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THE DESIGN AND CONDUCT OF PARK AND VISIT AND VEHICLE FOLLOWING SURVEYS

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MAY, A.D. and TURVEY, I.G. (1985) The design and conduct of park and visit and vehicle following surveys. Working Paper 198, Institute for Transport Studies, University of Leeds.

The report assesses the development and potential of two individual survey techniques; the Park and Visit and the Vehicle Following surveys.

The Park and Visit Survey has its origins in work conducted by Inwood for TRRL in 1966 and is primarily concerned with ease of access effects in terms of search and search plus walk times, when looking for a parking space.

The Vehicle Following surveys, used extensively by Wright (1975), relate to the degree of searching and hence more directly to the route choice and congestion related effects of parking in city centres.

Both surveys can be budgeted at a fairly low cost and involve the use of small survey teams, over a short period of time. Yet each survey is robust in nature and yields information of a behavioural nature largely omitted from conventional parking usage data collection.

1. INTRODUCTION

Conventional parking supply and usage surveys provide information on the need for parking space and parking control, but provide less information on the effects of controls or of lack of space. In particular they provide little guidance on the costs involved in finding parking spaces and gaining access to final destinations. The types of cost which might arise include time spent searching for parking spaces, the additional congestion caused by searching traffic and the time spent walking to and from destinations. These costs are potentially of considerable importance in situations in which parking occupancy is high, and they are likely to be significantly affected in such circumstances by changes in parking charges or controls, by increases in parking provision or by intensified enforcement. In particular increased enforcement could have counteracting effects by encouraging illegal parkers to search for legal spaces, hence adding to costs, and reducing illegal use of legal space, thus reducing costs.

The introduction of wheel clamps experimentally in central London in May 1983 raised the possibility of both these effects occurring, and the Institute for Transport Studies was awardeda contract from the Transport and Road Research Laboratory to develop survey methods which could identify those effects. This report describes the survey methods; a companion report (May and Turvey, 1984) presents the results of the study of wheel clamps to which they were applied.

The two survey methods developed to complement the more conventional parking characteristic surveys were:-

(1) <u>The Park and Visit Survey</u>

The Park and Visit Survey was designed to measure time spent searching for parking spaces and walking from them to a final destination. In addition, it provides a measure of the availability of parking spaces, which will influence the amount of searching traffic, and of journey times in the area, which might be influenced by the amount of searching traffic.

(2) <u>Vehicle Following Survey</u>

The Vehicle Following survey was designed to detect vehicles searching for parking spaces and to record the time which they spent doing so. It also provides information on the amount of through traffic at certain points and an indirect measure of travel time.

While the Park and Visit Survey simulates drivers' actions, the Vehicle Following survey records the actual behaviour of a sample of drivers.

This report discusses the Park and Visit and Vehicle Following survey methods in Parts I and II respectively. Each method is assessed in the same manner in terms of survey background, sampling problems and the procedures adopted, survey mechanics and costings, analysis and interpretation of survey results, and problems arising from the survey.

The companion report (May & Turvey, 1984) provides an example of their application.

PART I

THE PARK AND VISIT SURVEY

2. BACKGROUND AND DEVELOPMENT OF THE SURVEY METHOD

The Park and Visit Survey was a method developed by Inwood (1966) to test the effect of meter charge increases in Central London on access time. 31 destinations throughout Central London were selected. The destinations were distributed amongst areas with and without meter charge increases and each address was visited on 10 unspecified occasions. Starting from each address in turn, the times taken to find a vacant meter, park the car, walk back and then extract the car were recorded. The search process was determined very largely by the restriction of movement to available one-way streets and by the locations of known meter spaces, which were searched in order of their nearness to the address.

The survey method was successful in identifying significant reductions of as much as 95% in total access time (finding the space, walking back, returning to the car and leaving the parking space).

However, the survey as described by Inwood appeared to suffer from a number of weaknesses:-

(i) by starting at the destination, the method did not replicate the search for a space en route to the destination, which itself could be influenced by the approach route taken.

(ii) no indication was given of the prior knowledge of the drivers; in practice drivers new to an area are less likely to know the most suitable parking locations, but may be less restricted in their area of search than experienced drivers; a driver involved in the survey will gradually develop from novice to expert in terms of his knowledge of available spaces.

(iii) no indication was given of times at which surveys were conducted, yet experience suggests that parking spaces are much scarcer at certain times than others.

(iv) the wheel clamps study required information on access costs using both legal and illegal parking spaces.

(v) the basis for sampling addresses was unclear.

To overcome these problems, several ideas were developed. These included using a large sample of drivers with different levels of knowledge and a large sample of addresses of different types. Both of these were rejected for practical and cost reasons; any such procedures would have required a substantially larger number of runs if time of day differences were to be isolated from type of driver or address differences. A second suggestion was to combine a continuous timed circuit of the area with a beat survey to record available spaces. For any address in the area, the nearest space at any time and the time to find it could then be calculated later. This approach was rejected largely because timing constraints meant that the timed circuit could not be driven at the same time as consultants were recording parking availability; it would therefore have required an expensive repeat parking beat survey. There were also doubts about the ability to estimate actual search times from the timed circuits. This approach may however be worth investigating further as a way of overcoming some of the sampling problems.

The procedure finally adopted involved

- selecting four addresses to provide a reasonable geographical spread of search areas within each study area.
- starting at selected points on the periphery of the area of study.
- both following fixed routes and adopting a free ('random') search routine to replicate both experienced and inexperienced driving patterns.
- recording times to both legal spaces and illegal spaces of pre-defined levels of risk acceptability.
- sampling among times of day and, if necessary, days of the week.

3. MECHANICS OF THE SURVEY METHOD

3.1 CHOICE OF ADDRESSES AND START POINTS

From a given survey area a number of addresses are selected, to be visited by the Park and Visit Team. An equal number of 'start' points are then selected on the periphery of the survey area and each start point is associated arbitrarily with one of the addresses.

