

A DATA BASE FOR THE EVALUATION OF ROAD USER RISK IN AUSTRALIA

REPORT

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<u>Abstract:</u> The report details a national travel survey undertaken throughout Australia commencing August 1985 for one year. It was a self-administered mail-back survey design. Forms were sent to nearly 30,000 households in all states to collect information on their day-to-day travel behaviour for one sample travel day in that period. Information was collected for each day of the year for all modes of travel including public transport. The data is in a form which, after expansion (weighting), allows for the calculation of road user exposure to risk.				
<u>Keywords:</u> Exposure, Crash Risk, Travel Survey, Mail-Back Questionnaire, Self-Administered, Weighting, Respondents, Pilot Testing, Validation, Response Rates.				

Notes

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A DATA-BASE FOR THE EVALUATION OF ROAD USER RISK IN AUSTRALIA

1. INTRODUCTION

In the context of road safety research, it is necessary to have not only data on road crashes which lead to death or injury, but also to understand and quantify the degree to which people use the road system. (i.e. the degree to which they are exposed to crash risk). These two pieces of information -- the number of crashes, and travel exposure -- provide important data on crash rates; data which permit the formulation of policy-oriented strategies for road safety planning.

Different statistical indicators of exposure to crash risk need to be considered to determine crash rates. The simplest measure of crash risk is the number of persons who have had crashes per unit of population. This can be used to assess the risk for an average person, i.e. it reflects the general risk of having a crash while travelling.

Total travel exposure (i.e. the number of trips a person has made, the distance travelled, and the amount of time spent travelling) also provides indicators which can be used to determine crash risk.

Crash rates based on each of the above indicators of travel exposure provide different, meaningful measurements of crash risk. For example, information on:

- o crashes per trip provides a measure of the risk a person runs when participating in an out-of-home activity;
- o crashes per kilometer travelled allows the relative risk of vehicular travel to be assessed, and
- o crashes per time spent travelling is especially useful for assessing crash risk in cases where the number of kilometers travelled is less important than a risk factor related to time spent travelling (e.g. in the case of pedestrians).

Since each of the four crash rates referred to above (including the general crash rate for an average person) shows only one particular aspect of the problem, forecasting and analysis is most profitably carried out using all four rates as a basis.

1.1 Objectives of the Study

While data on crashes are fairly readily available in Australia, the corresponding data necessary to evaluate exposure to crash risk do not exist at a national level. The aim of this study is, therefore, to create a data base which, when expanded (weighted), can be used to evaluate road-user risk in Australia. This report outlines the way in which road-user exposure information was collected on behalf of the Federal Office of Road Safety by Socialdata Australia.

1.2 The Target Population

Many past studies on exposure have concentrated on collecting information about vehicular travel only. Frequently, the survey sample was created from interviewing a sample of persons with drivers' licences or registered vehicles. For example, Carroll et al. (1971) sent questionnaires to licence-holders and had these people report all travel in a given vehicle for varying periods.

Apart from the problems inherent in surveys which require drivers to report vehicle usage on a recall basis, previous surveys have generally equated car usage with road usage, and ignored the very significant number of road users who walk, ride bicycles, and use public transport. A total perspective of road user exposure needs to include travel by all of these modes, as well as details of those persons who do not travel at all.

The target population in this study, therefore, was all potential road users -- i.e. the whole population. In addition, since it is necessary to have data on both users and non-users, the sample needed to be household based, including (ideally) all persons in the household.

1.3 The Collection of Data on Travel Behaviour

This section deals with the methodological requirements for collecting travel data to calculate exposure, and highlights the versatility (multiple uses) of the data collected in this way.

1.3.1 Methodological requirements

To calculate accurate and valid statistical data, there are certain minimal qualitative requirements. The most important of these are:

- o Information on all trips should be gathered. Since it has been shown that people find it easier to remember a particular subset of trips (e.g. trips by car only) in the context of their total travel throughout the whole day than in isolation, all trips, including walk trips, need to be collected (Jones, et al., 1982; Hendrix, 1979).
- o Information on the respondent's actual behaviour during a specific period of time needs to be collected. If "average behaviour" is reported (e.g. "how do you usually travel ...?"), the results reflect the respondent's subjective self-estimation and not actual behaviour (Brög and Neumann, 1977).
- o Diary-type techniques improve data accuracy by minimising respondent self-evaluation (Schwertner, 1979).
- o Systematic biases in the results which occur due to non-response (Wermuth, 1985) should be addressed.
- o Travel behaviour for an entire year should be assessed to determine the effect of seasonal differences.

1.3.2 A Multi-Purpose Data Base

The actual data elements which were collected in this study are described in Section 3.1.2, and can be seen in the questionnaires in Appendix B . This section, however, gives an indication of the richness of the data base. It can be used both to calculate exposure rates, as well as to quantify travel characteristics of the population of Australia, in general.

The basis of the travel data collected in this study was the individual trip -- the movement from one "trip purpose" to another. It can be described in terms of trip length, trip duration, mode used and trip purpose. A trip is, however, usually not an end in itself, but serves as a means to undertake activities at the destination. Out-of-house activities are actually the triggers for mobility; they are the expression of the way in which individuals and households have organised their daily lives.

Out-of-house activity patterns -- all activities from the time of leaving home to the time of returning home -- are often called sojourns. These sojourns can be seen in the total context of all travel patterns for the day.

Some people carry out all activities in a single sojourn, while some leave the house several times, and others not at all. The proportion of people who leave the house at least once on a given sample day (i.e. those who are mobile) is often called the share of mobiles and this can also be established from the survey data. It is also possible to calculate the average number of trips per person and trips per mobile. For mobile persons, an average number of trips per sojourn can also be calculated.

Furthermore, it is possible to differentiate between distance per trip, distance per sojourn, and total distance per person per day. Similarly, it is possible to differentiate between trip duration per trip, per

sojourn, and per day. This is generally called travel time and can be reported per person or per mobile. The travel time is a component of the daily time budget. Further important indicators of this time budget are the duration per activity, the total time out-of-house and the average time spent at home.

