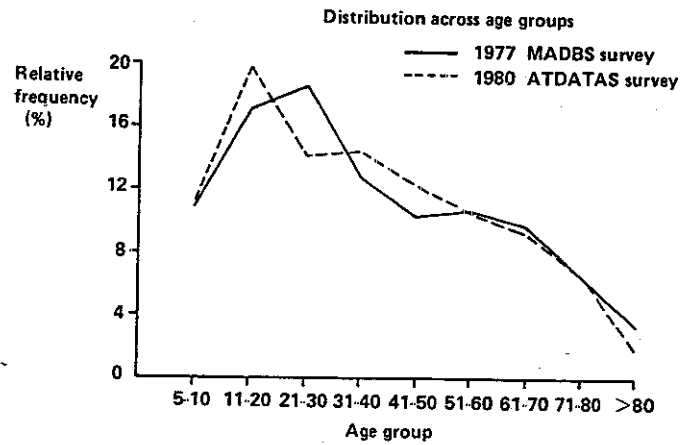
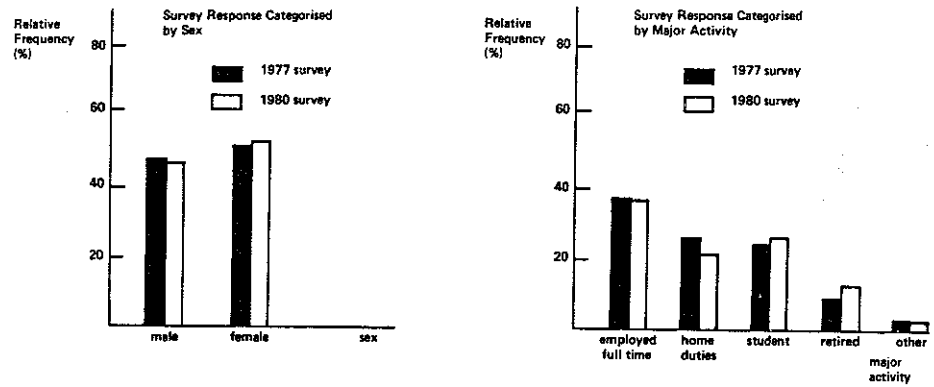


Fig 3 — Analysis of survey response by person characteristics

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Other checks of a socio-demographic nature are to be found in Figs 2 and 3. These figures show differences between ATDATAS survey respondents and a spatially equivalent set of MADBS HIS respondents with respect to household and personal characteristics. It is apparent from these figures that only minor differences exist in the socio-demographic mix of the two samples. It is unlikely that the socio-demographic differences exhibited would contribute significantly to a change in trip making.

Some direct evidence in substantiation of this last statement can be produced by using that pool of respondents, contacted in 1980, who had participated in the 1977 MADBS HIS. Mobility information was available for these people whether or not they assented to participate in the 1980 survey. This information, from the 1977 MADBS HIS, is set out in Table 3. The comparison of most interest is between persons supplying full or partial diary information and those declining to supply diary information. No real mobility differences emerged between these two groups. Note, however, that those unable to fill out diaries in 1980 (primarily for reasons of poor health or illiteracy) had very low mobility levels.

TABLE 3

AVERAGE NUMBER OF TRIPS REPORTED IN 1977 BY PERSONS
CONTACTED IN 1980 WHEN CATEGORISED BY ACTIVITY

Diary Participation Status	Mean 1977 Number Trips/Person
Persons supplying full or partial diary information	3.45
Persons declining to supply diary information	3.40
Persons unable to supply diary information	1.75

In an attempt to compensate for the finding that those unable to fill in diaries had very low mobility levels and in order to obtain truer estimates of trip under-reporting in transportation study home interview surveys, in the following analyses those with a stated inability to supply self-reported diary information in 1980 were excluded from the 1977 data set. This, of course, could only be done for participants in the 1977 survey who were contacted in 1980, thus establishing their ability/inability to supply diary information. Obviously it was impossible to establish this characteristic for 1977 survey participants who had either moved from the dwelling or who were not contacted in 1980. Some upwards bias due to this source may therefore remain in the under-reporting estimates derived from comparing the two surveys. It is estimated, however, that this

represents a very minor source of bias in the under-reporting estimates.

Travel in Adelaide March/April 1977 - October/November 1980

To demonstrate that true mobility levels remained approximately constant for the period March/April 1977 - October/November 1980, firstly, seasonal variations in travel in Adelaide are examined and then aggregate travel statistics analysed for the years 1977-1980.

In order to provide adjustment factors for use in estimating annual average daily traffic (AADTs) the S.A. Highways Department has maintained a regular program of traffic counting in the Adelaide Metropolitan Area. These adjustment factors are used in converting counts taken on particular days and particular months to AADTs. They therefore represent daily and monthly indices of the amount of car travel. Average weekday monthly adjustment factors for the Adelaide Metropolitan Inner area (which encompasses the eastern and north eastern suburbs) are displayed in Table 4. A low adjustment factor implies above average car travel in that month and vice versa. As seen from Table 4, with the exception of December (above average car travel) and January (below average car travel), monthly variations are slight. Importantly the amount of car travel in March/April is almost identical to that in October/November. In fact the months of October/November were chosen to conduct the activity diary survey for this reason (with most sampling occurring in October). No data on monthly variations could be obtained for public transport travel.