The number and location of the addresses will depend on the size of the area of study, the difficulty of finding a parking space and, inevitably, the resources available. For the Central London study, in which searches of up to 5 minutes were commonplace, a single address gave a reasonable indication of conditions within a 250m radius of it. As will be seen from Figure 1, this enabled an area of about 0.25 km to be covered adequately by four addresses. The choice of area itself was determined to be bounded by the network of main roads giving access to it. It is important to note that the addresses chosen are not necessarily wholly typical of all addresses in their area. Search and walk times will inevitably vary from address to address on the basis of meter distribution, network configuration and traffic management measures. However, the differences in conditions between before and after surveys are likely to be reasonably typical of the area as a whole.

3.2. THE SEARCH PROCESS

The search process is then replicated both by a fixed route, in which the driver has no choice and variations between survey runs are wholly dependent on conditions on the ground, and by a free ('random') search routine. The fixed route is devised to link each address and the corresponding start point, using a route that would be sensible for a driver seeking somewhere to park. This procedure is repeated for all pairs of start points and addresses. A further fixed route is then devised to link each address and the next start point such that a full tour of all addresses from their corresponding start points, together with connecting links will give a comprehensive fixed circuit of the survey area. Careful design of the route can provide useful additional information on meter availability in, and travel times through, the area. Figure 1 shows an example of the fixed circuit linking four pairs of addresses and start points and indicates the confines of a typical survey area.

On reaching an address the driver then uses his own initiative and knowledge of the area to search for 3 different types of parking space:-

(1) The nearest conceivable parking space. This is the sort of parking place that a person might be tempted to use if he/she were only making a call of a minute of two. It is the nearest vacant length of kerb to the address. Double parking is allowed if this is already taking place along the length of road being studied.

(2) The nearest reasonable illegal space. This is the sort of parking place that a person might be tempted to use if he/she were making a longer call and prepared to risk parking illegally. It is the nearest vacant length of single yellow line, a diplomatic space, a disabled driver's space or a resident's space.

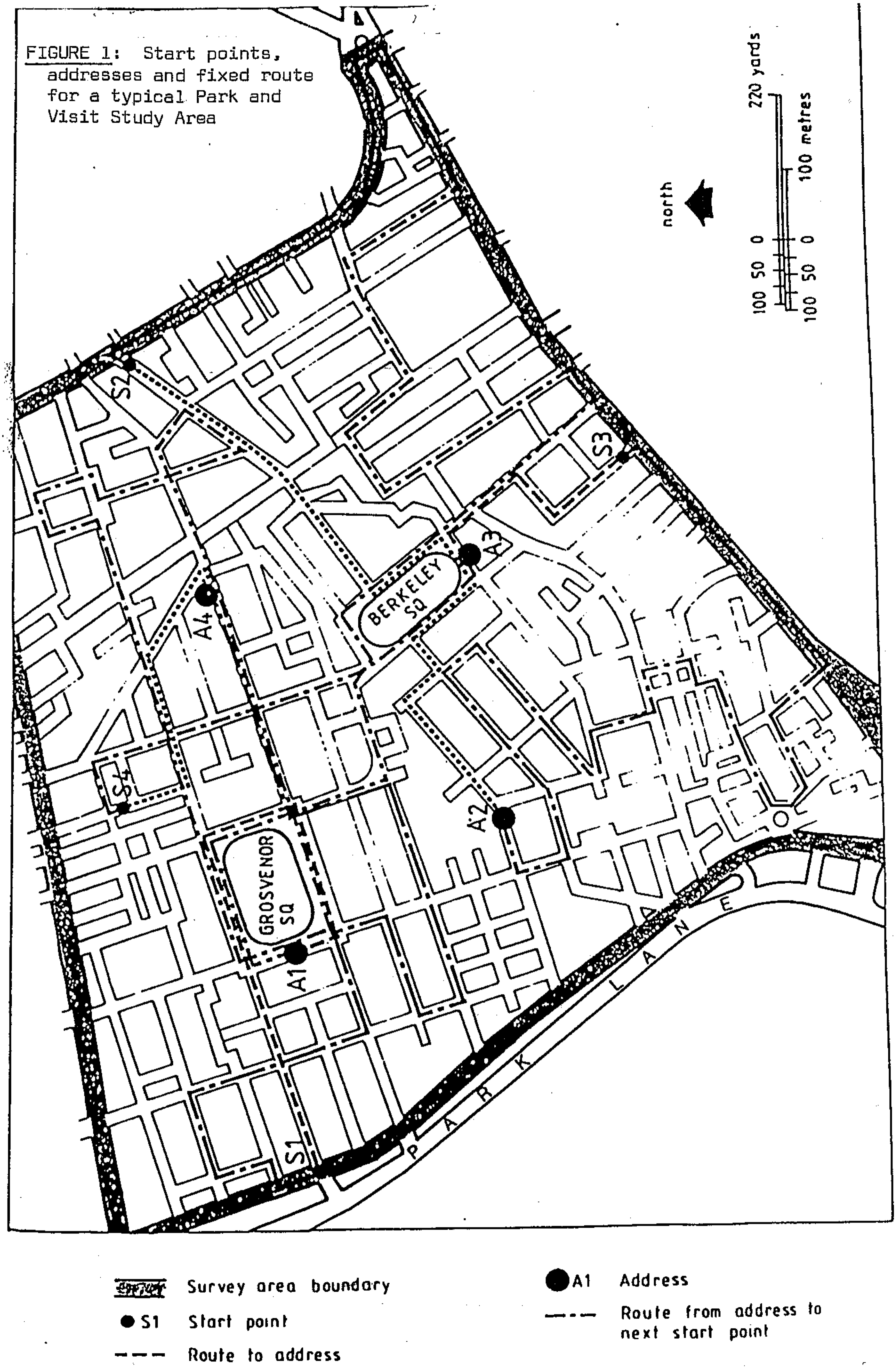
(3) The nearest available legal meter space.

Having achieved these parking places or having satisified himself that none is available (see 3.4), the driver then returns to the address which he has just visited and from there proceeds, via the fixed route, to the next start point.

