LOOKING BEYOND COMMUTER TRAVEL IN CAPE TOWN:

METHODOLOGICAL LESSONS FROM THE APPLICATION OF AN ACTIVITY-BASED TRAVEL SURVEY

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ABSTRACT

The way the passenger transport problem has, in the past, been framed in Cape Town and other South African cities, and the nature of the transport modelling exercises that have given rise to large-scale surveys, have resulted in a limited understanding of travel behaviour beyond home-based work trip-making and morning peak period traffic volumes. Within a new South African transport policy environment however - where the discourse has shifted from ‘commuter-based’ to ‘customer-based’ service provision, and from supply-side to demand-side strategies - current understandings of travel needs and behaviour are insufficient. Little is understood of household constraints on travel decisions, of non-work, informal work, off-peak and non-motorised travel needs, as well as of so-called ‘equity gaps’ in transport supply. Richer, better quality data are required to implement and monitor the new transport policy, and innovative methods will be required to collect and analyse these data.

This paper reports on the experiences of a survey aimed at collecting rich data through methods that are, to a large extent, innovative in the South African context. This survey, in the form of an activity-based household travel survey, was conducted in late 2000 and early 2001. The choice of, and some theoretical background to, the survey methodology is discussed. A description of the survey instrument, sample selection, survey administration and data capture and analysis is provided. Methodological lessons from the design and administration of the survey are identified. These centre around the importance of interviewers in successful surveying, interviewer versus self-completion of activity diaries, the impact of computer-assisted interviewing technology on substitution rates, recall periods, and trip recall.
1. **INTRODUCTION**

This paper reports on the administration of an activity-based household travel survey in Cape Town, between August 2000 and February 2001. The purpose of the paper is to recount how the survey was prepared for, how it was administered, and what methodological lessons were learnt from this experience. Despite being fairly new to South Africa, in international terms the survey instrument and administrative procedure developed represent no great innovation. For delegates attending this conference therefore - some of whom were instrumental in developing the activity-based methodology that I will be describing later - greatest interest will probably lie in how this analytical framework was interpreted to be of relevance to, and applied in, a developing world context. This is a topic around which there is little published literature.

The paper will begin by briefly reviewing past travel analysis in Cape Town and other South African cities, in order to establish the scope of current representations of travel behaviour (section 2). From the gaps in understanding that this review reveals, the objectives of the survey will then be identified (section 3). The paper will go on to discuss the study’s theoretical and analytical framework (section 4), survey instrument (section 5), target population and sample selection (section 6), survey administration (section 7), and data management (section 8). The paper will conclude with a discussion on methodological lessons (section 9).

2. **PAST TRAVEL ANALYSIS AND CURRENT REPRESENTATIONS OF TRAVEL BEHAVIOUR**

A review of the international literature on travel analysis reveals a number of methodological streams. These include: aggregate, land use-transport interactive, disaggregate, dynamic, micro-simulation, activity-based, stated preference and strategic policy appraisal methods. The emergence of each of these streams has led to particular data requirements, which have in turn given rise to particular data collection methods.

A review of the South African literature on travel analysis reveals four discernible overlapping periods in which travel analysis was dominated by either a particular theme, or a group of related themes. These periods and the methodological streams they employed, are discussed briefly in turn.

The first period occurred during the late 1960s, 1970s and early 1980s and was concerned primarily with the collection of the data necessary for the calibration of the earlier travel demand forecasting models in South Africa. Most of these models took aggregate four-stage form, with MINI-TRAMP and DELTRAN the most commonly applied software. In reviews of transport modelling software and travel data sets available in South Africa, Ferreira (1977), Jordaan (1989), Crous and Price (1993) and Wilmot et al (1990) illustrate that between 1965 and 1985 most of the major urban centres applied these models in one form or another, and administered the surveys and traffic counts necessary for their calibration and updating. The surveys that were administered typically took the form of racially stratified home interviews. Their scope was usually, but not always, limited to weekday morning peak periods, within which data was collected on variables like trip purpose, origin, destination, mode use, travel time, distance and frequency (Wilmot et al 1990).

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1 The survey forms part of my PhD research into local area travel needs and movement network configuration. This research is funded by the South African Department of Transport’s Southern Transportation Centre of Development, and supervised by Peter Wilkinson of the University of Cape Town and Professor Phil Goodwin of the University College London.
The second discernible period of travel analysis occurred during the mid 1980s and early 1990s and was concerned primarily with analysing the impacts of apartheid urbanisation and segregation policies on the travel patterns of ‘black’ workers, and with gathering data on the travel patterns of the ‘black’ population necessary for either informing urban transport policy formation or for including previously excluded township areas in travel demand forecasting studies. Studies concerned with the travel impacts of apartheid policies were undertaken by Fourie and Morris (1985) and Morris (1982, 1986), and by various urban geographers (Pirie and Khosa 1992). Studies concerned with gathering data to inform policy and travel demand forecasting studies were undertaken by various consultants and transport authorities.

A third period of travel analysis occurred during the early 1990s and was concerned primarily with the collection of the travel data necessary for the calibration of newly acquired EMME/2 four-stage travel demand modelling software. Whereas numerous software packages were in application in the late 1980s, Davies et al (1995) demonstrate that by the early 1990s almost all South African transport authorities had converted to the Canadian software EMME/2. This shift can be attributed to the superior flexibility, multi-modal assignment and graphics capabilities of EMME/2 over earlier four-stage modelling software (Crous and Price 1993, Davies and Rontiris 1992). Data collection to calibrate and update these models occurred between 1989 and 1999 (Davies et al 1995). In many, if not most instances, the models have been calibrated for the weekday morning peak period when congestion is generally worst, and consequently travel data (i.e. origin, destination, timing, mode use) were either collected for only work trips or trips occurring within the weekday morning peak.

The fourth, and most recent, period of travel analysis occurred during the latter half of the 1990s and was concerned primarily with the collection of data to inform a post-apartheid government policy shift from ‘commuter-based’ to ‘customer-based’ passenger transportation (NDOT 1998). The identification and analysis of ‘customer segments’ in post-apartheid transport policy was based on October Household Survey (OHS) data collected by Statistics South Africa, and a home interview survey to compensate for the work trip focus of the OHS. In the survey, data were collected mainly on mode use, availability and satisfaction, travel time and expenditure, and attitudes towards mode switching.

How then have travel needs and behaviour been represented as a result of the analytical activity described above? A combination of apartheid policies, that dictated an analytical focus on the daily transportation of labour in and out of cities, and the dominance of predictive four-stage travel demand models and their data requirements in South African travel analysis, has resulted in most representations of travel behaviour being restricted to either home-based work trip-making or travel occurring within peak periods. In both instances the focus has been on interzonal (i.e. longer distance) travel.

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2 Fourie and Morris (1985) and Morris (1986) applied activity-based methods to study the effect of long journey times on the daily activities of black commuters in Pretoria. Data were collected on work trip lengths, time budgets and mode use.

3 Personal or home interview surveys of the trip generation, travel characteristics and infrastructure needs of ‘black’ travellers were undertaken by Davies and Bester (1994), de Lange and Vorster (1989) and Pienaar (1994). Survey and cordon counts of ‘black’ and ‘coloured’ commuters were undertaken by Aron et al (1990), CTCC (1981) and VKE (1986, cited in Wilmot et al 1990). Surveys of the impact of the emerging mini-bus taxi industry on the mode choice of ‘black’ travellers were undertaken by Freeman (1987), and Oosthuizen (1986) and VKE (1989) (both cited in Wilmot et al 1990). Perhaps the most important study however was the national passenger panel survey run between 1987 and 1994, which collected longitudinal data on the transport expenditure, mode availability, mode use and transfer and travel time of ‘black’ (or ‘disadvantaged’) commuters (van der Reis et al 1993, van der Reis and Lombard 1995).