The data elements sketched here serve to illustrate the ability of the data base to be used to evaluate all aspects of exposure, and the multitude of uses apart from those specifically related to road-user risk.

2. THE METHODOLOGY

2.1 The Survey Design

The survey required all persons 9 and over in the sample households to complete and mail back survey forms which had information on all travel on a given day -- and from which information on road exposure could be obtained. The methodology used was based on one which was developed in the Federal Republic of Germany for use in a "Continuous Survey of Travel Behaviour (KONTIV)" in 1976 and 1982. Development of this methodology began in 1972 when a critical review of survey methods used in travel surveys had shown that considerable improvements to survey design were both necessary and possible (Sozialforschung Brög, 1972). This led to the development of a new survey design which was based on a diary technique, but which used interviewers. The expense of this method led to further research and testing (reported in Brög and Ampt, 1983), and finally to the development of what is known as the KONTIV design -- based on the comprehensive diary technique but which was also economical enough to be used on a large scale (Brög, 1982). Surveys using this technique have been undertaken in many European countries (e.g. Brög et al., 1985a) and in the United States and Israel (Brög et al., 1985b).

It is particularly important to achieve high response rates, as it has been shown that those people who do not respond have different travel patterns than those people who do respond (Brög and Meyburg, 1980). A principle objective in the development of the survey design, therefore, was to encourage high response rates.

2.1.1 The basic philosophy of the design

The design used in the current study adheres strictly to the premise that the respondent is the focal point for all considerations of survey design (Brög and Neumann, 1977). Examples of these considerations are:

- o the entire survey design is as attractive as possible for the respondent (i.e. the respondent is motivated by efforts such as stamped instead of franked envelopes, etc.)
- o the survey instrument is designed to be easily understood
- o each individual question is as easy as possible to answer (this was to be done using repeated checking during several piloting phases).

In other words: Although the survey was designed by the researcher, it was designed for the respondent.

The following elements were the basis of the most important principles of the design used in this study.

- (a) Trips were defined on the basis of activity and not on travel mode.
- (b) The survey was self-administered, which meant that the respondents were able to give well-considered answers and were not affected by an interviewer.
- (c) All persons 9 years of age and over were requested to answer individually; proxy responses were discouraged.
- (d) Whenever necessary respondents could answer in their own words.
- (e) To keep responses as concise as possible, semi-structured questions were used. This meant that all the most common answers which could be understood by all respondents were listed and could be ticked, while for all other questions, the answers were open-ended.
- (f) The layout and artwork was designed so that complicated examples were not needed. Two-colour questionnaires made sequence guides or filters as straightforward as possible.
- (g) Obvious coding devices were not used on questionnaires, since these are frequently confusing for respondents.

2.1.2 Principles of the application of the survey design

Based on the philosophy outlined above, the principle aspects of the survey design are as follows:

- (a) The sampling unit was the private household (where information was sought for all persons aged 9 and over).
- (b) Only one person needed to fill out the socio-demographic details on the Household Form, while each person in the household aged 9 or over was requested to fill out the travel (Person) forms for a specified travel day. Every person in the household had the same travel day.
- (c) In principle, the addresses were household based and were obtained by block-listing all addresses in selected Collector's Districts (see Section 3). A small sample of data (990 households gross) in rural Victoria was selected from Electricity Authority records, and an even smaller sample (225 households) in 2 sparsely settled areas was selected from Electoral Rolls (person-based) -- see Section 3.2.
- (d) The survey was carried out for every day of the year (including weekends) from August 1, 1985 - July 31, 1986.
- (e) To improve the survey response rate, a series of reminders was sent to non-respondents. They were sent at weekly intervals over a period of 4 weeks. On each reminder letter, households were given a new travel day -- the same day of the week as the original travel day, but 1, 2, 3 or 4 weeks later.
- (f) To inform and motivate respondents, households received a package which included a letter from the Federal Minister of Transport (Appendices A-F).

(g) To enable respondents' questions to be easily and quickly answered, contact phone numbers (manned by survey staff) and an information brochure were provided. The phone service was always available for the cost of a local call.

The attention to detail extended to the pre-coding and coding described in Section 3.7.

Since these principles were adhered to, the data obtained from the survey reported here should be of very high quality and contain a minimum of systematic bias.

2.1.3 Sample design and selection

Since the travel behaviour data collected were to be used for calculation of exposure, it was necessary to ensure that they matched those variables for which crash data were already known.

Information on crashes is available by season, day of week and time of day. For this reason it was desirable to represent every single day of a calendar year. This means that it should be possible to calculate exposure for both weekdays and weekends across the total spectrum of seasonal variations (e.g. weather conditions, holiday periods, etc.). Travel days were allocated systematically to each town/city which meant that the distribution of days of the week, as well as days of the year, was as even as possible for each geographic area and for the whole of Australia.

Since data are available on the age of people involved in crashes, it would have been ideal to include all persons in the survey **sample**. As respondents were required to complete the forms themselves, however, information was not sought from people under 9 years of age, although the number of people in the household less than 9 was collected.

To ensure that the survey provided information on travel in different regions of Australia, information was sought for five geographical strata. The stratification was as shown in Figure 1. All capital cities were chosen, a provincial city in each State, a country town/city and a contiguous rural district in all States except Tasmania, and "coastal" towns from Queensland, Victoria and New South Wales. Two sparsely settled areas were chosen -- Brewarrina in N.S.W., and Kalgoorlie in W.A. While the sample was not designed to be representative of "Australia as a whole", it is representative of all capital cities, and the remainder of the sample was designed to cover the most important types of cities/towns in Australia.

The sample was chosen from these regions from a list of Collectors' Districts provided to the Federal Office of Road Safety by the Australian Bureau of Statistics. Overall, the sample of households was selected from 25 cities/towns in Australia. Table 1 shows the size characteristics of the sampled areas.