3.3 DATA COLLECTION/SURVEY TEAMS

Survey results are recorded on forms which include blank maps of the relevant parts of the study area. One form is used for the route from start to address and for the 'random' search; a

FIGURE 1: Start points, addresses and fixed route for a typical Park and Visit Study Area



second is used for the route to the next start point. On each form details of day, date and circuit number are recorded. In addition the time is recorded at each start point, address and possible parking place and on crossing selected major junctions. In the London surveys this was done using a Casio CP10 calculator with time recorder and printout; the printout was then attached to the appropriate form. Finally on the random search route the route taken and possible parking locations are marked on the map, while on the fixed route the number and location of available meter spaces are recorded. In this way search and walk times can be calculated directly or by interpolation.

In order to collect this data each survey team is made up of 3 persons:-

(1) Driver/supervisor

(2) Travel time recorder/mileage recorder.

(3) Fixed route available meter recorder/random search route recorder.

It is important to familiarise the survey team with the fixed route and the nature of each of their roles prior to the start of the main survey. Equally important is the need to carry out pilot survey work in order to locate addresses and start points which cover the whole of the survey area, and also to time the duration of one complete fixed circuit. This will then enable a daily timetable to be constructed with say 15 minutes between circuits to allow for fluctuations in travel times throughout the day and rest periods for the survey team.

Selection of the driver requires particular care since, as noted earlier, a driver who knows the area may limit himself to particular parking locations, while a novice may spend some time familiarising himself with the area, its parking locations and traffic management measures. In the London studies drivers who knew the area reasonably well, but were not regular central London drivers were used. Analysis of their search routes suggested that there was in practice little evidence of changes in search pattern with greater familiarisation. Ideally, the same driver should be used for both before and after studies. In practice with a one year survey interval this proved impossible in London, and it was not possible to assess the effects of not doing this.

3.4 LIMITATIONS ON SEARCH TIME

One of the main problems with the survey method is that, in areas where meter occupancy is high, search times can vary considerably, making timing of the run uncertain, and reducing the number of runs per day which can be timetabled. In the pilot surveys in Mayfair a 15 minute cut-off was used, and no meter space had been found within this time on 25% of occasions.

It was realised, however, that search times followed a negative exponential distribution (since vacant spaces were rare and hence roughly random events) and that this could be used to estimate mean search times from a lower cut-off. The choice of cut-off is inevitably a trade-off between accuracy in the application of the negative exponential relationship and survey costs. For the main surveys in London a 5 minute cut-off was applied, which meant that meter spaces were not found on roughly 30% of occasions in the more heavily parked Mayfair area. Figure 2 presents the results of the pilot survey, in which the effect of the 15 minute cut-off can be seen, and the 'before' survey in Mayfair with a 5 minute cut-off. It is clear that little further information is gained from a 15 minute cut-off. Section 5.2 presents the basis by which the negative exponential distributions were fitted, and the goodness of fit obtained.

3.5 TIMING AND NUMBER OF CIRCUITS

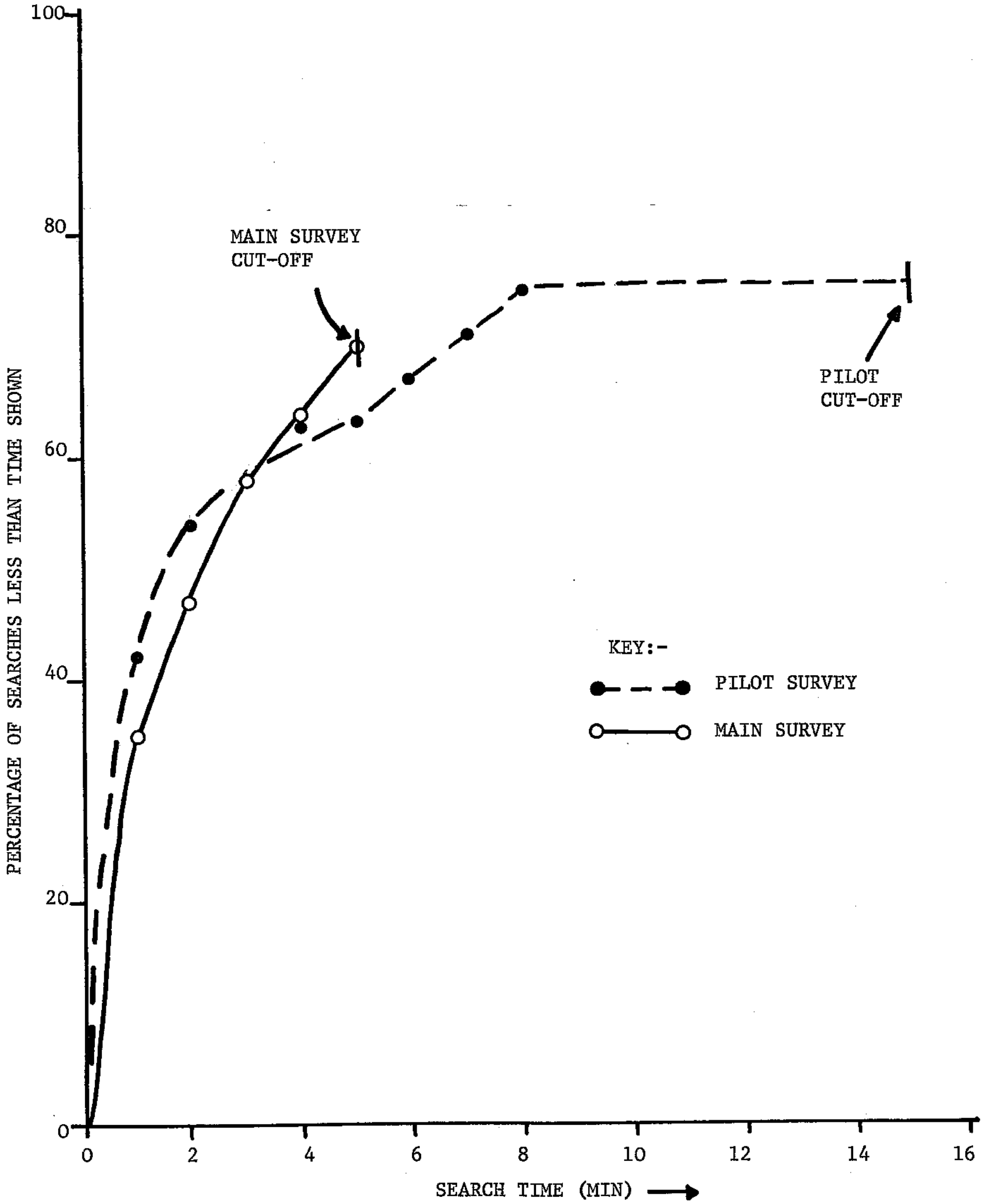
With a five minute cut-off it was possible, even with the low speeds of Mayfair, to complete a 12.3 km fixed route and four searches in well under 80 minutes. This permitted six circuits to be started at fixed times during the day. The start times selected for London were 07.30, 08.50, 10.40, 13.00, 14.20, 16.10, giving coverage of the full period from 07.30 to 17.30 with breaks of 30 minutes mid morning and mid afternoon, and of one hour at midday. This arrangement enabled conditions at the same time on different days to be compared. Analysis of the 'before' data indicated that there were significant differences in search times (at the 95% confidence level) for different times of the day, but not for different days. This reinforced the need for careful timing of individual circuits. The days of the week surveyed were chosen simply to provide a continuous survey programme which gave sufficient circuits. Estimates based on the 'before' surveys indicated that 6 circuits over eight days would only be sufficient to identify a 32% change in search time in Mayfair at the 95% confidence level. It would clearly be appropriate in further applications to test the effect on confidence limits of a longer survey period.