4 In other words, a shift in concern from transporting peripherally located labour into and out of employment centres, to improving the access of prioritised ‘customer segments’ (e.g. ‘stranded’ travellers living in peripheral townships without access to public transportation) to the full range of educational, social and economic opportunities offered by urban agglomerations.
travel by motorised modes. There are of course exceptions that provide insights into non-work, off-peak and non-motorised travel behaviour, but these are limited and many had as their underlying purpose the development of trip generation rates for use in the first stage of the four-stage travel demand forecasting procedure, rather than the development of a complex understanding of behaviour, choices and constraints.

This problem of limited scope is compounded by the age of much existing data. A review of published studies involving household or personal interview surveys in Cape Town reveals that most surveys were conducted eight or more years ago. Subsequent surveys (with the exception of the earlier mentioned survey of 'customer segments') - in the form of the final National Passenger Panel in 1994 and the annual October Household Surveys - have focused almost exclusively on home-based work trips. Subsequent surveys in other cities - in Pretoria and Durban in 1999 - while covering more than just work trips, have focused on only the morning peak. Data on all but work trips (and morning peak trips in some other South African cities) are therefore outdated.

The issue of outdated data aside, in order to identify where gaps in knowledge exist, it is necessary first to conceptualise, at a crude theoretical level at least, what complete knowledge of travel behaviour might encompass. The difference between the respective scopes of complete and current knowledge would thus represent gaps in knowledge or understanding. There are numerous possible ways in which the scope of such complete knowledge could be conceptualised and measured. It is conceptualised here in terms of four basic interrelated dimensions: the personal, functional, logistical and temporal. Travel is undertaken by people, and the particular circumstances of each individual influences his or her travel opportunities and choices (i.e. the personal dimension). The need for people to travel is derived from their need to engage in a variety of activities distributed across space (i.e. the functional dimension). In order to move between activity sites people need to make (sometimes highly complex) arrangements regarding how they will travel (i.e. the logistical dimension). Where and how people travel change over time in response to changes in their personal circumstances and in their broader environment (i.e. the temporal dimension). Measured within these dimensions, major gaps in current knowledge can be crudely summarised as follows:

- the needs and behaviour of the different kinds of people who travel - particularly those travellers experiencing the greatest constraints on their mobility and access;
- how individual travel decisions are made within the context of household relationships, responsibilities and survival strategies, and how life-cycle stage influences travel behaviour;
- arrangements and decisions regarding travel to non-work activities generally, and the relationship between these and work trips;
- travel by persons involved in informal income generating activities;
- travel by non-motorised modes generally, and their relationship with motorised modes;
- the timing of trips across the day (particularly the off-peak periods) and across the week, and the influence of school holidays on travel patterns; and
- how, and over what timeframe, travellers respond to changes in the factors that influence their travel arrangements and decisions.

3. **Study objectives**

Having identified these gaps, why is understanding of travel patterns (as opposed to prediction) important, and why is it important for this understanding to be broader than simply of work- and peak-related travel? The point was made earlier that aggregate (and later disaggregate) four-stage demand models and their data requirements have dominated South African travel analysis. The same can be argued to
be true internationally, even though more recently many European, North American and Australasian countries have applied alternative methods - in the form of activity-based, stated preference and panel analysis - to a far greater extent. The dominance of the four-stage analytical framework has resulted in much greater importance being attached to the prediction (through mathematical modelling), than to the understanding (through empirical observation), of travel.

It has been argued that an increasingly fluid and globally competitive urban economic context casts aspersions on longer term predictions, and an emphasis on prediction has hampered the ability of much travel analysis to develop an understanding of current behaviour in a period of rapid change (Gillespie et al 1998). Policy changes have also been argued to have rendered mainstream travel analysis increasingly obsolete (Axhausen 1997, Goodwin 1998, Hutchinson 1981). Internationally a clear change in transport policy discourse can be observed in recent decades - from what is referred to in the British literature as ‘predict and provide’, to a greater emphasis on travel demand management. A similar, but much more recent, change is apparent in the transport policy of the new South African government, to which as mentioned earlier has been added a discursive shift from ‘commuter-based’ to ‘customer-based’ service provision. Within ‘predict and provide’ policies the urban transport planning problem was defined as one of avoiding the congestion associated with forecast traffic growth. As a consequence (at least in the South African context, as discussed earlier), travel analysis usually focused on (typically inter-zonal and motorised) commuter peak travel when congestion is at its worst. The implicit underlying assumption was that a transport system which satisfies the need for travel during the commuter peak, will be able to satisfy all other travel needs worth satisfying. As policies have recognised that it is neither financially, socially nor environmentally desirable to simply match predicted traffic with increased road construction, so it has become increasingly clear that new ways of conceptualising and analysing travel behaviour are necessary, and that the scope of analysis needs to extend beyond simply work and peak trips.5

Greater uncertainty, together with demand-side and equity-oriented passenger transport policies, thus necessitate an analytical emphasis on the diversity of current tangible accessibility problems, and on the complexity of travel adaptations to changes in urban transport systems brought about by the introduction of demand management strategies. While still necessary for the purposes of infrastructure design, longer term traffic predictions are no longer of paramount importance because road construction is no longer, or at least should not be, the cornerstone of passenger transport policy. To identify accessibility problems, or so-called ‘equity gaps’, the scope of empirical observation clearly needs to extend to cover all travel undertaken by all people. To identify travel adaptation to change, travel behaviour needs to be observed over time, and regarded more as a dynamic process of adaptation (or ‘churn’), than as an equilibrium state. Understanding of behavioural patterns and responses to change, derived from empirical observation, is thus important, and studies focussed on improved understanding through empirical observation are important in and of themselves.

Given the gaps in, and importance of, understanding discussed above, what then are the objectives of the study recounted in this paper? The general objective is to demonstrate the diversity of travel needs and behaviour through empirical observation, and in doing so to begin to fill some of the gaps in

5 Some authors have gone further to argue that the restricted scope of past travel analysis has in fact introduced a routine bias in the way in which the urban transportation problem has been understood, and in the nature of the interventions that have been implemented as a result. More specifically that a perception has been created that shorter slower journeys are less important than longer faster journeys (when in terms of the rhetoric of most urban development policies they are in fact the most important), and that shorter distance non-motorised travel, depended upon by many of the transport disadvantaged, has thus either been underestimated or neglected in the planning and design of infrastructure improvements (Dimitriou 1993, Hillman 1994, Mashiri 1997, Vasconcellos 1997, Weatherall 1997).
understanding identified earlier. Based on cross-sectional observation, the study will attempt to indicate the degree to which current representations of travel behaviour misrepresent the full diversity (and complexity) of travel needs, and to indicate what the true extent of these may be. It will not attempt to investigate the dynamics of travel adaptation to policy change (or seasonal change) however, as this would require the collection of longitudinal data not possible within the timeframe of the research project. It will however, in a pseudo way (through the analysis of income bands and life-cycle stages), attempt to investigate the dynamics of travel adaptation to household change.