Area Type	S.A.	W.A.	N.T.	Tas	ACT	Qld	Vic	N.S.W.
Capital City	Adelaide	Perth	Darwin	Hobart	Canberra	Brisbane	Melbourne	Sydney
Provincial City	Whyalla	Geraldton	Alice Springs	Devonport /Burnie	-	Townsville	Geelong	Newcastle
Country & Contiguous Rural District	Central Yorke Peninsula (Maitland)	Esperence	-	-	-	Charters Towers	Bendigo	Dubbo
"Coastal"	-	-	-	-	-	Gold Coast	Warrnambool	Nowra
Sparse	-	Kalgoorlie	-	-	-	-	-	Brewarrina

Figure 1: The Sample Framework

Area	Total Persons	Occupied Private Dwellings	Persons 10 years and Over	Total Private Dwellings
Sydney	3 204 119	1 065 079	1 820 191	1 147 493
Melbourne	2 722 487	892 047	1 539 849	962 932
Brisbane	1 028 146	331 915	617 569	358 056
Adelaide	931 618	320 165	525 937	338 595
Perth	898 574	298 134	524 894	321 197
Hobart	168 190	55 637	95 243	60 093
Darwin	56 209	15 113	38 704	15 944
Canberra	212 575	66 959	128 791	69 818
Newcastle	144 729	51 769	79 547	55 103
Dubbo	28 461	8 363	16 478	9 048
Nowra	46 751	15 771	27 535	22 719
Geelong	149 641	48 987	84 002	54 291
Bendigo	60 851	19 771	34 331	20 859
Warrnambool	21 259	6 711	11 716	7 192
Townsville	93 582	26 853	58 453	29 241
Charters Towers	10 184	2 839	6 350	3 268
Gold Coast	155 737	51 391	104 184	61 962
Whyalla	29 807	9 336	16 652	9 492
Central Yorke Peninsula	4 153	1 302	2 396	2 131
Geraldton	18 906	5 572	11 472	6 179
Esperence	10 600	3 087	6 541	3 570
Devonport/Burnie	60 386	20 260	33 186	21 172
Alice Springs	1 606	248	1 077	583

Table 1: Persons, Age and Dwellings in the 25 Survey Areas
(Australian Bureau of Statistics, 1981 Census)

2.1.4 The mailback technique

The mailing system in this type of survey design is very significant since it is important that the questionnaires and reminders reach the household at the "ideal time". If the questionnaires arrive too early, they may not be completed because the household has forgotten or the questionnaires have been lost by the time the travel day arrives. If the questionnaires arrive on the travel day or later, the household does not have a chance to prepare itself for reporting and may resort to recall. This has been shown to cause much less accurate reporting. Alternatively, questionnaires which arrive too late are frequently deemed "useless" or outdated and this can cause non-response. It is, therefore, essential that mail is carefully controlled and monitored.

A mailing test which is described in Section 3.4 was conducted to assess the variability of the mailing system in Australia. Based on the results of this test, it was decided to mail the questionnaires to arrive slightly earlier (2-3 days before the first travel day) than has been the case in similar European studies (1-2 days). To achieve this mail was posted either 3 or 4 days before the travel day, i.e.:

Melbourne, Adelaide, Perth, Brisbane:

Mail time - 1 day

Arrival time - 2 days before travel day

All other destinations (including Sydney):

Mail time - 2 days

Arrival time - 2 days before travel day.

The methodology required the use of postage stamps rather than franked or Reply-Paid envelopes. Tests in the past (Hafermalz, 1976) have shown that this has a significant effect on response, and consequently stamps were used on all mailings -- the pre-contact letter, all questionnaires and reminders, and on the reply-paid envelopes.

The survey design used the following mailing procedures:

- o Four days before the first travel day, the household received a "pre-contact" letter from the Federal Minister of Transport, notifying it of (and legitimising) its inclusion in the survey (Appendix A).
- o The first questionnaire was sent out in a package which included a reply-stamped envelope, a follow-up "motivational" letter from the Minister, and an information brochure. Households were also advised of their travel day (e.g. Thursday, August 1) (Appendix B).
- o One week after this travel day, if there was no reply, a first reminder (a white postcard) was sent with a new travel day (e.g. Thursday, August 8) (Appendix C).
- o The second reminder (letter) was sent after two weeks (if necessary), again with a new travel day (e.g. Thursday, August 15) (Appendix D).
- o Three weeks after the originally designated travel date, households were sent the third reminder which contained another questionnaire, an information brochure, a stamped reply envelope, as well as a reminder letter from the Survey Director. The travel day would have been, for example, Thursday August 22. (Appendix E).
- o Finally after four weeks, the fourth reminder (a blue postcard) would have been sent to non-respondents for Thursday August 29. (Appendix F).

The philosophy behind the mailing effort was to encourage the highest response rate possible. For this reason even details such as different shapes (letters/postcards) and colours (blue/white) were considered important.

2.1.5 Motivation of respondents

Since the survey methodology is a method which has no interviewer contact with the household, the motivation of respondents through other methods becomes very important. Relevant factors are:

- o who establishes contact with the household?
- as well as the provision of information on:
- o who should complete the survey forms?
 - o what is the purpose of the survey?
 - o what does the household have to do?
 - o who can be contacted if there are questions?

The official return address of the organisation commissioning the survey reinforces the official nature of the survey. At the same time, the household needs to be convinced of the privacy of its answers. For this reason on some occasions the Department of Transport letterhead/ address was used, while on others that of Socialdata Australia was more appropriate (See Appendices A-F). All envelopes had as the return address that of the local Socialdata Australia office, but the official nature of the survey was also clearly emphasised by adding "1985/86 Survey of Day-to-Day Travel in Australia for Commonwealth Department of Transport, Canberra". The only address on the questionnaires was that of the local survey office, since it was at this stage that privacy was being stressed most.

To substitute for the personal contact between an interviewer and the household, the survey design offered the household a telephone service, making it possible to phone any of the 5 survey offices (Perth, Adelaide, Melbourne, Sydney, Brisbane) or (for the cost of a local call) the 008 number. About 1200 calls (i.e. from about 4% of the gross sample of households) were received in the offices around Australia and of these about 200 were on the 008 line. It is considered that most of these would not have responded, or the data that they supplied would not have been accurate, if this service had not been provided.