4. SURVEY COSTINGS

The survey implementation costs per survey team per day, at 1984 prices, were:-

(1)	Car Hire (1300cc)			£19.00
(2)	Petrol			£ 5.10*
(3)	Staff costs			
	1 Supervisor	£3/hr)	) 8 hrs	£24.00
	2 Enumerators	£2.50/hr)		£40.00
(4)	Cost of providing survey sheets			£ 4.50*

FIGURE 2: CUMULATIVE DISTRIBUTION OF RANDOM SEARCH TIMES IN MAYFAIR : MAIN AND PILOT SURVEYS



(5) Cost of supervision £15.00**

* Depending on size of survey area
** which can be shared if necessary with other surveys.

This gives a daily cost of £93-£108 or a cost of around £1000 for a ten day survey for one area.

5. INTERPRETATION OF RESULTS

5.1 DIRECT TABULATIONS

On completion of a number of circuits over a survey period all the data to be analysed is contained on the survey sheets. This allows presentation of results at the aggregate (whole area) level or at a disaggregated (individual address) level.

Available tabulations include:

(i) time to find the nearest conceivable and reasonable illegal spaces: these were typically under one minute and presented no analysis problems;

(ii) available meter spaces : these can be recorded in aggregate or for individual sections of the fixed route; the average time between available meter spaces can also be recorded as a simple indicator of the costs involved in the search process;

(iii) travel times on the fixed route: these can be recorded in aggregate or for individual sections of the fixed route; they can also be further disaggregated into times for individual links in the network if desirable.

5.2 METER SEARCH AND SEARCH PLUS WALK TIMES

For successful searches, search times can be recorded directly from the 'random' search. In addition the times from the last meter space observed before reaching the address, and the first observed on leaving it can be used as separate (but probably, given the fixed route, higher) estimates of search time.

Walk back times can be calculated by measuring the actual distance on a map from the parking place to the address. If a walking speed of 4.5 km/hr is then assumed, one can calculate walk back times. Since any visit involves walking in both directions, it may be appropriate to double these times.

The data is complicated by the 5 minute cut-off. A simple statistic which avoids any problems is the percentage of occasions on which a vacant meter space could be found within the 5 minute period allowed.

If the mean is to be estimated for search or search plus walk times then the distribution of the times must be related to a 'best fit' curve and an expression derived to estimate the mean value.

As noted in section 3.4 above, a negative exponential distribution appeared to fit the data well, and for this the best estimate of the mean is given by

$$\hat{\mu} = (P_x - P_y)/\log_e (x/y)$$

where P_x is the time for the xth percentile of the distribution. It is common practice to use the quartiles for such estimates in which case

$$\hat{\mu} = (Q_3 - Q_1)/\log_e 3$$

However, in some cases the upper quartile search time exceeded 5 minutes and was not observed. Instead the tertiles were used, for which

$$\hat{\mu} = (T_2 - T_1)/\log_e 2$$

and T_2 T_1 are the upper and lower tertiles. Table 1 indicates the 'before' values for search time observed for the 'random' searches from the eight addresses in Mayfair and Bloomsbury, together with the percentages of successful searches and the goodness of fit of the distributions. It will be seen that only in one case in Bloomsbury, where meters were always available, was the negative exponential distribution inappropriate. This result is not surprising; meter spaces are no longer rare events in such circumstances, and an estimate of the mean is easier to achieve.

TABLE 1 Mean random search times in Mayfair and Bloomsbury, 1983.

	Address	% successful searches	mean search time (sec)	goodness of fit (r^2)
Mayfair	1	65	205	0.83
	2	72	216	0.98
	3	76	222	0.97
	4	64	313	0.95
Bloomsbury	1	83	199	0.95
	2	85	165	0.94
	3	100	29	0.80
	4	87	147	0.98

6. SURVEY PROBLEMS

While the survey method devised represents an improvement on that by Inwood, two problems remain.