The research questions to be addressed in the study are as follows:

- What is the nature and extent of all travel (across 24 hours and across the week) in terms of amongst other things, trip purpose, mode use, range, chaining and timing - and in particular, in relation to the gaps in understanding discussed earlier, what is the relative importance and nature of non-work, informal work, non-motorised and off-peak travel?
- What is the influence of household income, and access to private transportation, on travel behaviour - and thus in a pseudo way, what are the dynamics of behavioural change in response to households becoming wealthier and poorer?
- What is the influence of neighbourhood form (i.e. land use distribution and street pattern) and residential location on travel behaviour?
- What is the influence of household life-cycle stage on travel behaviour - and thus in a pseudo way, what are the dynamics of behavioural change in response to households ageing, separating and forming?
- What is the influence of personal circumstances on travel behaviour in terms of amongst other things, trip purpose, frequency, mode use and range - and in particular, in relation to current gaps in understanding, what are the impacts of (un/under)employment, household divisions of responsibility and survival strategies on travel behaviour?

4. THEORETICAL AND ANALYTICAL FRAMEWORK

Of the methodological streams identified at the beginning of this paper, activity-based methods appear to be best suited to pursuing the above objectives. They are best suited to analysing travel behaviour within a personal and household context, and because of their diary format, have shown to be better at collecting data on all travel. International studies (in the United Kingdom, Australia and the United States) that have compared the quality of travel data collected using conventional trip diaries and activity diaries, have shown that trip recall - particularly short trips, non home-based trips and trips made by non-motorised modes - tends to be higher (perhaps by around 13-22%) in activity diaries (Arentze et al 1997, Barnard 1986, Clarke et al 1981a, Stopher 1992). The better trip recall in activity-based survey methods is generally attributed to the fact that in activity diaries the respondent is required to account for his or her time continuously and is therefore forced to recall past events more rigorously, and that recounting activity participation (as opposed to trip-making) matches more closely the way people think and function. The above finding can perhaps be corroborated in comparisons of data sets in Cape Town where an activity diary survey in 1981 found that ‘coloured’ households generated 13.6 trips per day (Cameron et al 1984), whereas an earlier more conventional trip diary survey in 1976 found that households within the same racial stratification generated only 7.4 trips per day (Moolman 1976). The latter survey did however exclude non-motorised trips for all but work and education purposes, which would account for some (probably about 50%) of this 84% discrepancy. This suggests that amongst households with greater reliance on public transport and non-motorised
modes, and with proportionately fewer formally employed members, activity diaries might recall closer to 30% more trips than conventional trip diaries.

Despite a couple of applications in the early and mid-1980s, activity-based methods are to a large extent unknown and untested in South Africa (Behrens 2000). To the earlier listed study objectives can therefore be added that of testing activity-based methods of data collection and analysis in the South African context.

4.1 Theoretical origins of activity-based methods

The theoretical roots of activity-based methods lie primarily in geography, and more specifically in ‘time geography’. Time geography (or ‘chronogeography’) emerged out of research undertaken in the late 1960s and 1970s, by Torsten Hägerstrand and his colleagues Tommy Carlstein, Bo Lenntorp and Solveig Märtensson, a group of Swedish geographers based at Lund University - who became known as the ‘Lund School’.

Hägerstrand (1970) argued that in analysing only mass probabilistic behaviour, regional science - a growing field within the social sciences at the time that specialised in the analysis of human behaviour in space using mathematical models - was unable to engage with important questions of poverty and quality of life of the individual. Hence his seminal paper presented at the Ninth European Congress of the Regional Science Association in 1969 posed the question: ‘what about people in regional science?’.

Here he argued for an analysis of the micro-situation of the individual, as well as of what he referred to as the ‘twilight zone between biography and aggregate statistics’, where the life and identity of the individual was not lost in large-scale analyses of aggregate behaviour. Such micro-analyses, he argued, provided insights into the operation and performance of urban systems not possible in aggregated analyses.

Hägerstrand’s critique of regional science formed part of a larger body of literature that was critical of the direction the social sciences, more generally, were taking in the 1960s and 1970s. During this period social science, and regional science in particular, was dominated by what became known as ‘social physics’, where laws derived from the natural sciences were applied to explain human behaviour, and humans were essentially equated to particles or electrons - the gravity model applied in trip distribution modelling is a clear example of this. Critics of social physics saw fundamental differences between the natural and social sciences. The social sciences were argued to have revealed few, if any, of the rational behavioural regularities observed in the natural sciences. They argued that these differences placed significant limitations on the explanatory and predictive abilities of mathematical models of human behaviour based on analogies to mathematical relationships in the natural sciences. This criticism led Lee Cronbach (1986) to observe, somewhat satirically, that ‘whilst particles are attracted to each other, they never fall in love’. It was thus argued that the models of human behaviour developed in the social physics period had produced simplistic ‘rational’ outcomes that bore little resemblance to the real world (Pas 1990, Polak 1987).

Hägerstrand and his colleagues at the Lund School argued that in order to analyse the micro-situation of the individual, time needed to be incorporated into space studies as a way of disaggregating aggregate population statistics. In the theoretical framework of time geography they developed, time and space were regarded as resources, and the primary determinants of the human experience were seen to be the constraints that restrict an individual’s utilisation of these resources⁶. Constraints took three forms:

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⁶ Some authors have suggested that the contemporaneous, and broadly similar, work of Stuart Chapin, an American sociologist and urban planner based at the University of North Carolina at Chapel Hill, was equally influential in the
'Capability constraints' referred to the physical and technological limitations of an individual. ‘Coupling constraints’ referred to the need for an individual to undertake certain activities at certain time-space locations, or ‘stations’, with other people - which results in a ‘bundling’ of individuals’ activities at specific stations (e.g. schoolchildren attending school classes). ‘Authority constraints’ referred to institutionally imposed restrictions and regulations (e.g. office or shopping hours) - which result in a hierarchy of overlapping ‘domains’ in time-space within and beyond which an individual’s access is controlled.

Two key analytical tools were developed by the Lund School to trace an individual’s, or a group of individuals’, utilisation of time and space resources, and the constraints that are imposed upon this: ‘time-space paths’, and ‘time-space prisms’.

A time-space path, or ‘trajectory’, referred essentially to an individual’s activity schedule through time and space. The paths of individuals were not seen to be isolated. As indicated above, they come into contact in the form of bundles, in accordance with the varying influence of the three types of constraints, and the positioning of ‘stations’ in time-space. The activities of a human population were therefore conceived of as forming a web of individual paths which flow through, and at times connect at, a set of time-space stations.