TABLE 4

A.A.D.T. MONTHLY ADJUSTMENT FACTORS INNER METROPOLITAN AREA, 1981

Month	Weekday Adjustment Factor	Month	Weekday Adjustment Factor
January	0.989	July	0.975
February	0.943	August	0.958
March	0.934	September	0.935
April	0.933	October	0.934
May	0.954	November	0.916
June	0.971	December	0.879

Information on the variation in vehicular trips in the period 1977-1980 is derived from two sources. One represents summary statistics gleaned from the annual ABS survey on motor vehicle usage. During the period 1976-1980 two of these surveys were conducted, corresponding to the years 1976 and 1979 (ABS

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1979, 1981). Results from these surveys are only available in very aggregated form. Spatial specificity is limited to Adelaide statistical division* and within this region no distinction is made between commercial and private vehicular travel. These restrictions, notwithstanding, it appears from ABS results that vehicular distance travelled in Adelaide changed very little between 1976 and 1979. In 1976 5,967.1 million vehicular km. were travelled within the Adelaide region compared to 6,207.7 million vehicular km. in 1979. If the implied average growth factor of fractionally less than one per cent p.a. is applied between the years 1977-1980 then the increase in vehicular kilometers travelled in Adelaide during this period is calculated to be approximately four per cent.

Substantiating information on the growth in vehicular traffic between 1977-1980 can be found in (unpublished) traffic count data gathered by the South Australian Highways Department. Traffic count data relevant to the eastern and north-eastern suburbs of Adelaide are displayed in Table 5. Figures in this table represent estimated annual average daily traffic (AADT) along principle roads in the study area. Where multiple counts were taken along a road these have been averaged; however, count data at any point was only included if counts at that same point had been taken for each of the three years. The conclusion to be drawn from this data is essentially the same as that from the ABS data; namely that vehicular traffic in Adelaide between 1977 and 1980 increased by about four - five per cent.

TABLE 5

ESTIMATED ANNUAL AVERAGE DAILY TRAFFIC FLOW ALONG
PRINCIPAL ROADS - EASTERN SUBURBS, ADELAIDE

Year	Estimated Total Annual Average Daily Traffic Flow along Principal Road; Eastern Suburbs Adelaide	Biennial Percent Increase
1976	232, 353	
1978	236, 625	1.81
1980	242, 305	2.41

Note: Details of roads included and counts for each road are included in Barnard (1984a).

Footnote: In 1976 the area of survey coverage was somewhat larger than the Adelaide statistical division, extending in the north to Hamley Bridge, Kapunda and Truro, in the south to the shores of Lake Alexandrina and also including Kangaroo Island. Advice from ABS officers indicated that, because of the dominance of the Adelaide metropolitan area, the variation in spatial coverage would not greatly affect estimates of vehicle distance travelled.

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Information on changes in public transport trip making between 1977 and 1980 is unfortunately more scant. Apparently no systematic checks of bus loads were conducted in Adelaide prior to 1980 (from private correspondence with the State Transport Authority of South Australia). Information, however, is available at an aggregate level on public transport usage (bus, tram, train) for all of Adelaide from S.T.A. Annual Reports. Relevant information is repeated in Table 6. Once again these figures indicate about a four per cent increase in travel between 1977 and 1980.

A final set of pertinent information relates to population changes in Adelaide during the period under study. This information for all of Adelaide and for LGAs lying within the 1980 survey area is contained in Table 7. Note that for the

TABLE 6

ESTIMATED PASSENGER JOURNEYS BY PUBLIC TRANSPORT
WITHIN THE ADELAIDE METROPOLITAN AREA

Year	Estimated Number of Passenger Journeys	Per cent Change from Previous Year
1976/77	70,359,000	-
1977/78	69,304,000	-1.5%
1978/79	70,526,000	1.8%
1979/80	73,210,000	3.8%

TABLE 7

ABS ESTIMATED POPULATION FOR THE ADELAIDE STATISTICAL DIVISION
VARIOUS LGAs 1976-1981

Area Designation	Year				Per Cent Change 1977-1980
	1976 (Census)	1977 (Estimate)	1980 (Estimate)	1981 (Census)	
Statistical Division					
Adelaide	900,432	906,637	925,509	931,886	2.1
Study Area LGAs					
Burnside	38,461	38,286	37,765	37,593	-1.4
Campbelltown	41,252	41,612	42,711	43,084	2.6
Kensington & Norwood	9,651	9,507	9,086	8,950	-4.4
Payneham	17,545	17,331	16,706	16,502	-3.6
St Peters	9,304	9,128	8,621	8,458	-5.6
Walkerville	7,207	7,132	6,912	6,840	-3.1
LGAs Adjacent to Study Area					
East Torrens	4,687	4,777	5,055	5,152	5.8
Stirling	10,753	11,202	12,664	13,193	13.1
Tea Tree Gully	55,318	57,605	65,048	67,737	12.9

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Adelaide statistical division the population between 1977 and 1980 increased by 2.1 per cent; however, for the six LGAs comprising the 1980 study area the population decreased by slightly less than 1.0 per cent. A further observation is that for three LGAs (Tea Tree Gully, East Torrens and Stirling) that lie immediately outside the study area, but which necessitate travel through the study area to access the city centre and major retail developments, population increased by 12.5 per cent.