6.1 VARIATIONS IN DRIVER PERFORMANCE

Drivers are likely to vary in their ability to find spaces and to judge the acceptability of illegal spaces. Given the ready availability of acceptable illegal spaces at present in London, the latter was a minor problem. However, the search routine and kniowledge of likely locations of available spaces can critically affect the estimation of search times. In the 'before' surveys checks were made on the search process to determine whether there was any obvious pattern of increase in knowledge of available spaces during the survey period. Table 2 presents the results for one junction on a search route in Mayfair. There is no evidence of such a pattern; the most popular, but least successful, left turn remained popular throughout the study period, while the rarely used, but always successful right turn did not increase in use after first being tried on Day 5. However, Figure 3 compares before and after search locations at one destination in Bloomsbury, suggesting that the two drivers did use markedly different search routines. The implications for the survey results are not clear, but it seems appropriate, if the survey method is to be further developed, to study the way in which drivers search for spaces. The vehicle following survey described below provides a means of doing so.

6.2 SEARCH PLUS WALK TIMES

While search times for unsuccessful searches must be longer than the 5 minute cut off, search plus walk times need not be; a meter found after ten minutes outside the address would involve less search plus walk time than one found after five minutes at a ten minute walking distance from the address. This makes the application of a negative exponential distribution less satisfactory for search plus walk times, and resulted, in some of the London 'after' surveys, in a reduction in search time accompanied by an increase in search plus walk time. To some extent the use of first and last meter spaces may offer a means of overcoming this problem, since two estimates of walk (and search) time are available for every circuit. This was not tested in the London surveys, and would be worth investigating further. Otherwise the only solution will be to increase the cut off and hence the proportion of successful searches.

TABLE 2 : NUMBERS OF CHOICES OF ALTERNATIVE ROUTES AT SOUTH STREET/SOUTH AUDLEY STREET JUNCTION

Choice made :	Straight		Left		Right		N/A(1)
Meter found?	Y	N	Y	N	Y	N	-
Day 1	2	0	2	1	0	0	0
Day 2	1	1	3	1	0	0	0
Day 3	3	0	1	2	0	0	0
Day 4	1	0	3	1	0	0	1
Day 5	1	1	2	0	1	0	0
Day 6	3	0	1	1	1	0	0
Day 7	2	0	2	1	1	0	0
Day 8	1	1	2	1	0	0	1
Totals	14	3	16	8	3	0	2
Percentage of total	31	6	36	17	6	0	4

(1) Meter found before reaching South Audley Street

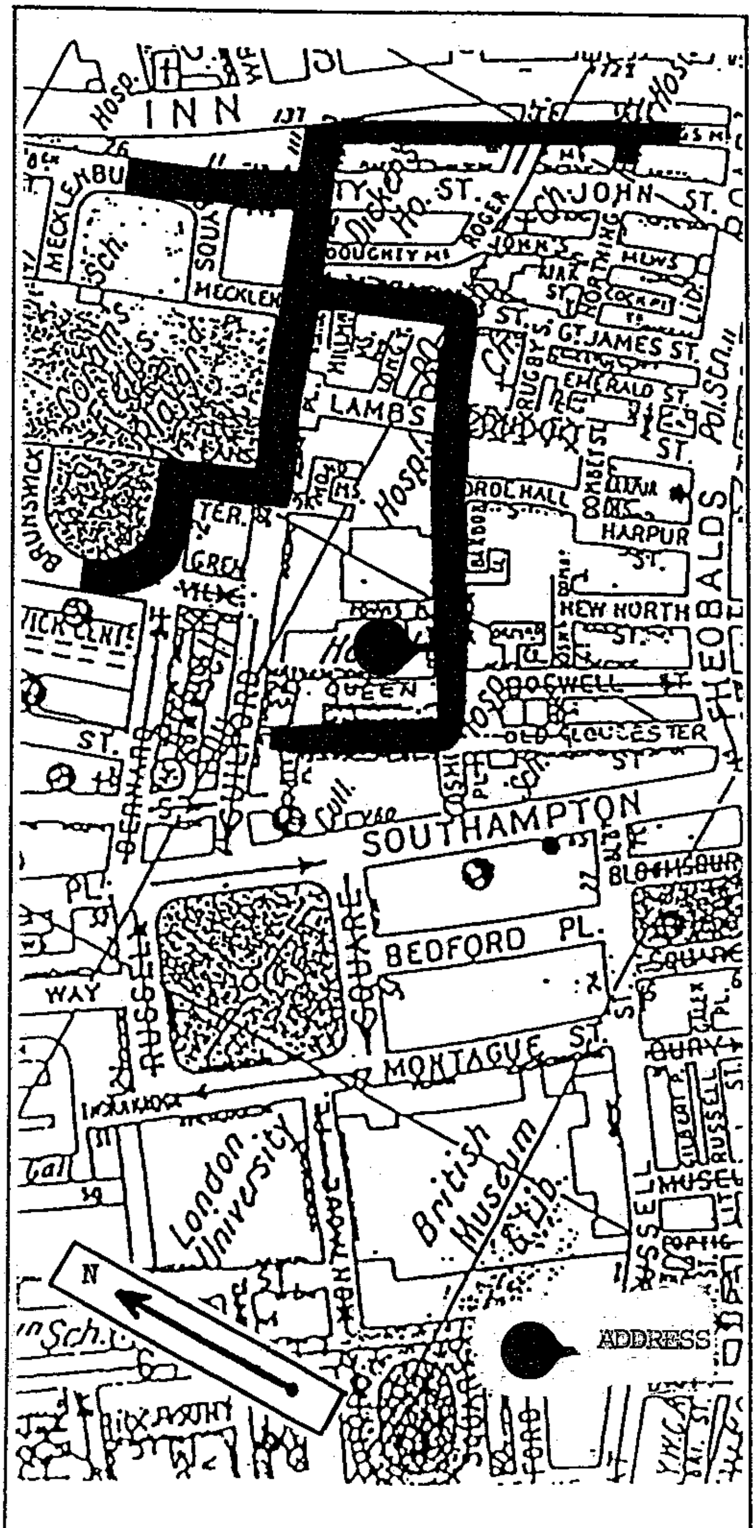
FIGURE 3.