Figure 1: Time-space paths, stations and bundles

A time-space prism referred essentially to the ‘autonomy’ of individuals to determine their time-space paths. The above-mentioned capability, coupling and authority constraints were seen to be central in defining the shapes and sizes of these prisms, and the paths that individuals took through them. The height of a prism was defined by the available time within which an individual could move from one spatially fixed activity to another, and make a discretionary trip(s) within this time as part of a trip chain or journey. The width of a prism was defined by the distance that could be covered by the individual to discretionary trip destinations within the time available. The amount of time available and the speed of travel were determined by the activity-based methodological stream in travel analysis (Bowman and Ben-Akiva 1996, Kurani and Lee-Gosselin 1996, Pas 1996). Thrift (1977) however argues that Chapin’s work is distinct from that of the Lund School in that activity participation and the human experience more generally were seen to be the outcome of choices that reflect the desires and values of the individuals who make them, rather than a series of constraints or ‘negative determinants’. Chapin (1974) argued that an individual’s demand to participate in various activities within an urban environment was motivated by a number of basic human desires, from ‘survival’, to ‘social encounters’, to ‘ego gratification’. The factors that were seen to impinge upon an individual’s choice of activity in order to meet one or more of these desires included: a ‘propensity’ for that activity to occur (e.g. the role of the individual within the household), a perceived ‘opportunity’ for the activity to happen (e.g. an accessible and appropriate place within which to conduct the activity), and an ‘appropriate situation’ within which the activity can occur (e.g. an appropriate time for the activity to occur).
the travel mode used therefore places constraints on an individual’s time-space path. For instance, as
the speed of the mode used increases, so the angle of the prism becomes more acute - non-motorised
modes therefore result in narrower prisms, and a smaller range of possible ‘discretionary’ destination
choices, than motorised modes. Time-space prisms enabled the collection of data on what people can
and cannot do, rather than simply on what they chose to do (as in the case of revealed data collected in
time use surveys). This was argued to be more instructive for the purposes of formulating policies
aimed at the creation of an ‘isotropic plane of choice’, or ‘equitable urban environment’ - the Swedish
policy ideal at the time (Thrift 1977).

Figure 2: Time-space prisms

Note: Diagram (a) illustrates the effect maximum travel speed has on the width of a prism, where \( v_1 \) represents driving
speed and \( v_2 \) cycling speed. Diagram (b) illustrates the effect time has on the height of a prism, where \( t_1 \) is the end
of working hours (16h30), \( t_2 \) is the close of a child day-care centre (17h30), and \( t_3 \) is the adjusted close of the day-
care centre (17h15). Diagram (c) illustrates the constraints placed on a parent leaving work (\( s_1 \)) by car (\( v_1 \)) and
needing to draw cash from an automated telling machine (\( s_3 \)) on the way to collecting his or her child from the day-
care centre (\( s_2 \)) before \( t_2 \). From (c) it can be seen that the parent has the choice of few if any discretionary \( s \) trip
destinations, and would only have the choice of undertaking the trip chain by bicycle (\( v_2 \)) if the day-care centre
extended its closing time to 18h30.

4.2 Emergence of activity-based methods of travel data collection
and analysis

The time geography theoretical framework, and more specifically its techniques of empirical
observation, proved to be influential in various spheres of the social sciences. Time geographic
techniques were used in the field of social theory, and more particularly the notion of constraint was
adopted by analysts of travel behaviour in the field of transport planning. The emergence of activity-
based travel analysis in the late-1970s and early-1980s marked what Eric Pas (1990) argues in his
retrospection to be the only Kuhnian ‘paradigm shift’ in the evolution of the field. Pas argues that the
shift from aggregate to disaggregate analytical methods that occurred in the 1970s was essentially a shift
in statistical technique, rather than a shift in paradigm. The paradigm shift referred to involved, in
essence, a redefinition of the phenomenon being analysed - activities, and the demand for travel derived
from participation in these, replaced trips as the new unit of observation. The paradigm shift was
however more than the kind of scientific revolution envisaged by Thomas Kuhn (1970) where one
system of thinking is discredited by the scientific community and supplanted by another. It was the first
time that positivism (with its associated stable, law-like ontology; objective or scientifically neutral
epistemology; and hypothetico-deductive methodology) came into conflict, or at least coexisted, with
other paradigms, in the field of travel analysis.7,8

7 For a good illustration of this kind of paradigm conflict and coexistence, see the academic exchange between Janusz
Supernak and John Polak in the mid-1980s. (Supernak 1983, Polak 1987, Supernak and Stevens 1987)
8 Time geographic research, and the early applications of activity-based methods in travel research, might be argued to fall
more neatly within a ‘social constructionist’ or ‘critical social science’ paradigm (with its associated dialectic, socially

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With a limited number of possible exceptions, the earlier aggregate, disaggregate and land use-transport interactive methodological streams mentioned earlier had up until this point been based upon: the analysis of discrete trips; the analysis of choices in relation to discrete trips (using the theoretical framework of utility maximisation); and the achievement of, or at least the assumption that cross-sectional data collected on trip-making behaviour were in, some form of equilibrium state. Critics argued that these hitherto trip-, choice- and equilibrium-based analytical methods (operating largely within a positivist paradigm) neither explained travel behaviour and responses to transport system changes very well - particularly behavioural phenomena like trip chaining, timing, suppression and inducement, and intra-personal variability over time - nor were capable of identifying the varying impact of transport policies on different users. Earlier methods had been developed primarily for the long-term planning and design of road capacity improvements. The shift from supply-side to demand-side transport policies internationally, that began in the 1980s, and more particularly the emergence of shorter term travel demand management strategies, highlighted the limitations of these methods in estimating the impacts of alternatives to increased road capacity (e.g. peak spreading, ‘park-and-ride’, telecommuting). Despite incremental improvements, it was argued that such methods remained fundamentally the same as those originally developed in the seminal transport studies of cities like Detroit and Chicago in the 1950s and 1960s (Jones et al. 1990, Hutchinson 1981, Pas 1998, Weiner and Ducca 1999).

That time geography offered a theoretical framework that could overcome some of the limitations of earlier methods, was first recognised in the late-1970s. Pioneering studies into activity-based methods were undertaken by Ian Heggie, and his colleagues Mike Clarke, Martin Dix and Peter Jones at the Transport Studies Unit (TSU), at Oxford University (Clarke et al. 1981b, Jones et al. 1983). The work on activity-based methods in the 1980s focused mainly, but not exclusively, on understanding travel behaviour, and on new approaches to data collection and data analysis. The emphasis in the activity-based approaches to data collection and analysis developed by the TSU, was on understanding the complexity and interrelatedness of travel patterns within households, and with the constraints that this interrelatedness placed on an individual’s travel choices. In contrast to earlier methodological streams, as stated earlier, the emphasis was therefore not solely on travel, but on people’s participation in activities and the connectedness among various activities, both for one person and for groups of people. It was argued that it was not possible to understand how travel behaviour might respond to changes in the transport system, without a much deeper understanding of the everyday lives and activities within which travel decisions are embedded.

5. **Survey Instrument**

The kind of data required by the emergent activity-based methods discussed above clearly necessitated more detailed survey instruments than had previously been employed - principally in the form of trip diaries. In designing activity diary instruments, decisions needed to be made on a number of issues. These decisions included: their functional scope - whether activity descriptions are open or coded, and whether activity descriptions are required for all activities, out-of-home activities, or just place-related activities; their temporal scope - whether time intervals are open or fixed; their time horizon - whether activities are recorded for the previous day, or during the diary day; the diary period - the days of the week selected, and the number of days; and the administrative procedure - whether the diary is constructed ontology; value-driven epistemology; and deconstructionist and analytical methodology) (Neuman 1991, Terre Blanche and Durrheim 1999).

9 Most work on predicting travel behaviour, and on the development of activity-based travel forecasting models occurred later, in the 1990s, by which stage numerous other academic institutions in countries like the United States, The Netherlands, Germany and Japan had developed research capacity in the activity-based field as well.
recorded in a personal interview, telephone interview, or by self-completion, and whether in interviews paper or electronic questionnaires are used. Theoretically at least some of these design options - the extent of activity disaggregation, the diary period and the administrative procedure - can apply to almost any diary form. Others are specific to particular forms.

5.1 Generic activity-based survey instruments
A review of the available literature revealed five generic activity-based surveys instruments. These generic forms, and their design features, are discussed in turn.