The population data, when taken in conjunction with the aggregate travel information, indicate that trip making per person only increased on average by two-three per cent between 1977-1980. It can thus be concluded that for any increase in aggregate trip making found between the 1977 and 1980 surveys, only a small amount can be properly attributed to actual changes in individual travel behaviour. The strong implication is that remaining differences between aggregate 1977 and 1980 survey results can be inputted to characteristics associated with the distinctive types of survey methodology used in 1977 and 1980. These arguments, of course, do not deny that significant changes in travel behaviour could have occurred at a micro level (e.g. within some socio-economics classes) between the two surveys. Given the very small aggregate changes that occurred, however, even this seems unlikely.

TRAVEL COMPARISONS BETWEEN THE ACTIVITY DIARY AND HOME INTERVIEW SURVEYS

The above evidence demonstrating a discernable but slight increase in trip making within the spatial area of survey coverage during the period 1977-1980, contrasts sharply with the large differences which emerged from comparisons between the two surveys. These comparisons, in general, showed trip rates to be much higher in the 1980 activity diary survey than in the 1977 HIS.

In view of evidence that only a very small proportion of these differences can be attributed to actual changes in trip making behaviour, two possibilities remain; either that respondents in the HIS (inadvertently or deliberately) understated their true level of trip making or that in the activity diary survey respondents overstated their true level of travel. The latter of these possibilities seems remote, since recording trips in activity diaries requires a degree of effort which exceeds that associated with reporting trips in an HIS. Also there is no reason to believe that the benefits (e.g. in improved transport facilities) perceived by respondents to be concomitant with (over) reporting trips should be any different under the two survey approaches.

Much more probable is that respondents inadvertently under-reported trips in the 1977 HIS. This argument is strengthened by known weaknesses with HISs as currently applied in data gathering exercises for transport studies. These relate to the use of 'proxies' in gathering travel information for household members not present at the interviewing time and the lack of a convenient frame of reference to facilitate respondents' recall of trips. 'Proxies' in this context refer to

household members who supply travel information about the true respondent when the latter is not present. An example of a more suitable frame of reference is a chronological ordering of the respondent's activities for the day on which travel information is sought. It is apparently very difficult for respondents to recall travel in isolation from other activities (Jones et al. 1980). This difficulty in recall is exacerbated in conventional applications of HISS by the respondent's complete lack of awareness at the time that travel is undertaken of the need to store this information for later recall.

For ease of presentation, in the analyses that follow, differences that do arise between surveys are attributed to trip under-reporting in the 1977 MADBS HIS. Although this may not be entirely valid, in view of the relatively short time span between the two surveys, evidence that the level of trip-making in this period does not appear to have greatly altered, and the widely recognised superiority of activity surveys in capturing trips, this is probably a reasonable approximation.

Overall, the weekday trip rate for persons older than 12 years in the 1980 activity diary survey was 37 per cent higher than in the 1977 home interview survey (i.e. 4.06 trips/person/weekday in 1980 compared to 2.97 trips/weekday in 1977). The modal pattern of trip rate differences between the two surveys is revealed in Table 8. A major modal source of the trip rate increase between the 1977 and 1980 surveys was almost a trebling in the number of walk trips reported. Bicycle trips showed the next largest increase (up 58 per cent), followed by car driver trips (up 28 per cent) and car passenger trips (up 24 per cent). On the other hand, reported public transport trips remained approximately constant in the two surveys.

More precise information concerning the modal pattern of trip reporting can be extracted by splitting trip rates into two components; the average proportion of the sampled population travelling using a particular mode on any day (termed 'share of mobiles') and the average number of trips undertaken using that mode by those mobile persons (termed 'mobility per mobile'). This is done in the right hand columns of Table 8. It is evident from these statistics that car driver trip under-reporting can be attributed more to differences in 'mobility per mobile' than 'share of mobiles', whereas the opposite is true for car passenger, bicycle and walk trips. These findings are intuitively reasonable. They imply that for car driver trips, under-reporting is primarily caused by respondents forgetting that some trips were made, but remembering and reporting that they travelled by car. Conversely, under-reporting for car passenger trips and for walk and bicycle trips, in particular, can be traced to some interviewed persons completely omitting to divulge any information on travel by these modes. A probable explanation is that some interviewers or some respondents or both, perceived this type of information to be relatively unimportant. The picture conveyed by these statistics is, then, that in transportation study home interview surveys a concerted attempt is made to correctly report/recall car driver and public transport trips, and in the latter case, with success. It would equally appear, however, that often little attempt is made to supply/gather information on travel by the minor modes.