PARK AND VISIT SURVEYS

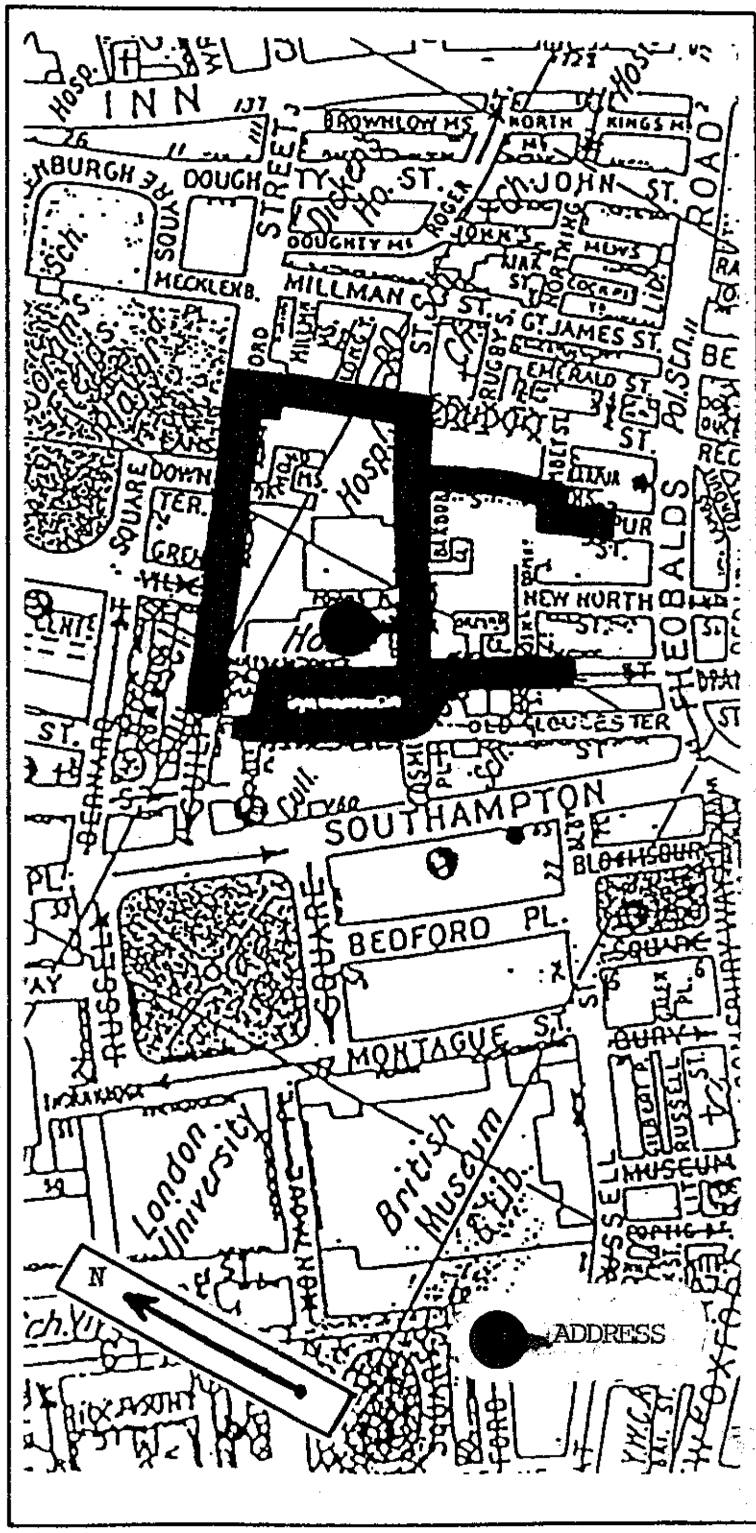
GREAT ORMOND STREET, BLOOMSBURY

ROUTES TAKEN DURING THE RANDOM SEARCH PROCESS

'BEFORE' STUDY, (1983)



'AFTER' STUDY, (1984)



PART II

THE VEHICLE FOLLOWING SURVEY

7. SURVEY BACKGROUND AND DEVELOPMENT

One element which is missing from all conventional parking usage survey methods is that of determining on an experimental basis the routes which vehicles actually take through a study area in order to achieve their ultimate parking destination. In modelling terms, conventional origin and destination data and assignment routines may well misspecify the route taken and underestimate the resulting flow on the network.

Wright (1976a) used the vehicle following technique in a bid to overcome limitations in conventional data collection and modelling. The survey covered an area of 22 km enclosed within the City of Westminster boundary and including a large proportion of the area of Central London. The main objective was to build up a picture of traffic movement within the city at minimal cost which could be used to evaluate a wide range of possible alternative traffic management measures and other transport proposals on different scales. Vehicles were followed both from points on major routes on the city boundary, and from points randomly distributed on the road network within the boundary. Vehicles which were followed were picked up at random. The test vehicle entered the appropriate traffic stream about 1/2 km upstream from the selected point, and as it passed the selected point the navigator instructed the driver to continue following the vehicle immediately ahead. If there was no vehicle ahead, the test vehicle stopped and waited for one. The drivers had no fore-knowledge of where the selected points were. A run stopped when the vehicle being followed parked, stopped to pick up or set down a passenger, left the city boundary, or was lost. Taxi drivers proved the most competent when following vehicles, and in the survey only 6% of vehicles were 'lost'.

In Central London a high proportion of trips are "through" trips and, as a survey area decreases in size the percentage of through trips rises. This posed major problems for Wright, who was interested in vehicles starting within the area or entering it and terminating within it or leaving it. For surveys of parking usage the areas will be smaller, and internal traffic relatively insignificant. Since the interest is in terminating traffic, traffic originating in the area can be ignored, and the survey can be concentrated on entry points. These, and the area boundary, need to be selected so as to keep the volume of through traffic followed to a minimum. The number of sample entry points also needs to be limited to reduce sampling problems. The following sections describe the modifications made to Wright's method for the purposes of the study of the effects of wheel clamps in Central London. It is worth noting that a standard registration number survey of moving vehicles was also attempted in conjunction with a survey of parked vehicles' registration numbers. However, the survey required 23 survey staff for approximately a quarter of the area, and the requirements of the matching routines made the analysis unacceptably complex.