2.1.6 Design of the Questionnaire/Instrument

Three types of information were collected via the questionnaires:

- o household data (on the Household Form)
- o socio-demographic data about all persons 9 years of age and over (on the Household Form)
- o trip/activity data (on the Person Form).

Another factor to assist in achieving a high response rate was that the questionnaire was designed to be as "respondent-friendly" as possible by:

- o having a clear graphic design and layout with large lettering and two-colour print
- o ensuring instructions were simple
- o framing questions and answer categories in everyday language.

These measures made form-completion easy, and as a secondary consideration, made coding relatively straightforward as well.

The reminder letters/postcards were each worded slightly differently, each time including three main messages:

- o If you have filled it out and sent it - thank you
- o If you have filled it out and not sent it - please send
- o If you have not filled it out, please complete for "New" Travel Day.

This was designed to minimise the annoyance of receiving reminder letters.

2.1.7 Data preparation and coding

After completed questionnaires were received, there were three important steps carried out in the field of data preparation and coding:

- o editing of the questionnaires -- including phoning respondents for missing or non-comprehensible data;
- o pre-coding of open-ended questions (e.g. trip purpose);
- o entering the data into the computer (i.e. transferring it to disk).

This meant that each questionnaire was checked in detail by office staff prior to data entry. Three of the elements of the above task warrant further description.

The answer categories for "trip purpose" had been deliberately limited either to the most frequent, unambiguous answers, (i.e. work, education, shopping, home) or to categories which were shown in the pilot to be frequently forgotten (to pick up or drop off someone). This was to simplify completion for respondents and at the same time to allow for the possibility of accurate post-coding in the office. Consequently one of the major office "pre-coding" tasks was involved with this question. Office staff had detailed definitions as part of a 94-page Procedures Manual.

The pre-coding phase also gave office staff the possibility of checking for, and rectifying (with the help of respondents) cases where:

- o return trips were not reported. (After the first pilot test some changes were made to the questionnaire design to reduce this problem. While these changes significantly reduced the incidence of the problem, it continued to occur.)
- o trips were reported as "un-linked", i.e. people had reported each leg of a walk-bus-walk trip.

It should be emphasised that no information was "invented" by office staff if some information was missing or could not be obtained.

Data entry was done using an interactive programme especially developed for this study. It was interactive in that an extensive series of edit and logic checks were included in the data entry phase. It was impossible, for example, to enter trips for more persons than were included on the Household Form, to end a trip before it was started, to be less than 9 years of age.

2.2 Validation

During the conduct of this project it was essential 1) that the basic hypotheses upon which the methodology was based be shown to hold true in the Australian environment, and 2) that data collected be shown to be accurate and as unbiased as possible. For example, one of the hypotheses in the response and non-response adjustment phase (Appendix G) is that people who respond first in mail surveys are those who travel most and that the number of mobile persons in subsequent response waves diminishes. To this end "fifth reminder interviews" were carried out with a small sample of people who did not respond to any of the four reminders. This type of validation was actually validating the hypothesis.

Validation was also carried out to check the validity of individual responses. This was done using a "re-interview" method which also allowed the collection of data on unlinked trips.

2.2.1 "Fifth reminder" interviews

For a small sample (35) of households in Sydney which had not responded to any reminders, an interviewer called to collect information

about the travel day which would have been the fifth reminder day. This personal interview provided information on why the questionnaires had not been completed, as well as a general indication of travel behaviour on the previous travel (4th reminder) day. The results of these interviews are shown in Section 3.8 and were used while making response and non-response adjustments (Appendix G).

2.2.2 "Re-interviews"

In the second type of validation, respondents in about 300 households were reinterviewed to check the accuracy of information supplied. Where possible the phone was used, otherwise personal interviews were held. In each State, for a one week period, all respondents who returned questionnaires were contacted. The interviews usually took place on the day after the questionnaire was received in the office. This ensured that no more than 4 days had elapsed since the travel day (usually less) and that respondents could recall their travel on the prescribed day as accurately as possible. An excuse was given to speak to all responding persons and they were asked to report their travel day again, reporting unlinked trips (i.e. each leg of the trip). A format similar to that used for the 1981 Sydney Travel Survey (State Transport Study Group, 1982) was the basis for the questionnaire used for this survey. Interviewers were given one day's training prior to commencement of validation interviews.

This methodology gave figures for two validation checks:

- o underreporting of trips by mode and purpose; this could be used to check correct values for this type of bias:
- o the composition of each multi-mode trip; this provided data to check the structure of unlinked trips when they were derived from linked trips.

2.3 Adjustments for Bias

Whatever method is used to collect data, there is always bias or error in that data. Richardson (1982) identified several sources which could apply to this type of survey:

- o Travel surveys are invariably sample surveys and the sample selected may not be truly representative of the population.
- o Even from the sample of persons chosen, not everyone responds -- they may refuse or sometimes they cannot be contacted.
- o Information from the people who do respond does not always reflect behaviour with absolute accuracy. This can often be exacerbated if the survey instrument is poorly designed, or because of poor recall or reporting by respondents.

Clearly, each of these areas needs to be addressed at all stages of design, development, implementation and analysis if the data set is to be accurate and of maximum use.

2.3.1 Reduction of sampling bias

Sampling error was reduced by choosing a sample (described in Section 2.1.2) which had a minimum of inherent bias. By using Census results, comparisons can readily be made between the socio-demographic characteristics of the sample and those of the population. This means that sampling errors are relatively well definable and could be corrected for using factoring procedures.

2.3.2 Reduction of non-response bias

Correction of non-response bias is more complicated. The effect of this bias is reduced because the survey had a relatively high response rate (65.3%). However, this does not alter the fact that people who do not respond have significantly different travel characteristics from those who do (e.g. Brög and Meyburg, 1980) and the possibility of adjusting for this type of bias needs to be examined.

It is clear that a critical factor to the overall quality of the data is a comprehensive understanding of response and non-response. For this reason it was necessary to accurately record certain information relating to household response, including the number of reminders.