TABLE 8

WEEKDAY RATE COMPARISONS BY MODE*

Mode	Trips/Person/Day			Share of Mobiles			Mobility per Mobile		
	(a) MADBS HIS	(b) Activity Diaries	a/b %	(a) MADBS HIS	(b) Activity Diaries	a/b %	(a) MADBS HIS	(b) Activity Diaries	a/b %
Car driver	1.79 (0.06)	2.30 (0.06)	78%†	0.48 (0.01)	0.51 (0.01)	94%	3.73 (0.08)	4.56 (0.07)	82%†
Car passenger	0.49 (0.03)	0.61 (0.03)	79%†	0.22 (0.01)	0.26 (0.01)	85%†	2.29 (0.07)	2.31 (0.05)	99%
Public transport**	0.27 (0.02)	0.28 (0.02)	96%	0.15 (0.01)	0.15 (0.01)	100%	1.75 (0.03)	1.83 (0.04)	96%
Bicycle	0.12 (0.01)	0.19 (0.01)	63%†	0.05 (0.01)	0.08 (0.01)	63%†	2.53 (0.11)	2.35 (0.06)	108%
Walk	0.23 (0.02)	0.59 (0.02)	39%†	0.11 (0.01)	0.26 (0.01)	42%†	1.99 (0.06)	2.23 (0.04)	89%†
Other	0.07 (0.01)	0.07 (0.01)	100%	0.02 (0.00)	0.03 (0.00)	67%	3.42 (0.33)	2.98 (0.28)	115%

NOTES: * Bracketed figures represent standard errors

** Almost entirely bus trips since the Eastern and North Eastern suburbs of Adelaide are not presently serviced by tram or train.

† Differences between surveys significant at five per cent level.

TABLE 9

WEEKDAY TRIP TIME AND DISTANCE COMPARISONS BY MODE*

Mode	Travel Time/Trip (mins)			Travel Distance/Trip (k/ms)		
	(a) MADBS HIS	(b) Activity Diaries	a/b%	(a) MADBS HIS	(b) Activity Diaries	a/b%
Car driver	16.58 (0.20)	13.51 (0.13)	123+	6.34 (0.10)	5.66 (0.07)	112+
Car passenger	16.39 (0.38)	14.23 (0.25)	115+	6.78 (0.20)	5.86 (0.14)	116+
Public transport	32.31 (0.55)	31.94 (0.47)	101	6.71 (0.16)	7.14 (0.13)	94+
Bicycle	15.34 (0.64)	13.15 (0.41)	117+	3.31 (0.17)	2.72 (0.10)	122+
Walk	12.85 (0.44)	10.23 (0.25)	126+	1.59 (0.07)	1.30 (0.02)	122+
Other	14.49 (0.65)	17.49 (0.76)	83+	6.24 (0.33)	7.63 (0.34)	82+

* Bracketed figures represent standard errors.

+ Differences between surveys significant at five per cent level.

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Further information on the modal pattern of trip reporting is contained in the average trip time and trip distance information for each mode shown in Table 9. Trip times have been calculated from reported information and distances from coded networks. Both trip time and trip distance comparisons convey a similar picture; that is, the pattern of trip reporting in the 1977 HIS favoured long trips, rather than short trips, when compared to the 1980 activity diary survey. This confirms observations often made in transport study documents that it is short trips that go mostly under-reported in HISs (e.g. Wilbur Smith and Associates 1969, p. 44). Note especially, by reference to Fig 4, that the number of long trips per person captured in both surveys was about the same, but the activity diary survey captured more medium and short distance trips. As a result, reported total distance travelled per person per day increased from 17.2 km in the 1977 survey to 20.0 km in the 1980 survey. Because, however, the percentage increase in total distance travelled (16 per cent) is not as great as the percentage increase in number of trips reported, distance/trip declined from 6.0 km in the HIS to 5.0 km in the activity diary survey. Moreover, with the exception of public transport and unclassified modal trips, the percentage decline between the two surveys in distance and time per trip was remarkably constant across modes.

When trips are classified by purpose, as is done in Table 10, interesting variations in reporting again emerge. The level of home based work/school trip reporting is about the same in both surveys. Also 'home based other' trips, in total, show a comparatively good correspondence between the two surveys, with only about a 20 per cent discrepancy. The reason for this, however, is due to the weight attached to shop/personal business trips in this category, which have been apparently well reported in the 1977 HIS. Evidently less well reported in the HIS were home based social/recreational trips and, even worse, home based serve passenger trips. Large variations in trip reporting between the two surveys also existed for purposes within the 'non-home based' category. These differences suggest that the practice of applying single adjustment factors to correct for 'home based other' and non-home based trip under-reporting in HISs may be inappropriate.

Of the three main trip purpose categories, home based work/school, home based other and non-home based, the last of these exhibits the largest discrepancies in trip reporting between the home interview and activity diary surveys. Specifically, almost three times more trips in this category were reported in the activity diary survey than in the HIS. It can be seen from Fig 5 in conjunction with Table 10 that many of these extra trips were lunchtime trips, especially walk trips, made to and from work or education. Even social/recreational trips, however, which are unlikely to be made during lunchtime, show a large reporting discrepancy between the surveys and unlike other non-home based trip purposes are not generally shorter in length for the activity diary survey.

With respect to trip time and trip distances for other purposes, the general trend of shorter trips being reported in the activity diary survey is again evident. This is especially true for non-home based shopping/personal business trips and home based social/recreational trips.