8. MECHANICS OF THE SURVEY METHOD

8.1 SELECTION OF AREA AND START POINTS

For the parking survey purposes vehicles originating and finishing in the area are unwanted and likely to be small in number. By defining a boundary immediately inside the network of main roads most of the parking search process of interest will be able to be recorded, while keeping the proportion of through vehicles to a minimum. Since some terminating vehicles may use the surrounding main road network to reenter the area of interest, an outer boundary is required which includes those main roads and any one way streets which link them. Any vehicle crossing the outer boundary can be considered a through vehicle.

In selecting entry points it is worth checking all local roads crossing the inner boundary inbound, and concentrating on those with higher flows but a small percentage of through vehicles. Detailed origin - destination data is clearly valuable at this stage. The final choice should include entry points from each direction, but it seems more appropriate to keep the number of entries small to achieve a high sample at each point.

Figure 4 shows a typical survey area, with the inner and outer boundaries and three entry points.

8.2 SELECTION OF VEHICLES

Taxis have the twin advantages of having drivers likely to perform the task well and being reasonably unobtrusive. In London black taxis were hired on a fixed charge basis for periods not exceeding 3 hours (to avoid driver fatigue).

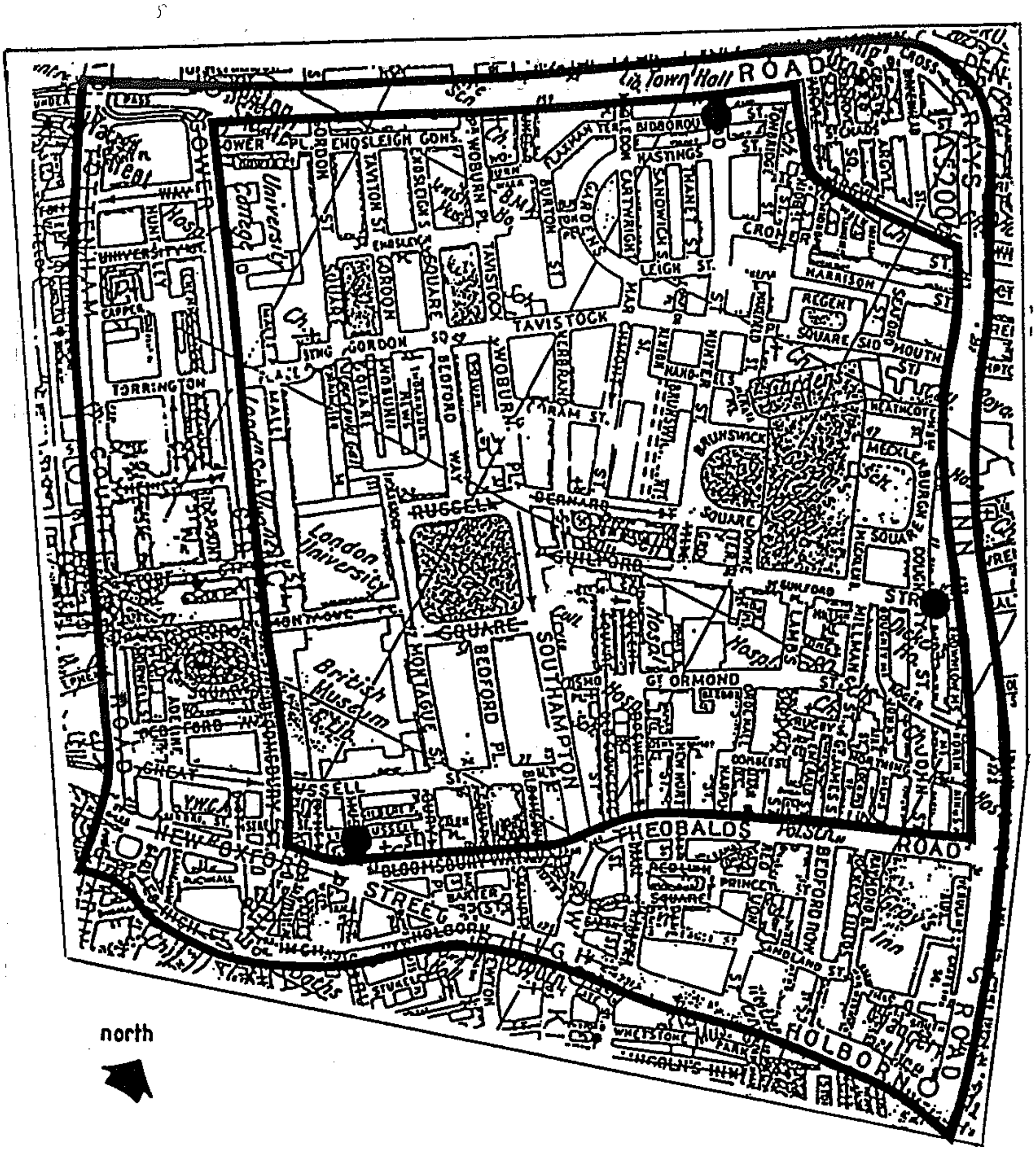
From a given start point a vehicle is selected. It is usually appropriate to concentrate on private cars, but it may be necssary to sample from different approaches to the entry point if they are likely to be associated with destinations in different parts of the survey area. If traffic is light the first vehicle entering after the taxi from the required direction is followed. If the traffic flow is heavy a car in the traffic stream must be chosen such that the taxi can join the traffic stream immediately behind the car to be followed.

The run ends when one of the following events occurs:-

(1) The car stops adjacent to the kerb and a passenger alights or is picked up.

(2) The car parks at an on-street or off-street location and the driver leaves the car.

(3) Contact with the car being followed is irretrievably lost.



NOTE : Inner and outer boundaries
Start points

FIGURE 4: Start points and inner and outer boundaries for a typical vehicle following study area.

(4) The car crosses the outer boundary and leaves the survey area.