- combined sedentary/travel activity diary tables;
- time-blocked combined sedentary/travel activity diary tables;
- linked sedentary and travel activity tables;
- in-depth interactive interviews and game simulation; and
- memory joggers and activity sheets.

Combined sedentary/travel activity diary tables were used in the earlier activity-based surveys administered in 1976 by the Oxford TSU in Abington (as a pilot survey) and Banbury (as the main survey), even though in Abington a ‘free-form’ diary was tested in which respondents were free to choose any way of recording their activities in a notebook provided (Clarke et al 1981b, Jones et al 1983). The diaries involved all household members keeping a temporal and spatial record of the activities they engage in, and of the trips they take in order to access these activities. The diaries were kept for seven days, and self-completed. Dairies for young children were kept by adults. Problems with the Abington and Banbury diaries included ambiguous location descriptions, difficulties in separating and describing activities, and fewer recorded activities and trips later in the seven day period. The relative advantage of combined sedentary/travel activity diary tables would appear to be that they are easy to understand. Their relative disadvantage is the limited amount of data they collect.

![Figure 3: Example of a combined sedentary/travel activity diary table (after Jones et al 1983:60)](image)

Time-blocked combined sedentary/travel activity diary tables are a form of activity-based survey instrument that has been applied in South Africa. An early application was in six middle income ‘white’ and ‘coloured’ residential areas in Johannesburg, Pretoria and Durban (Cameron et al 1984). A later application used a diary to analyse the behaviour of informal food traders in New Crossroads, KTC and Nyanga (in Cape Town) (Dierwechter 1999). In both of these diaries, activities and time intervals were prescribed. In the former the diary was kept for one day and self-completed, and in the latter it was kept for three days and completed by the interviewer in multiple visits. The relative advantage of time-blocked combined sedentary/travel activity diary tables would appear to be their simplicity and low respondent burden (no writing is required, just block marking), even though Cameron et al (1984) did report that a significant proportion of respondents found the diary too complicated. Their relative disadvantage is prescribed activities and time intervals which can result in coarser activity duration, travel time and trip timing data, or even omission.
Linked sedentary and travel activity tables are a modification of combined tables whereby sedentary activities and travel activities are recorded in one table, and travel activities are then recorded again in greater detail in another table. In this way more detailed data can be collected than in combined sedentary/travel activity tables. This form of diary was administered in a self-completion survey in Adelaide in 1980 over the course of a week (Barnard 1986). The relative advantage of linked sedentary and travel activity tables would appear to be that they are capable of recording greater detail on travel activities than combined tables. Their relative disadvantage is that the simultaneous completion of two tables makes them more complicated to understand and thus present a greater respondent burden.
In-depth interactive interviews involve establishing activity schedules and travel patterns, and asking household members how they would alter this if a change in the transport system, or in any other constraint on their daily activity schedule and travel behaviour, were to occur. A well-documented example is the Household Activity-Travel Simulator (HATS) developed by the Oxford TSU and first applied in 1976 (Jones 1979a, 1979b, Jones et al. 1983). In the HATS interview, the respondent is asked to plot his or her home activities, non-home activities and interlinking travel activities for the previous day, on a gameboard, using different coloured blocks. Having established the individuals actual activity-travel behaviour for a particular day, the individual is then asked to rearrange this represented activity-travel pattern in response to a range of hypothetical temporal or transportation supply changes (e.g. changing working hours, bus availability) through rearranging the blocks. The revised individual activity-travel patterns are then quantified and analysed. A HATS kit was acquired from the Oxford TSU, and applied in South Africa by the (then) National Institute for Transport and Road Research in a pilot study in 1985 involving fourteen (‘black’ male) individuals living in Mabopane and Soshanguve (in Pretoria). The study was limited to the previous working day. Respondents were reported to have found the apparatus too complicated, and considerable explanation time was required. It was also reported that while pencil and paper were taken seriously, the apparatus was felt to be childish and condescending (Morris and van der Reis 1986). Despite these and other problems, Morris (1986) concluded that such a study was feasible, and recommended that a larger commuter survey, as well as subsequent studies with other research objectives, be conducted. The relative advantage of in-depth interactive interviews would appear to be their ability to collect qualitative and predictive data. Their relative disadvantage is their complexity and inappropriateness for larger scale surveys.
Out of home activities

Travel

Home activities

Memory joggers and activity sheets are a form of survey instrument that have been developed and applied in the United States in the 1990s. The memory jogger is intended to get the respondent to either think through the 24 hour recall period and order activities in time, or to keep a brief record during the diary period to assist in more detailed recall later. Information on each activity identified in the memory jogger is then recorded on a separate sheet within a booklet. The level of detail of the questions regarding each activity depends on the objectives of the survey. In some cases the questions on the sedentary activity, and how (and if) the respondent travelled to that activity site, are separated onto two sheets (Cambridge Systematics 1996, Stopher 1992). Some diaries have been self-completed, while others have been completed through a computer-assisted telephone interview. An example is the two 24 hour day diary administered in Portland in 1994 (Cambridge Systematics 1996). The relative advantage of memory joggers and activity sheets would appear to be their ability to collect the most detailed data of any form of activity-based survey instrument. Their relative disadvantage is their inflexibility (if an activity is forgotten in the memory jogger it is difficult to insert later as activity sheets are numbered) and intimidating length. In paper form a single 24 hour diary booklet can be up to 25-30 pages long, depending on the amount of activities performed by the respondent.¹⁰

¹⁰ Recent innovations in the United States, in the form of more flexible ‘day planner’ diaries (without memory joggers), have however reduced booklets to 16 pages in total (Stopher and Wilmot 2000).
Figure 7: Example of a memory jogger and activity sheet (after Cambridge Systematics 1996)

MEMORY JOGGER

<table>
<thead>
<tr>
<th>Household member name:</th>
<th>Day:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What did you do? | How long? | Where did you do it?

continued for 24 hour day … ↓

ACTIVITY SHEET: Activity 1

<table>
<thead>
<tr>
<th>What was this activity?</th>
<th>How long did activity take?</th>
<th>Where did activity take place?</th>
</tr>
</thead>
</table>

Were you already there? (circle yes or no) No Yes ↓

<table>
<thead>
<tr>
<th>How did you get there? (circle only one)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. public bus</td>
</tr>
<tr>
<td>2. MAX</td>
</tr>
<tr>
<td>3. car, van, truck, motorcycle</td>
</tr>
<tr>
<td>4. school bus</td>
</tr>
<tr>
<td>5. walk, wheelchair</td>
</tr>
<tr>
<td>6. bike</td>
</tr>
<tr>
<td>7. other (specify)</td>
</tr>
</tbody>
</table>

Did you have a household vehicle available for this trip? No Yes ↓

Did you have a household vehicle available for this trip? No Yes ↓

When did you start that activity? start ____

Did you have a household vehicle available for this trip? No Yes ↓

Number of household members on trip? ↓

At exactly what time did your trip, start ____ , end ____ → Go to your next activity

At exactly what time did your trip, start ____ , end ____

repeated for each activity listed in memory jogger

5.2 Development and testing of survey instrument

Given that the survey was to be conducted in some parts of Cape Town where low levels of literacy and education are prevalent, the decision was made initially to adopt a form of self-completion diary table that would appear to be easiest to comprehend. Resources were not available to test various forms of diary tables, so decisions on the suitability of instruments had to be made on the basis of the published experiences discussed earlier, and where necessary, personal judgement. The first diary table developed therefore took the form of a combined sedentary/travel activity table on the grounds that this instrument appeared to be the simplest to understand.