TABLE 10

WEEKDAY TRIP RATE, TIME AND DISTANCE COMPARISONS BY TRIP PURPOSE (ALL MODES)*

Trip Purpose Category	Trips/Person/Day			Travel Time/Trip (mins)			Travel Distance/Trip (k/ms)		
	(a) MADBS HIS	(b) Activity Diaries	a/b %	MADBS HIS	Activity Diaries	a/b %	MADBS HIS	Activity Diaries	a/b %
Home based:									
work/school	1.03 (0.03)	1.04 (0.02)	99	23.32 (0.31)	19.00 (0.25)	123+	7.80 (0.13)	6.85 (0.11)	114+
shop/personal business	0.81 (0.04)	0.86 (0.02)	94	14.93 (0.33)	11.12 (0.22)	134+	4.17 (0.11)	3.68 (0.08)	113+
social/recreational	0.51 (0.03)	0.74 (0.02)	69+	17.83 (0.46)	14.08 (0.26)	127+	6.82 (0.20)	5.79 (0.13)	118+
serve passenger	0.23 (0.02)	0.41 (0.02)	56+	12.94 (0.55)	8.51 (0.19)	152+	4.41 (0.20)	3.96 (0.10)	111+
Non-Home based:									
work/school	0.04 (0.00)	0.24 (0.01)	17+	13.80 (1.39)	10.91 (0.42)	126+	4.39 (0.54)	4.22 (0.21)	104
shop/personal business	0.21 (0.00)	0.40 (0.02)	53+	13.25 (0.50)	9.40 (0.26)	141+	4.52 (0.23)	3.44 (0.11)	131+
social/recreational	0.12 (0.00)	0.25 (0.01)	48+	14.52 (0.70)	13.73 (0.48)	106	4.65 (0.29)	4.91 (0.14)	95
serve passenger	0.02 (0.00)	0.12 (0.01)	17+	15.57 (1.42)	10.03 (0.45)	155+	5.55 (0.64)	5.13 (0.26)	108

* Bracketed figures represent standard errors.

+ Differences between surveys significant at five per cent level.

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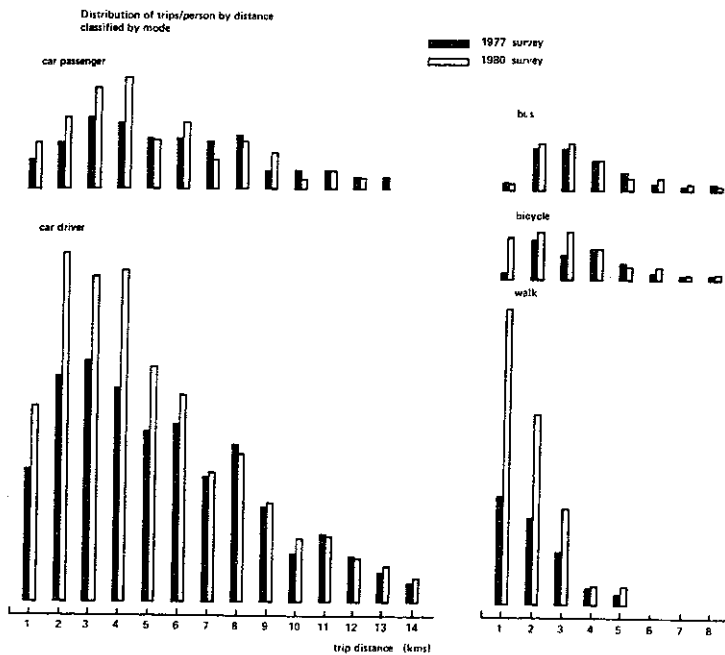


Fig 4 - Distribution of trips/person by distance classified by mode.

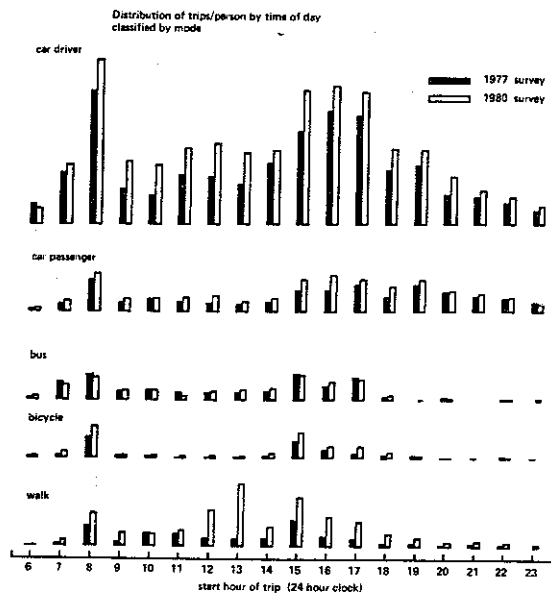


Fig 5 - Distribution of trips/person by time of day classified by mode.

There is also evidence in Table 10 that type of survey instrument affects not only the reporting of the incidence of travel, but also for any given trip, the reporting of characteristics for that trip. This evidence comes from comparing ratios of average travel times and distances for the two surveys (columns 6 and 9 in Table 10). As explained earlier, travel times represent reported information whereas distances were 'objectively' derived from coded networks. In both surveys travel times were calculated by taking difference between reported trip start time and reported trip finish time. Comparisons of columns 6 and 9 in Table 10 reveal that the ratios of travel times (i.e. average trip time MADBS HIS/average trip time activity diary survey) are consistently greater than the corresponding ratios for travel distances. This implies that for a trip of given distance, reported travel times are on average less in the activity diary survey than in the HIS. That is, when respondents are required to fill in their entire day's activities they tend to compress the time they report for travel, or conversely, when only required to supply details of travel activities, tend to expand this time (an intuitively plausible result). The conclusion is that reported travel times are to an extent dependent on the type of survey instrument used.