The estimation and correction for non-response bias in this survey is based on the hypothesis that, in mail-back surveys, more reminders are likely to be needed to get people who make fewer trips to respond. This occurs because a "travel" survey seems most relevant (and therefore invokes a quick response) from those who make most trips. Often it takes several reminders to the little-old-lady-who-makes-one-trip-to-the-corner-shop before she is convinced that she too is important. This hypothesis was validated by interviewing a sample of non-respondents.

Whereas socio-demographic adjustments are common, correction for the non-response is relatively rare. A technique to calculate non-response used in this survey estimates both the direction and degree of error. Its principle advantage is that it uses data internal to the survey. Correction or adjustment factors are calculated by studying trends in the speed of household response. The procedure is described in detail in Appendix G.

2.3.3 Reduction of other biases

The remaining problems which affect data quality are often the most difficult to deal with since they are usually not readily quantifiable.

Those which stem from poor questionnaire design are difficult to correct for because they are not easy to recognise. For example, respondents always answer questions, even if they are ambiguous in their eyes, meaning that data are always obtained. The quality of that data, however, depends on every respondent interpreting the same question in the same way. This means that the development and testing of questionnaire wording was of extreme importance — an aspect which is described in Sections 3.3 and 3.4.

Finally, those problems which normally occur because of respondent recall problems or lack of incentive have also been addressed in this methodology. The problem of recall was eliminated to a large extent by the prospective nature of the study. In addition, "incentives" were given at all phases beginning with the pre-contact letter from the Federal Minister of Transport informing the household that the survey would take place, through to the availability of advisory information in the form of brochures and a telephone service.

3. THE STUDY DESIGN

Section 2 of this report contains a description of the methodological aspects of the study design used in this survey. This section describes all operational aspects of the study from the development phase, through testing and implementation of the survey, to the preparation of the data for analysis. Firstly, however, there are some brief comments on the data collected.

3.1 Data From the Survey

3.1.1 File structure

The data base has been produced in the form of three primary files: a household file, a person file and a trip file. There is also an "unlinked" trip file (described in detail in Section 4) which provides information on all legs of multi-modal trips. Each household is identified by a unique sample or identification number which gives information on State and region within the State. Exact documentation of the file structure appears in Appendix H.

3.1.2 Data elements

The items of information available from the survey are listed on the next page. Again, exact details appear in the Appendix H. Definitions for all data elements appear in the Procedures Manual. Exact questionnaire wordings can be found in Appendix B.

HOUSEHOLD INFORMATION

Household Size

Total persons
Persons less than 5 years
Persons 5-8 years
Persons 9 and over

Telephone in Home

Yes/No

Vehicle Ownership

No. of bicycles
No. of motor bikes
No. of cars/stationwagons
No. of other vehicles

PERSON INFORMATION

(Persons 9+ years)

Sex

Male/Female

Year of Birth

Year --> Age

Country of Birth

Australia
UK/Ireland
New Zealand
Greece
Italy
Yugoslavia
Vietnam
Other

Highest Schooling

Primary School
Secondary School
University, technical
or business college

Employment Status

Home duties
Looking for work
Retired/Age Pensioner
Other, not employed
Studying - Full time
 - Part time
Employed - Full time
 - Part time

Occupation

Asked, not coded

PERSON INFORMATION (ctd)

Driver's Licence

Car
Truck
Motor Cycle
None

Travel Day

Day and Date

TRAVEL INFORMATION

Reasons for Non-Travel

Own illness
Other family member's illness
Weather
Studying, doing other things at home
Had visitors
Not at home but in one place all day
Transport problems
Preferred to stay home, no need to leave
Other

Total Number of Trips/Person
Number

Origin of First Trip

Home/Other

Start and Finish Time of each trip

Time of day

Destination Purpose of each trip

Work
Education
Home
Shopping
To pick up/drop someone off
Business as part of work
Medical/Dental
Private Business (e.g. bank)
Social Welfare
Services (e.g. hairdresser)
Visits
Sport (active/passive)
Other social/recreation
Other

Distance of each trip

In 100 metres

Duration (derived)-mins

3.2 Sample Selection

As discussed in Section 2.1.3, the method chosen for selecting the major part of the sample involved listing dwellings in Census Collector's Districts (CDs). CDs were provided to the Federal Office of Road Safety by the Australian Bureau of Statistics for each of the 25 towns/cities included in the sample.

In each of the approximately 1745 CDs, people trained as "listers", listed dwellings according to a very structured system. All listers knew exactly at which point to start (nearest to north-east corner), had to travel in an anti-clockwise direction and report every single detail of that block, including dwellings, non-dwellings, vacant lots, etc. Blocks within each CD were randomly numbered and blocks were then listed in that sequence. From the 60-90 dwellings listed in each CD, 15 were finally selected for inclusion in the survey using the sample entry facility in the SAMGEN programme (Section 5.1). A total of 28,348 dwellings were selected.

Recruiting personnel and listing of all CDs took about 4 weeks, and the data entry of the sample about one and a half weeks in March/April 1985.

In addition, the Road Traffic Authority (RTA) of Victoria commissioned a sample of 990 rural households which were included as part of the survey and appear in all results in this report. These addresses were provided by the RTA and were selected from electricity authority records.

It was considered important to include a small sample of sparsely settled areas and, since expense prevented block-listing, it was decided to use addresses from electoral rolls, even though there is known under-reporting of the population in this source, and the electoral rolls are person-based. The addresses from Kalgoorlie and Brewarrina were, therefore, selected by taking a skip interval through the electoral rolls for each area. Manual checking ensured that one household was not represented twice.

3.3 The Test of the Survey Instrument - The Skirmish

A Skirmish of 50 households (gross) took place in Sydney between February 18 and March 1, 1985. The primary aim was to test the content, wording, and layout of the questionnaire to determine if questions were clearly understood and to ensure that they were not ambiguous. The secondary aim was to test the reaction to the survey in general. In particular, it was necessary to determine the suitability of the form of address ("The Householder" vs. "The N.S.W. Resident", vs name) and the method of approach (mail questionnaire vs. personal interview).