A pre-pilot test of this instrument indicated however that some respondents found the table confusing when recording sedentary activities that did not involve travelling. These respondents clearly felt that it was necessary to fill in each cell of the diary table, and therefore only recorded travel activities. The pre-pilot test indicated that it was necessary to distinguish between sedentary activities and travel activities, so a form of linked sedentary and travel activity diary was developed for the pilot survey. In an attempt to keep the simplicity of a combined table however, both the sedentary and travel activity tables appeared on one page so that the link between the two was visible and repetition was unnecessary. Other changes included general rewordings, dropping the activity frequency question, and replacing the travel distance question with a travel time question (and deriving distances in data analysis through the use travel speed assumptions for different modes at different times).
The experience of the later pilot survey indicated that self-completion activity diaries are problematic, particularly amongst respondents with lower levels of education. It was apparent that amongst some respondents (and interviewers) there was a difficulty in reading and completing tables as a series of intersecting columns and rows. A common problem was the completion of travel details in the same row as a sedentary activity. So, for instance, the completed diary table might read that the first activity of the 24 hour day was sleeping, and this was done by mini-bus taxi two to three times a week. Another common problem across the entire sample was a lack of symmetry between forward and return trips (even though this is less of a problem, as it can be rectified in data capture). So, for instance, the forward journey might include a walking trip to a bus station and a bus trip, whereas the return journey (between the same origin-destination pair) indicates only a bus trip. Surprisingly, problems were not encountered in describing activities in the space available on the questionnaire, and in time recall. With regard to the latter, given that some unemployed adults are unlikely to schedule their daily activities within prescribed time constraints in the same way that an employed worker or scholar would, it was expected that such respondents may have difficulty in recalling start and end times, and estimating activity durations. This was not the case, even though some respondents failed to account for all their time in the diary period and the reasons for this are unclear.

As will be discussed later, the pilot survey yielded poor results for a number of reasons. Of relevance here, with regard to the survey instrument more specifically, it was clear that the multi-day activity diary...
format was too elaborate for respondent self-completion, across all sample stratifications (although often for different reasons). An effort was made to determine how activity diaries had been administered in other developing world contexts. Only two such surveys were found, one in the Philippines (Villoria 1993) and the other in Indonesia (Roland Kager pers comm 2000). Both of these surveys it appears took the form of recall interviews (as opposed to self-completion questionnaires), and as discussed earlier, South African applications amongst lower income ‘black’ respondents took the form of recall interviews as well (Morris 1986, Dierwechter 1999). Earlier time use surveys in South Africa (Fourie and Morris 1985, Tshatsinde 1999), as well as the contemporaneous time use study conducted by Statistics South Africa (Mpetsheni and Budlender 2000), have also been interviewer administered. The amendments made before the subsequent main survey therefore focussed on the interviewing procedure, rather than the survey instrument format per se. These amendments are discussed later (in section 7), but in essence multi-day self-completion was replaced by previous day recall computer-assisted personal interviewing (CAPI). An advantage of CAPI interviews is that logical checks can be put into place that prevent gaps in diary time or missing/beyond range data, and interviewers can prompt respondents when it becomes apparent that trip segments or waiting times have been omitted. A further advantage is that for most (but not all) database fields, data collection, coding and capturing is collapsed into one stage. Together these advantages, Kalfs and Saris (1997) contend, lead to increased speed, reduced costs and improved data quality, even though relative benefits have yet to quantified empirically in a systematic way.

6. TARGET POPULATION AND SAMPLE SELECTION

This study is interested in the travel patterns of metropolitan Cape Town’s population as a whole, using households as the primary sampling unit. The National Census of 1996 estimated that the population of the Cape Metropolitan Area (CMA) was 2 557 456 people (or 651 599 households) - which the Cape Metropolitan Council (CMC) believe was closer to 2 683 000 people (or 681 000 households) (Dorrington 2000). Assuming an annual population growth rate of 3%, the CMA population in 2000 may therefore be around 2,878 to 3,019 million people.

It was clear from the outset of the study that resources were not available with which to undertake a survey that would yield data that are statistically representative of the CMA population as a whole. With the available resources it was only possible to survey 204 households (including all household members who were either independently mobile or generated their own individual activity schedule). A sample of around 2 400 households would have been required to yield statistically representative data from the six sampling areas discussed below. The data collected and analysed are thus ‘indicative’ of diversity, rather than ‘representative’ of reality. Given the objectives of the survey I believe this is justifiable. The data will not be used to calibrate a predictive model, nor make claims of statistical representivity. They will be used to investigate the diversity and size of gaps in understanding, and to explore a new research method in South Africa.

The sample of 204 households (678 individuals) was stratified into three equally sized - high, middle and low - household income bands. The national census of 1996 was analysed to determine the cut off points for these bands, and these 1996 values were then adjusted, using the Consumer Price Index, to relate more accurately to current incomes. The sample was distributed proportionately across these three bands. Thus around 68 households in each income band were surveyed.

11 Another was found in Nagpur, India (Ranganathan et al 1988), but a copy of the paper was not acquired.
The sample of households was then clustered into selected neighbourhoods of the Cape Metropolitan Area. For each income stratification, two sampling areas were selected. Thus around 34 households were surveyed in each of the six sampling areas. The two sampling areas were selected on the basis of ease of access to commercial and employment opportunities. The first was a residential neighbourhood with a mixed pattern of land use, and an open, pedestrian-oriented street pattern. These ‘inner location’ sampling areas have local access (meaning within a 2.5-3 km walking distance) to commerce and employment opportunities. The second was a residential neighbourhood with little or no local access to commerce and employment opportunities.
(formal) commerce and employment opportunities, and a closed, car-oriented street pattern. These are called ‘outer location’ sampling areas.

Sampling area boundaries coincide with transport zones used by transport planning authorities, and enumerators areas used by Statistics South Africa. Candidate sampling areas were analysed using 1996 census data to ensure that the majority of households fell within the appropriate income band. This was the case in all the chosen sampling areas, with the exception of Salt River/Woodstock where the different income bands are evenly distributed. Households were selected at random from a sampling frame in each of the sampling areas. The sampling frame took the form of an inventory of street or shack addresses. Only households falling within the appropriate income band were interviewed. Randomly selected households who fell into the wrong band were substituted, as were households unable to provide previous day recall diaries for at least 70% of household members.

Thus in summary, the sample may be described as randomly selected, proportionately stratified and quasi-clustered.

7. Survey administration

Due to my inexperience in administering travel surveys, interviews with ten experts in the fields of travel analysis and survey administration were conducted during the course of 1999 and 2000. This process culminated with a seminar with nine invited delegates in August 2000. In the interviews and seminar, advice was sought on numerous issues concerning the administration of the survey. As a result of much of this advice administration went through a number of phases in which aspects of the instrument and interviewing procedure were tested and refined.

7.1 Pre-pilot test

The first of these phases was a pre-pilot test conducted in March 2000. Six households (17 individuals) living in various parts of Cape Town were asked to keep a one day diary using the pre-pilot test survey instrument discussed earlier. The households all fell within the high income band, but represented six different life-cycle stages. The purpose of the pre-pilot test was to check for any problems in the wording and format of the questionnaire, as well as to produce a set of dummy data with which to check the data coding, capturing and analysis system described in the following section. As a result of the test a number of fairly minor changes were made to the survey instrument and the data field coding.