Table 11 compares trip reporting by four main socio-economic descriptors; sex, age, major activity and life cycle stage. Evidence from this table indicates that the differences in trip reporting between the two surveys may be systematically related to certain socio-economic characteristics. Age in particular appears to exert a strong influence on trip reporting. For the young (exemplified by school students and age category 12-20 years) there is a good correspondence between trip reporting in the home interview and activity diary surveys. Conversely the elderly (retired, age greater than 60 years) reported many more trips in the activity diary survey than in the HIS. The apparent high level of trip under-reporting for this group in the HIS may be due, in part to their modal mix of travel, favouring walk, which trips, as noted previously, are not well reported in HISs. An implication is that the elderly may be much more mobile than was ever supposed from analyses of HIS data. Similar considerations apply to housewives. Differences in trip reporting between men and women in general, however, appear to be slight.

Further statistical investigation of socio-economic variations in trip reporting was carried out using chi-square tests. These tests involved comparing for each socio-economic category the observed number of trips from the activity diary survey with the number of trips that would have been expected from applying the 1977 trip rate for that socio-economic group and a constant adjustment factor of 1.37 (ie. $4.06/2.97$). This construction reflects an hypothesis that although an overall reporting difference existed between the surveys this was invariant across socio-economic groups. For three of the four socio-economic characteristics considered in Table 11 the hypothesis was rejected at the one per cent statistical significance level. The hypothesis that reporting differences were invariant between males and females could not be rejected at even low levels of statistical significance.

TABLE 11

TRIP REPORTING ANALYSIS BY SOCIO-ECONOMIC CHARACTERISTICS

Socio-Economic Descriptor	Trips/Person/Day			Socio-Economic Descriptor	Trips/Person/Day		
	(a) MADBS HIS	(b) Activity Diaries	a/b ^a		(a) MADBS HIS	(b) Activity Diaries	a/b ^a
Age Group (Years):				Life Cycle Group:			
12 < age < 20	3.20 (0.11)	3.79 (0.19)	80+	Married heads:			
20 < age < 30	3.53 (0.12)	4.41 (0.16)	80+	married, no children, husbands <34 years	3.58 (0.27)	5.21 (0.59)	69+
30 < age < 40	3.74 (0.16)	5.03 (0.22)	74+	married, no children, husbands 34-59 years	3.03 (0.38)	3.79 (0.41)	80
40 < age < 50	3.31 (0.19)	4.14 (0.21)	80+	married, no children, husbands ≥60 years	1.64 (0.20)	3.21 (0.31)	51+
50 < age < 60	2.46 (0.14)	3.88 (0.21)	63+	married, youngest child <5 years	3.37 (0.20)	4.54 (0.42)	74+
60 < age < 70	1.90 (0.11)	3.06 (0.21)	62+	married, youngest child 5-15 years	3.35 (0.22)	4.05 (0.17)	83+
age > 70	1.50 (0.12)	2.34 (0.22)	64+	married, youngest child ≥16 years	2.69 (0.25)	3.15 (0.38)	85
Major Activity:				Spouses:			
Employed fulltime/ tertiary student	3.31 (0.07)	4.25 (0.10)	78+	married, no children, husbands <34 years	3.45 (0.30)	4.31 (0.30)	80
Home duties	2.88 (0.13)	4.34 (0.20)	66+	married, no children, husbands 34-59 years	2.92 (0.52)	3.45 (0.31)	85
School student	2.81 (0.11)	3.30 (0.16)	85+	married, no children, husbands ≥60 years	1.43 (0.19)	2.96 (0.30)	48+
Retired	1.85 (0.14)	2.94 (0.22)	63+	married, youngest child <5 years	4.45 (0.37)	5.27 (0.52)	84
Sex:				married, youngest child 5-15 years	4.04 (0.33)	4.86 (0.29)	83+
Male	2.93 (0.07)	3.95 (0.11)	74+	married, youngest child ≥16 years	2.35 (0.29)	3.35 (0.49)	70
Female	2.99 (0.08)	4.09 (0.12)	73+				

* Bracketed figures represent standard errors
 Difference between surveys significant at five per cent level

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ACTIVITY REPORTING COMPARISONS

The complement to analysis of travel is analysis of the other activities which actuate travel; for, as has been so often emphasised, travel is rarely desired of itself but regarded as a necessary evil in order to optimally participate in non-travel activities. This recognition has motivated research into activity time budgets, including temporal and spatial patterns of time commitment for non-travel activities. A major source of data for this research has been transport study HISSs, using activity data collected as trip 'purpose to' and 'purpose from' information. It is therefore instructive to examine not only trip reporting in the activity diary and home interview surveys, but also reporting of other activities.