The Skirmish resulted in some changes to wording, answer categories and layout. In particular, the problem of non-reporting of return trips was apparent and appropriate changes were made. As a result of the Skirmish, some questions which had been proposed (e.g. marital status) were omitted. Although it was originally thought that it may be necessary to have householders' names, the Skirmish indicated that there were no apparent problems associated with addressing mail to "The Householder". Although the Skirmish was done using a drop-off/pick-up method, respondents said they would be equally willing to complete the forms if it were a mail-back survey.

One of the more significant changes (and possibly unexpected) resulting from the Skirmish was the change of name of the survey on the Household Form. For the Skirmish it had been called "1985/86 Survey of Australian Travel". This was changed to "Survey of Day-to-Day Travel in Australia 1985/86" after it was shown that the concept of travel often meant 'holidays' or 'long-distance' to respondents.

3.4 The Mail Test

For every day of one week in March, 1985, letters of two sizes and weights ("pre-contact" letter size, and questionnaire weight/size) were sent to one household in each of the 25 towns/cities in the sample.

These people, in turn, sent a letter to the capital city of their State in the return envelope (A5) size.

The results of these mailings were analysed and the mailing schedule described in Section 2.1.4 was developed. Even though the most remote places (e.g. Esperence and Charters Towers) were included, the longest mail time recorded was 5 days for a letter sent from Sydney to another Sydney address!

3.5 The Pilot Test

The pilot survey was conducted from three State offices -- New South Wales, Victoria and South Australia. The sample for the pilot was equivalent to a "normal" week's mailing during the main survey and resulted in 220 households responding. Since the N.S.W. office was to be responsible for the A.C.T, the Victorian office for Tasmania, and the South Australian office for Northern Territory, households from all of these States were included in the pilot survey.

One of the main purposes of the pilot test was to test the survey management system. This included the operation of the complex micro-computer system and the use of MATSCAP (Mailback Travel Survey Coding and Administration Programme) which controlled all aspects of the survey mailing system. The pilot survey enabled changes and refinements to be made to the survey system. Another objective of the pilot survey was to test the ability of 9 year olds to complete the survey forms since in similar types of surveys previously 10 years of age had been the lower age limit. For the small number of 9 year olds in the survey, there appeared to be no problem.

The 008 phone number was offered to respondents during the pilot and the number of phone calls suggested that it would be of significant value for the main survey -- particularly as it became evident that most phone callers would probably respond, and in many instances may not have

otherwise responded.

The pilot survey was also designed to get an indication of the response rate. It ranged from 57% in Melbourne to 68% in Adelaide and averaged 63%. The small increase in response after the 4th reminder suggested that its impact needed to be monitored closely in the main survey. It was subsequently shown to have a more significant impact in the main survey.

Finally, the pilot survey also offered the opportunity to begin testing validation methods. Trial validation interviews of the "5th reminder" type (Section 2.2) were carried out at 20 households in the Sydney Statistical Division. Furthermore, it was of particular interest that key indicators (e.g. mode/purpose splits) paralleled the results of one other data source which was readily available for checking -- the Sydney Travel Survey (State Transport Study Group, 1982).

3.6 The Main Survey

In the main survey, about 30,000 households were sent questionnaires over a twelve month period. The first questionnaires were completed for August 1, 1986 and the last questionnaires (i.e. responding to the 4th reminder) were completed on August 28, 1986. The overall response rate was 65.3% (Section 3.6.3) with a total of 18,226 households and 45,056 persons reporting 144,875 ("linked") trips.

3.6.1 Survey organisation

There were five survey offices: one each in Sydney, Melbourne, Perth, Adelaide, and Brisbane. The six field officers staffing the offices undertook all tasks required in the survey. Training of these officers for this particular exercise was spread over a two day working session. Their responsibilities included:

- o collecting and posting mail at the G.P.O.
- o recording (via computer) the sample numbers of returned questionnaires on a daily basis
- o preparing the day's mailing (printing labels, stuffing envelopes etc. for all pre-contact mail, initial questionnaires, and 1st to 4th reminders)
- o answering phone enquiries
- o pre-coding of unstructured answers
- o phoning respondents to check unclear responses (e.g. missing return trips)
- o data entry.

All tasks involved in this work were described in the Procedures Manual which was progressively updated as necessary.

Mailing/preparation was carried out on all work days of the year and special mailing arrangements were employed for extended holiday periods such as Christmas and Easter.

3.6.2 Problems arising during the survey

In general, there were very few difficulties encountered during the field work for the survey. Two factors should, however, be mentioned.

The first of these was the initial low response rate in Victoria (particularly Melbourne) which was first noticed in the pilot survey, and continued for the first weeks of the survey. It is believed that this may have been the result of the "green surveys" common in Melbourne at that time. Householders were being asked to complete detailed surveys on their consumer preferences, after which they received considerable propaganda from the companies selling the goods they had rated. This resulted in considerable negative media coverage for surveys in general, which no doubt could have affected the response rates for this survey.

Secondly, a mail strike occurred at Sydney mail centres between 18 and 25 October, 1985. During this time no mail was sent from the Sydney office. Travel dates which were affected by this were re-allocated to 1 (or in some cases 2 weeks) later. In no instance was the day of the week altered. All questionnaires affected by the mail strike have been coded accordingly and have not been used for the calculation of weighting factors for the correction process. Its effect was seen as a temporary downwards fluctuation in the N.S.W. office response rates, although they quickly returned to normal after that time.

3.6.3 Response Rates

The response rates were monitored on a weekly basis for each State, for each office and by day of week. Overall response rates are summarised in Table 2 on the following page.

Table 2 shows that the response rates were generally highest in the smaller States and lowest in New South Wales and Victoria. The highest overall response rate was in Maitland (76.8%) in South Australia and the lowest in Alice Springs (49.2%), Northern Territory. Of the States/Territories, Tasmania (72.5%) had the highest response rate, and Northern Territory (56.2%) had the lowest. The response by reminder is shown in Table 7 of Appendix G.