7.2 Pilot survey

Following amendments made as a result of the pre-pilot test, a pilot survey was conducted in August 2000 using 11 students recruited through the University of Cape Town’s Job Opportunities Bureau as interviewers. Each interviewer underwent 2-3 hours of training prior to the survey. Training took the form of formal instruction, and mock questionnaire and diary completion. Prior to the pilot survey the intention was to sample 240 households in 8 sampling areas for 2-3 designated days, staggered over a 7 day week. At the time, the safety of the interviewers was a major concern. Apart from generally high levels of violent crime in Cape Town, one of the sampling areas, Mitchells Plain, was experiencing a flare up in an ongoing gang conflict, and in another, Khayelitsha, bus drivers and passengers were being attacked as part of a disagreement between mini-bus taxi operators and the local bus company over access to passengers. For safety (as well as transportation and language) reasons, interviewers were sought who lived in the different areas and were thus more familiar with potential dangers, and those recruited travelled in groups of three or four with a designated supervisor.
Each interviewer was instructed to survey one randomly selected household. Due to fewer interviewers being available than initially hoped, the areas surveyed were limited to Rondebosch, Salt River/Woodstock and Joe Slovo Park informal settlement in Langa. The interviewers were instructed to make contact with the household, in the early evening between 17h00 and 19h00, on three separate occasions. In the first contact the interviewer introduced him or herself, and the survey, to an adult in the household who, if possible, could read English. The adult was interviewed on the demographic and socio-economic situation of the household, and was shown how the individual activity diaries should be filled in. The adult household member was asked to show other household members how the diaries should be filled in, and to assist those unable to complete the diaries themselves. In the subsequent two contacts, the interviewers checked that all household members were filling in their diaries correctly, and where necessary, provided assistance by correcting or redoing incorrectly completed diaries with the individual concerned. These contacts were made the day after the day on which the diary was kept.

The purpose of the pilot survey was to test a number of aspects of the survey method. These included:

- refusal rates in the different sample stratifications and areas;
- the number of days for which households are prepared to keep diaries;\(^{12}\)
- the amount of interviewer time needed to collect completed household surveys;
- whether households mind being rejected as respondents on the grounds that they fall into the wrong income band, and whether it would better to simply interview all willing households; and
- the degree to which the diaries can be self-completed in the different sampling areas.

To get feedback on these issues, interviewers were asked to complete a questionnaire after their particular household survey was complete.

As indicated earlier, the pilot survey yielded poor results. Of the 24 students recruited, only 15 attended the training sessions. Two of the 15 interviewers dropped out during training, and another 2 during the pilot survey, leaving 11 interviewers and thus 11 household surveys were returned at a cost of R110 each. Of these 11 surveys, only 2 were fully completed. Of the 9 remaining surveys, 7 contained information that could be used for data capturing - in total 19 personal 24 hour diaries that could possibly, with editing, be entered into the data base and used to increase the sample size of specific individual traveller categories.

Why were the results so poor? The feedback received from interviewers, and back-checks with households, indicated a number of problems. Firstly, there was a general unwillingness to keep a diary for two consecutive days. Some household members who initially agreed to do this, subsequently failed to do so once the effort that was entailed became clear. Some households in fact agreed to keep diaries only if they were for one day. Secondly, it was apparent that many respondents, across all income strata, found the diary table difficult to comprehend, and that some of the interviewers found the survey difficult to administer. In quality checks it became clear that some interviewers simply dropped off the questionnaire and asked the household to fill it in themselves, and did not undertake the initial household interview and diary explanation as instructed in the training sessions. Thirdly, it was apparent that in the current real or perceived crime rate and associated prejudices, it is important that interviewers and respondents are of the same race. In those areas where this was not the case, and more specifically where ‘black’ interviewers were interviewing ‘white’ or ‘coloured’ respondents, very low response and co-operation was received. In Rondebosch, housing a predominantly ‘white’ population,

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\(^{12}\) International experience suggested that, in the absence of substantial monetary incentives and supervisory networks, 48 hours was the maximum achievable period (Arentze et al 1997).
only one in nine households agreed to be surveyed. In Salt River/Woodstock, housing a mixed ‘coloured’ and ‘white’ population, one in five households agreed to be surveyed. The equivalent ratio in Langa, where interviewers and respondents were all ‘black’, was one in two. In Rondebosch and Salt River/Woodstock many households refused to participate in the survey on the grounds that they would be providing information on when their homes would be empty and thus exposed to housebreaking, or that by providing information on the vehicles they owned this too would make them more vulnerable to theft. This attitude prevailed despite assurances of confidentiality, and a formal covering letter noting the approval of the survey received from Ward Councillors and relevant civic or resident organisations.

It was clear then that significant changes would be necessary as a result of the pilot survey. On the basis of the pilot test results, and the feedback received from interviewers, the following major amendments were made:

- the use of students as interviewers was discontinued, in favour of a more reliable and experienced market research company with interviewers of all racial groups (with concomitant impacts on cost and sample size);
- the diary period was reduced to only one 24 hour day (with concomitant impacts on data quantity and quality); and
- the diary table was filled in by the interviewer in a recall interview, rather than by individual household members in a leave-behind self-completion questionnaire.

7.3 Main survey

Three market research firms were invited to tender for the main survey. The three firms quoted costs on a previous day recall interview at R280,00, R199,00 and R103,00 per collected, coded and captured household interview (excluding VAT). The firm AC Nielsen MRA was appointed to conduct the survey (at R199,00 or ± US$26 per household interview). The paper format of the survey instrument was converted to an electronic one, so that the interview could be conducted with the use of computer-assisted personal interviewing (CAPI) software, and the interview transcript was translated into the three main languages spoken in the study area (Afrikaans, English and isiXhosa). The CAPI interview was tested (in an observed panel test and pilot survey), ± 20 interviewers were briefed, and data was collected between 23 October and 29 November 2000 and 26 January and 3 February 2001.

8. Data coding, capture and analysis

The database, within which the collected data has been captured, is relational, in that trip data are nested within personal data which are in turn nested within household data. The database fields are therefore divided into three groups. Household data fields enable questions to be asked of the travel behaviour of different kinds of households. Personal data fields enable questions to be asked of the travel behaviour of different kinds of travellers. Trip data fields enable questions to be asked of different kinds of trips. Even though the database is relational in nature, for the sake of simplicity it is however recorded in flat-line form. Thus household and personal data are copied into all database records. In this way filtered trip data continues to be related to household and personal data fields, and similarly, filtered personal data continues to be related to household data fields.
The records in the database take the form of trip segments. Trip segments are defined as one-way movements by a particular mode that involve travelling to or from a point of modal interchange, and leaving or arriving at an activity site or another point of mode interchange. A trip - a one-way movement between an origin and destination activity - can therefore be comprised of a number of trip segments. Had the data collected in this study been intended for the calibration of an activity scheduling model, records would have taken the form of activities more generally (i.e. including both sedentary and travel activities, and disaggregating the different activities undertaken in one place to a far greater extent). Because the objectives of the study were limited to understanding travel behaviour, this level of time use data was not required, and the associated difficulties with ensuring respondents define and report on ‘activities’ in the same way were avoided (Axhausen 1997). The contemporaneous time use study administered by Statistics South Africa will provide far richer data on time use, and could potentially be mixed with the data collected in this and other studies, should data be required for explorations into activity-based travel demand modelling in South Africa. These 24 hour time use data, from 2 members of 10 000 households, are due to be released in April 2001 (Debbie Budlender pers comm 2000).