Analogous concepts to share of mobiles and mobility per mobile can be used to analyse activity participation. These concepts, redefined as participation frequency and activity rate (terms favoured by Wigan in his work - e.g. Wigan (1983)), now refer to the proportion of persons participating in a particular activity on any day and the number of times participants in an activity engage in the activity during the day. Results from application of these concepts to data gathered in the home interview and activity diary surveys are displayed in Table 12. In deriving these results for the activity diary survey only the primary activity undertaken at each trip destination was used. It is evident from the first two columns of Table 12 that the major differences that arise in activity reporting in the two surveys are more due to the home interview survey respondents not supplying any information on some activities rather than neglect to supply supplementary information on further participation in the same activity. Not surprisingly the exception to this generalisation is the travel activity - the subject of survey study. For this activity participation rates derived from the two surveys are in high agreement, but as previously noted HIS travellers are apparently neglecting to supply information on all trips undertaken.

Also included in Table 12 is summary time budget information for each activity obtained from the two surveys, further details of which are shown in Fig 6. This figure depicts survey differences in the pattern of time commitment for each activity across the day. Generally the picture to emerge mirrors that obtained from the travel analyses of Section 4. There is a close correspondence between the two surveys in the time spent travelling. The difference of average time spent at home is also slight, but occurs entirely during the middle of the day and evening. The long tails exhibited by the HIS derived shop/personal business distribution is almost entirely due to extra time reported on personal business. There must be a suspicion that there was a tendency for interviewers to use this activity as a 'bin' in the 1977 survey. The largest differences which again emerge are for the social/recreational group of activities. Apparently little more than half of the total time spent on this activity was reported in the home interview survey.

TABLE 12

WEEKDAY PARTICIPATION IN ACTIVITIES BY ADULTS*

Activity	Participation Rate			Activity Rate			Average Daily Time Spent on Activity		
	(a) MADBS HIS	(b) Activity Diaries	a/b %	(a) MADBS HIS	(b) Activity Diaries	a/b %	(a) MADBS HIS	(b) Activity Diaries	a/b %
Work	0.39 (0.01)	0.49 (0.01)	80+	1.22 (0.02)	1.35 (0.02)	90+	3hrs 29mins (6 min)	3hrs 56mins (5 min)	89+
Education	0.05 (0.00)	0.06 (0.00)	74	1.10 (0.04)	1.21 (0.05)	91	13mins (2 min)	15mins (1 min)	87
Shop/Personal business	0.40 (0.01)	0.53 (0.01)	75+	1.65 (0.05)	1.60 (0.03)	103	42mins (2 min)	32mins (1 min)	131+
Social/Recreational	0.26 (0.01)	0.42 (0.01)	62+	1.32 (0.03)	1.46 (0.03)	90+	50mins (3 min)	1hr 24mins (3 min)	59+
Home	1.00 (-)	1.00 (-)	-	2.28 (0.03)	2.51 (0.04)	91+	17hrs 44mins (7 min)	16hr 41mins (6 min)	106+
Travel	0.82 (0.01)	0.92 (0.01)	89+	3.62 (0.06)	4.42 (0.02)	81+	57mins (1 min)	1hr 2 mins (1 min)	92+

* Bracketed figures represent standard errors

+ Differences between surveys significant at five per cent level.