Town	Gross Sample	Sample Loss*	Net Sample	Response	Response Rate
<u>Canberra/ACT</u>	735	15	720	482	66.9%
Sydney	6000	234	5766	3535	61.3%
Newcastle	450	21	429	283	66.0%
Nowra	420	52	368	207	56.3%
Dubbo	435	34	401	259	64.6%
Brewarina	105	18	87	48	55.2%
<u>NSW Total</u>	7410	359	7051	4332	61.4%
Melbourne	5955	248	5707	3515	61.6%
Rural Vic	990	85	905	622	68.7%
Geelong	330	10	320	219	68.4%
Warrnambool	390	13	377	250	66.3%
Bendigo	435	23	412	303	73.5%
<u>Vic Total</u>	8100	379	7721	4909	63.6%
Brisbane	3375	118	3257	2279	70.0%
Townsville	420	15	405	254	62.7%
Gold Coast	450	60	390	236	60.5%
Charters Twrs	283	36	247	145	58.7%
<u>Qld Total</u>	4528	229	4299	2914	67.8%
Adelaide	2970	221	2749	1922	69.9%
Whyalla	300	7	293	208	71.0%
Maitland	75	6	69	53	76.8%
<u>SA Total</u>	3345	234	3111	2183	70.2%
Perth	2970	55	2915	2038	69.9%
Geraldton	255	13	242	150	62.0%
Esperance	150	4	146	98	67.1%
Kalgoorlie	120	2	118	73	61.9%
<u>WA Total</u>	3495	74	3421	2359	69.0%
Hobart	615	44	571	412	72.2%
Wynyard/Burnie	255	22	233	171	73.4%
<u>Tas Total</u>	870	66	804	583	72.5%
Darwin	720	20	700	402	57.4%
Alice Springs	135	9	126	62	49.2%
<u>NT Total</u>	855	29	826	464	56.2%
TOTAL	29338	1438	27900	18226	65.3%

*(e.g. vacant dwellings, listing errors)

Table 2: Response Rates

3.7 Editing/Pre-Coding

As described in Section 2.1.7, office staff manually checked all questionnaires as they were returned to the office. This involved pre-coding of unstructured questions as well as telephoning of all households where problems could not be resolved. This was particularly important in ensuring that a high proportion of forms on which return trips were omitted could be completed.

3.8 Validation

Validation interviews were carried out as described in Section 2.2. The results are shown in the following tables. In total 168 households (408 persons) were interviewed. The number of trip makers (mobile persons) increased from 324 before validation interviews to 336 after the interviews, (i.e. 12 people [3.7%] had travelled on the travel day and not reported trips).

It should be noted that, by manually checking which changes would have occurred to validation interviews had normal pre-coding procedures been applied, it was estimated that 75.6% of all 'unreported trips' would have been identified in normal pre-coding procedures, meaning that overall underreporting was shown to be only about 2.6%.

Purpose	No. of Trips	
	Before Validation	After Validation
Work	144	152
Education	48	56
Shopping	204	236
Home	408	460
Drop off/pick up	88	88
Social/recreational	132	136
TOTAL	1024	1128

Table 3: Effect of Validation Interviews on Trip Purpose Reporting

As expected "return home" trips were most frequently forgotten -- although these are the trips which are most likely to be corrected in the pre-coding phase. Most accurately reported were the drop off/pick up trips.

Mode	No. of Trips	
	Before Validation	After Validation
Walk	244	348
Bicycle	28	28
Public Transport (incl taxi)	92	100
Motor vehicle	784	840
TOTAL	1148	1316

Table 4: Effect of Validation Interviews on Trip Mode Reporting

Clearly, under-reporting is most significant for walk trips (often short) while bicycle trips are reported most accurately.

The response to the "5th reminder interviews" was as follows:

- o 33.3% were found to be actual sample loss (e.g. vacant dwelling)
- o 28.6% were refusals
- o 38.1% responded fully.

The last category comprised almost totally people who 'just hadn't got round to it'.

The average number of trips per responding person in these interviews was 2.4, considerably less than the 3.3 trips per person in the main survey. Correspondingly, in these 5th reminder interviews, there were 3.0 trips per mobile compared with 3.9 in the main survey, suggesting support for the hypothesis (used later in Appendix G as the basis for a

trip factor) that, in general, the trip rate decreases as the number of reminders increase. Table 5 shows the overall comparison of trips per mobile.

Trips per mobile after:	1st Quest.	Reminder				
		1	2	3	4	'5'
	3.99	3.73	3.49	3.46	3.69	3.00

Table 5: Comparison of Validation Interviews with Main Survey by Reminders

4. PREPARATION OF TRIP DATA FOR EXPOSURE CALCULATION - A TRIP MODES FILE

4.1 Introduction

As discussed in the description of the methodology (Section 2), the survey instrument used in this study was planned to be as "respondent-friendly" as possible in a self-administered design. This meant that the definition of a trip from the respondents' perspective was what transport planners commonly call "linked" trips, i.e. trips are the movements from one activity to another and do not include the recording of all changes of mode which take place in the course of these movements.

For the purposes of calculating exposure, however, the amount of time (and the distance) spent walking to the bus shares equal importance with the bus trip itself. For this reason, a "trip modes file" was created in which all multi-modal trips (e.g. walk/bus or bicycle/train) have been broken up (for purposes of time and distance) into single mode trips. There is also a record in the file for each single mode trip (Appendix H).

The method of doing this is described in the following sections.

4.2 The Method

In order to gain an understanding of the magnitude of the task, the first step was to look at the number of multi-modal trips which were reported in the survey. Just over ninety four percent (94.1%) of all trips were reported by respondents as single mode, 4.8% as two-mode, 1.0% as three-mode and the rest (.085%) as four or five mode. Using the known times and distances for each of the single mode trips, it was possible to calculate an average speed for each mode in each of the "towns" surveyed.

For a two-mode trip it was assumed that the speeds determined in this way applied to the two parts of the trip; thus the time and distance for each part was calculated. In a few exceptional cases problems occurred if, for example, a car plus train trip had a reported speed lower than either the car or train speeds derived from the above. Observation suggested that these few cases would have no noticeable effect on the data base. If a town had a multi-mode trip involving a mode which had no single mode trip in that town, a standard speed for each mode was used. This was very rare, occurring only once or twice.