The coding of database fields is fairly straightforward. The only field codings that perhaps require explanation are those relating to trip chaining and mode transfer(s). With regard to trip chaining - a series of sequential one-way trips where the intermediate destination activity(ies) both influence route
choice to the final destination activity, and take less than 10 minutes to complete - the code describes the position of the trip in the chaining order. For instance, the second trip within a chain of three linked trips would be coded as [2.3]. This enables the data to be compared with other surveys where data on only the final trip within the chain was recorded. A similar coding system is applied to mode transfer(s). Thus the first mode used in a trip in which four modes were used, for instance, would be coded as [1.4]. In order to enable comparison with other surveys where data on only main mode use was recorded, a [.m] is added to that trip segment covering the greatest distance.

Figure 13: Hypothetical household 24 hour time-space path (after Clarke et al 1981b:3)

Note: The 24-hour time-space paths illustrated in this diagram are for a 6 person lower income household, living in a township on the periphery of a larger city. The household is composed of an adult relative, a father, a child of 5-12 years, a mother, and two infants of 0-3 years. The household awakes at 05h30. The employed members of the household begin their long commute by train and taxi shortly before 06h00 in order to arrive at work (1) by 08h15. It is clear that the peripheral location of their home (4) and the ‘authority constraints’ imposed by their working hours, places a considerable burden on their time resources. Most of their 24-hour period is taken up with working, commuting and sleeping, with little time left for other activities. The mother keeps the two infants with her throughout the day, and delivers and collects the older child from school (2) and sporting activities in the morning and afternoon (a form of ‘coupling constraint’). An arrangement with a neighbouring parent however means that she does not need to accompany the child to school at the beginning of the day. During the afternoon she stops at a local spaza shop (3) to purchase groceries. She has no access to private transport, so all her trips are undertaken on foot (a form of ‘capability constraint’). It is clear that her child-care responsibilities and limited mobility place considerable constraints on her travel choices. The father and adult relative begin their commute home after work at 17h00. The relative stops at a shebeen (3) on the way home to meet friends and watch a football game. The household eats at 20h30, and all members are asleep by 22h30.

Most of the quantitative analysis of the database will take the form of filtered cross-tabulations, and the pivot table function within Microsoft Excel software was found to be sufficient for this purpose. The data will also be analysed using some of the analytical techniques of time geography discussed earlier. Thus the time-space paths and ranges of typical households and individuals will be analysed as case studies, to undertake the kind of micro-analysis called for by Torsten Hägerstrand (1970). Household time-space paths illustrate interpersonal linkages and constraints, and how these influence travel behaviour. Most importantly perhaps in a developing world context, they can illustrate how travel behaviour is embedded within daily household survival strategies. A well-documented example of this
kind of household time-space path analysis is of the data collected in the earlier mentioned study in Banbury (United Kingdom) in 1976 (Clarke et al 1981b, Jones et al 1983). Ranges illustrate the spatial extent, or ‘footprint’ of a person’s activity participation. An example of an analysis of ranges is that of activity diaries kept by household members over (a remarkable) 35 days in Uppsala (Sweden) (Hanson and Hanson 1981, Hanson and Schwab 1995).

Figure 14: Hypothetical weekly household member ranges (in kilometres)

9. Methodological lessons
What methodological lessons then can be learned from the foregoing account? In retrospect it was probably a mistake not to have allocated a portion of the resources available, to testing different instruments (i.e. alternative diary table forms with varying functional and temporal scopes) and different administration procedures (i.e. self completion vs. interview vs. mail back, and the use of incentives, etc.). Other lessons, based more on trial-and-error than the kind of comparative testing referred to above, can perhaps be summarised as follows:

- The skills, professionalism and racial (and to a less extent gender) category of interviewers are probably the most important factors in determining the successful administration of surveys (with the complexity of activity diary methods) in South Africa. This was perhaps the most important lesson learned in the survey, and because interviewer skill and societal prejudice are not dealt with in the literature evaluating alternative activity-based survey instruments and administrative procedures in any significant way, came as a bit of a surprise. These factors were found to be of particular importance in the Cape Town context, where prejudices abound and many interviewers are poorly educated, and ultimately resulted in the in toto replacement of one set of interviewers with another.

- Leave-behind self-completion diary tables are too elaborate for Cape Town respondents generally. Amongst respondents with lower education levels, it was clear that tables are often difficult to read and complete. Amongst respondents with higher education levels, it was found that completion instructions are seldom read, with the consequence that unless correct diary table completion is easily self-evident, they are often incorrectly completed. Even when respondents understood exactly what was asked of them, completing the diary for a 24 hour period was sometimes regarded as tedious, with the result that forward and return journeys between the same origin-destination
pair were often asymmetrical, and trip segments were therefore underreported. This finding resulted in self-completion being replaced by recall interviews, and the avoidance of tables altogether in CAPI interviews. The pilot tests of leave-behind self-completion diaries indicated that very few people kept their diary over the course of the day - most recalled activity participation at days end - suggesting that not much data quality is lost when converting from self-completion to previous day recall.

- The use of CAPI technology led to lower refusal and substitution rates. Whereas in the pilot survey, 73% of the original randomly selected households needed to be substituted (89%, 80% and 50% in high, middle and low income bands respectively), in the main survey this figure decreased to 58% (82%, 68% and 25% in high, middle and low income bands respectively).

- Most respondents in Cape Town were reluctant or unwilling to keep a diary for more than a 24 hour period. This finding resulted in two and three day diary periods being replaced by a 24 hour period. As the previous 24 hour day is probably the longest period possible in a (single contact) recall interview, the conversion from self-completion to recall interview necessitated this reduction in diary period anyway.

- As expected, the activity diary survey instrument resulted in greater trip recall than previous trip diary survey instruments in South Africa – by between 18% and 35%. Whereas earlier trip diary surveys have estimated mean weekday trips per household at around 8.2 for middle income households and at around 6.4 for low income households, the activity diary survey yielded 9.7 and 8.2 mean weekday trips for these household income bands respectively.

Should activity-based methods be applied more widely in South Africa (and other developing world contexts)? They would undoubtedly provide valuable and detailed insights into travel needs and behaviour not possible in other survey methods, but as found in this survey, their data intensity and attendant difficulties in application increase surveying costs significantly - even though economies of scale in larger samples would probably bring the sampling unit costs quoted in this paper down. It is likely therefore that the cost of activity-based travel data, relative to those required by trip-based four-stage models, will be perceived in South Africa as high, and perhaps unjustifiably high in the context of resource scarcity (Peter Clark pers comm 1999). My own view is that, despite the costs and difficulties associated with obtaining richer travel data, the application of activity-based methods offers an important, if not essential, means to improve analyses of behaviour. As transport authorities begin to introduce the ‘customer-based’ services and ‘tough’ demand management measures envisioned in the new passenger transport policy discourse, it is likely that activity-based (together with stated preference and strategic policy appraisal) methods of assessing needs and behavioural responses will prove invaluable.

Solutions to the problem of increased survey cost, in my view, lie in data sharing. Because the analysis of human behaviour invariably involves questions of who did what, when, where and for how long, activity participation and time use data are relevant across numerous arenas of policy research. These include measuring formal and informal economic activity, paid and unpaid labour, social change, quality of life, service consumption and many other policy concerns (Harvey and Pentland 1999), as well as passenger transportation (van der Reis 1985). Thus possibilities exist for the cost of collecting activity participation and time use data to be shared by numerous commissioning agencies.

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