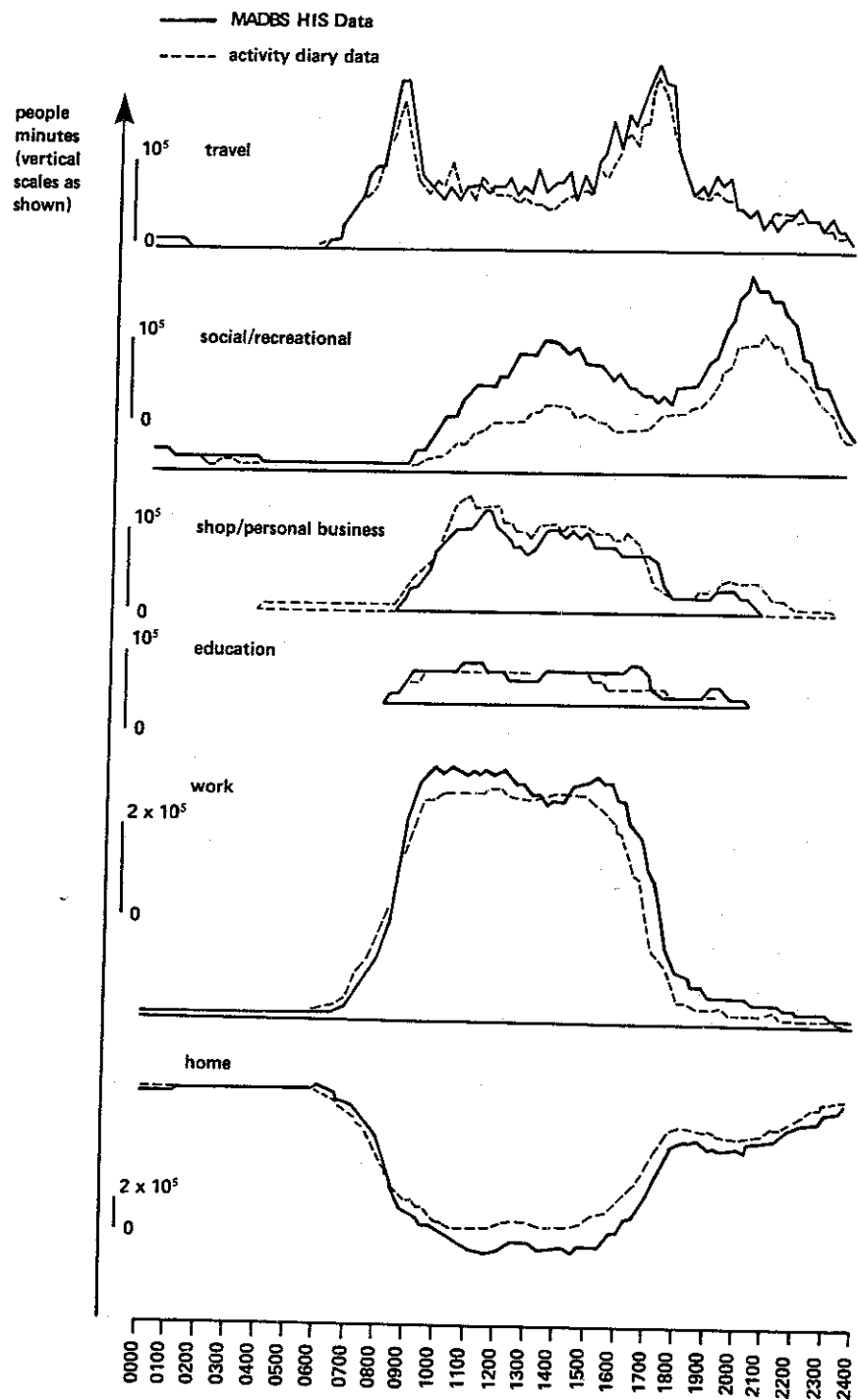


Fig 6 — Estimated pattern of time allocation to activities by time of day — Adelaide eastern suburbs adult residents

DISCUSSION

The overwhelming trend of evidence presented in this paper is of substantial trip and activity misreporting in the 1977 MADBS HIS. Moreover Barnard (1984b) and European research (Clarke et al. 1981, Van der Hoorn 1979 and Vidakovic 1983) provide evidence that problems with home interview surveys highlighted in this paper are quite widespread. The serious nature of these problems is likely to significantly limit planning and research use of home interview survey data, especially given evidence of temporal, modal, trip-end activity type and socio-economic variability in under-reporting.

A common initial use of the data has been to tabulate trips by purpose and mode in order to convey to the policy maker an overall impression of travel within the study area. These tabulations are made after car travel estimates derived from O-D travel surveys have been upwardly adjusted to correct for under-reporting detected from screenline counts. Because reporting of walk and bicycle trips is never checked, figures included in the tabulations for these modes are unadjusted. If, as has been argued in this paper, trips using these modes are under-reported to a significant degree the impression conveyed by these tabulations will unduly favour car and public transport trips vis a vis walk and bicycle trips.

The next step in the transport study planning process is to use collected data to develop travel demand models to forecast future travel levels. It would appear from transport study reports that the modelling process has, almost without exception, been conducted without due reference to data validation results. That is, models have been developed on raw data, unadjusted to account for trip misreporting. The effect of trip under-reporting is to nullify the randomness of the data, yielding instead a mixture of a random and choice based sample. The result is that unless the choice based element of the sample is effectively recognised, parameter estimates in the travel demand models will be biased.

Transport study home interview survey data has of late been used increasingly by research workers. Australian examples include Wigan (1983) and Wadhwa and Dexter (1983). Typically, researchers have used the data more intensively than in planning exercises and without adjusting to correct for trip under-reporting. One use of the data in this context has been to analyse usage and ownership patterns for the minor modes (e.g. Wigan 1981, 1982). A disturbing revelation for such research studies, is that trips using these modes may be seriously under-reported in home interview surveys. Another use has been to examine temporal and spatial differences in travel behaviour and activity participation. Significant trip and activity under-reporting may mean, however, that results obtained may reflect as much spatial and temporal variations in reporting rates, as underlying variations in actual behaviour.

SUMMARY

Research presented in this paper has used results from an activity diary survey to comment on the quality of data collected in a home interview survey. Data collected in the HIS was found to be deficient in many areas. Analyses indicate that HIS data may be unsuitable for investigation into all but a narrow band of urban transport topics. These include public transport travel, peak period car travel and longer distance car trips. While these topics are undoubtedly important, they by no means form a complete set of topics which should, in theory, be amenable to analysis using HIS data, and are of interest to the transport planner/researcher. This second group of topics includes analysis of off peak travel, travel by minor modes and activity time allocations. Results generated from applying HIS data to examine these and other topic areas should be treated with caution.

It is recognised that research presented in this paper is imperfect. Imperfections mainly stem from the time separation of the two surveys. Also, although it is highly probable that results are transferable to areas other than the eastern and north-eastern suburbs of Adelaide, this cannot be stated with certainty. Nevertheless, this research, in conjunction with previously referenced European results, does appear to have identified a significant and potentially serious deficiency with home interview survey data. In view of the widespread use of this data, the nature and extent of deficiencies identified deserve further attention.

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