Because there were only just over 1% of all trips with more than 2 modes, it was possible to take a relatively simplistic approach for this type of trip.

- o First it was treated as a two-mode trip where the first mode was the slowest of the modes used and the other mode was a composite of the remaining modes.
- o Then, the speed assigned to the composite mode was the average of the modes involved.
- o The composite mode trip was then further broken down in exactly the same way.
- o This process continued till all modes were isolated.

Initially the concept of imputing a different time/distance figure for the peaks and off-peaks was considered, but after some investigation it was decided that differences between them were not significant enough to warrant this distinction.

The resulting trip modes file can readily be used in conjunction with the normal data files for the calculation of exposure figures for all parts of all trips.

5. THE ADMINISTRATION PROGRAMS

To assist with the administration of the travel survey, a special set of computer programs was written. This package of programs was known as MATSCAP (MAILback Travel Survey Coding and Administration Program). The four major programs which make up MATSCAP are described in this section, although more comprehensive documentation can be found in the Procedures Manual.

5.1 SAMGEN

SAMGEN (SAMple GENerator) is a program which performs four main functions. The first use was to randomly select dwellings from the blocklist sheets. This was a user-friendly facility which simply required the operator to specify the number of dwellings listed in any block. It then randomly generated the dwelling numbers for the sample.

SAMGEN was also designed to facilitate the entry of address details into data files. The package has a variety of commands which minimise key strokes, e.g. if the street or suburb was the same as for the previous address, only the carriage return had to be pressed.

SAMGEN also enabled review and editing of these details during the initial data entry phase and at a later stage if addresses had to be changed.

5.2 ADDLABEL

The ADDLABEL (ADDRESS LABEL) program was used to prepare three types of material for mailing on each day of the survey:

- o worksheets which describe the work to be done on any one day,
- o address labels for envelopes which are sent to respondents,

- o imprints of the travel day and sample number on the questionnaires to be sent to respondents.

Some material had to be prepared on a routine daily basis (e.g. worksheets/labels/imprinting for reminders could only be done after the mail had arrived each day and returns had been entered via RETLOG). For other material it was possible to prepare the work in advance for specific days e.g. pre-contact letters and first questionnaires which were sent to all households in the sample, and were not dependent on specific daily returns.

The worksheets specified the travel day and mailing day for each type of mail and had to be checked and signed by officers on a daily basis.

5.3 RETURNS

The RETURNS program was designed to keep track of the status of responses from households in the survey. Its first function, therefore, was to enable the user to enter information about the responses received each day. The user simply entered the sample number and the actual travel day as the first task of the day after the mail had been collected.

The RETURNS program also allowed checking of the current status of the returns log (for any file) and editing of any information in the returns log. The latter facility enabled the entering of "Comment" codes such as 'refusal' or 'sample loss' codes which served to stop generation of further mail to any address.

5.4 CODER

CODER was the program used by Socialdata Australia personnel to enter the data once all pre-coding and manual editing had been completed in the offices.

Its primary function was to facilitate the user to input data from the questionnaires. The screens were set up to emulate the actual questionnaire design, making data entry as straightforward as possible. Editing checks were incorporated into the design.

The program also enabled the data stored on the disk to be examined, edited and backed-up as necessary.

After back-up, the data disks were forwarded to the Sydney office on a weekly basis for checking and storing. This meant that there were always copies of all coded data at two different places in Australia at any given time, and that if one were accidentally lost or destroyed another copy of the data could be readily obtained. At worst, if the original and back-up copy of the data were lost, only one week's worth of coding would have been lost, and this could have been recovered by recoding data.

6. DISCUSSION AND CONCLUSIONS

The NATIONAL SURVEY OF DAY-TO-DAY TRAVEL IN AUSTRALIA 1985/86 was carried out between August 1985 and July 1986. Its aim was to gather a valid data base suitable for use to calculate crash risk exposure for a large sample of persons spread geographically throughout Australia and distributed over a one year period. The survey provides a data base which, when expanded (weighted) to represent the entire population in each town/city, can be used directly in this manner.

Several points have emerged from the study.

- o The technique used -- a self-administered, mail-back questionnaire with four reminders, and as respondent-friendly as possible -- was shown to be suitable for a large scale travel survey. It was able to fulfil the Federal Office of Road Safety's (FORS) objective of "providing a data base for the evaluation of road user risk in Australia".
- o In addition, this project could provide the data for many other transport policy projects around Australia, particularly as the data base is the only consistent source of travel information for all Australian States and Territories.
- o Pre-testing forms and procedures in a skirmish and pilot test resulted in an operation which proceeded without problems for the entire survey period and ensured that the survey instrument could be easily understood and completed by the respondent.
- o Validation was undertaken and corrections for some biases were calculated.

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APPENDIX A

The Pre-Contact Letter



MINISTER FOR TRANSPORT
Parliament House,
CANBERRA A.C.T. 2600

Dear Sir/Madam,

As you are no doubt aware, road crashes are one of the biggest killers of people in Australia, particularly young people. Governments have done much to try and halt what once seemed like an endless spiral of road death and injury. To some extent, we have succeeded but we are now calling on you to help us further.

The Federal Department of Transport is conducting a National Daily Travel Survey to collect information on the travel habits of Australians during 1985 and 1986. Your household has been randomly selected to take part and I am asking for your help in collecting this urgently needed information.

The survey will enable us to better understand all the problems that surround road safety and will assist us in developing more effective measures to combat the road toll.

The specialist firm of Socialdata Australia will be conducting the survey on behalf of the Federal Government. In the next week or so a questionnaire will be forwarded to you by mail, together with a reply paid envelope. It will ask questions on how you get to the shops or to work, how far you walk or drive your car and so on.

All answers to the questionnaire will be kept strictly confidential and will be used for statistical purposes only. Please help us to save more lives by filling in the questionnaire (which will only take a few minutes) when it arrives, and returning it promptly.

Yours sincerely,

A handwritten signature in dark ink, appearing to read 'Peter Morris', written over a light-colored background.

PETER MORRIS