8.3 DATA COLLECTION

A separate map-based survey form is used for each run. On this the time of the start of a run and the run number are noted together, if necessary, with details of the weather, country of registration of the car, and sex of the driver. The time at which the car being followed passes every convenient junction is also recorded and the timing places are noted on the map of the area, on which the exact route being taken is also shown. At the end of the run the time and location of the end of the run are noted and if the car is found to be waiting at the kerb or has parked it is further noted whether the car is:

(1) At a parking meter

(2) On yellow lines

(3) At a resident's space.

(4) At a disabled person's space.

(5) Off street.

If the car has been lost or has passed through the area and over the outer boundary it is recorded as such.

For the London surveys times were recorded using a Casio CP-10 calculator with printout. The relevant section of printout was then attached to the survey record.

Originally it was thought best that at the end of a run the taxi should progress to the next start point so that an even distribution of runs across all start points was maintained. However, in the interests of saving travel time it was found more advantageous to return to the same start point should the run end close to its origin, providing that an equal number of runs was still maintained overall, in that session, from each start point.

9. SURVEY COSTING

The daily costs of the survey at 1983 prices amount to :-

(1) Taxi Hire £10/hr	£60	*
(2) 1 Member survey team £3/hr	£18	*
(3) Cost of survey sheets	£ 3	
(4) Supervisor costs	£15	**

* Assume 6 hours of survey per day at 1984 prices

** Which can be shared if necessary with other surveys.

This gives a daily charge of £81-£96.

Hence for a survey period of 10 days the total cost for one vehicle following survey team will be in the region of £900.

10. INTERPRETATION OF RESULTS

On completion of the survey, data may be tabulated at the aggregate level and by individual start address by reason for ending run, run duration, and mean run time.

Perhaps the most useful way of presenting data from the survey is to look at route distances and route choice involved in the process of travelling through the study area, be the nature of the run parking or through travel.

10.1 ROUTE DISTANCES

In order to compare route distances it is first necessary to 'standardise' the trips. This can be achieved by the use of 3 factors:-

(1) Crowfly distance : The length of a straight line drawn from survey origin to destination.

(2) Shortest route distance : The length of the shortest route from origin to destination, permitted by the network, allowing for one-way systems and banned turns.

(3) Actual distance : The length of route taken by the vehicle as it was actually followed.

From these factors two indicators may be defined:-

(A) Directness of routeing

$$\text{Directness} = \frac{\text{Shortest-Crowfly Distance}}{\text{Shortest Distance}} \quad (\%)$$

(B) Degree of searching

$$\text{Excess distance} = \frac{\text{Actual Distance - Shortest Distance}}{\text{Actual Distance}} \quad (\%)$$

A high value for the directness indicator would indicate an area of extensive one way streets, whilst a low value would reflect, say, a grid pattern of predominantly two way streets.

The results of calculations of excess distance have a more direct relevance to the parking situation and in particular to the degree of searching which has taken place before parking is achieved. Wright (1976b) suggests that most 'through' trips generally minimise their journey distance to within 10% of the shortest possible route. In central areas however the regular visitor may pursue longer routes in his search for less congestion. Analysis of the results suggested that 40% was a more appropriate threshold, beyond which searching could be deemed to have occurred, though this may have been a conservative value.

10.2 USE OF THE NETWORK

The effects of searching traffic on the network will depend on the number of right and left turns and the number of conflicting routes taken. These can, if necessary, be measured directly from the survey records.

11. SURVEY PROBLEMS

The survey method is particularly robust and easily transferred between different survey staff on successive days of the same survey. There is little requirement for any subjective input by the survey team and hence no problems of different perceptions of driving situations arose. Once the survey member has driven around the area prior to the survey to note the start points, area boundaries and parking habits within the area the exercise is one of pure data collection. The driver needs no knowledge of the survey methodology. Problems which do arise are of three kinds.

11.1 PRACTICAL PROBLEMS

(i) Poor drivers and vehicles.

In selecting different drivers and vehicles over successive days of a survey, an occasional slow driver or vehicle makes the car "loss" rate rise and may reduce the numbers of vehicles followed in any one period. Over a number of surveys the loss rate appears very stable at about 5% as does the number of runs per hour, which suggests that the influence of poor drivers or vehicles is negligible over a survey period. It is however worth limiting the involvement of any one driver to three hours to reduce the effects of such problems.

(ii) Start Points

At a start point the taxi is stationary (with its engine running). The survey member selects a vehicle coming from behind and asks the driver to follow the car. Two problems can arise here:-

1) In heavy traffic flow it can be difficult for even the most enthusiastic of taxi drivers to enter the platoon of traffic. This results in a less than random sample, as one would tend to select the last vehicle in the platoon.

2) The survey member has to select vehicles turning into the junction past the start point from specific directions. It is important therefore for the taxi to be stationary at least 50 metres from the junction so that it can easily move in behind the moving car. The distance from the junction must not be too great however, otherwise the orientation of the vehicle to be followed will not be discernable from the back of the taxi.

11.2 SAMPLE SIZES

It was found feasible in the London surveys to complete 12 and 16 runs per entry point over a six hour survey day. However, in Mayfair around 20% of these were through vehicles and in Bloomsbury 50% were. This and vehicle loss inevitably reduce the effectiveness and sample size of the survey; over the four days at three entry points a total of 129 parking vehicles were successfully followed in Mayfair, and 85 in Bloomsbury. With these sample sizes, it was not possible to detect significant changes in the proportion searching. Even in Mayfair, where the percentage searching for meters fell from 22% to 7%, this was not significant at the 95% confidence level. More information will be required before the appropriate samples can be determined, but it seems likely that a survey over 10 days, as costed above, would be desirable.

11.3 FINAL DESTINATIONS

One weakness of the survey is that it does not identify final destinations, which are necessary if walk times are to be determined, and useful for checking whether substantial excess distances arise from searching or lack of knowledge of the network. In the main London surveys observers were not permitted to interview drivers who had been followed. However, in a pilot survey undertaken as a student exercise all the drivers approached were willing to state their final destinations. It seems worth adding a simple question to the followed driver in future applications of the survey method, but it should be noted that this could reduce by about 15% the number of runs possible in a given survey period.

12. CONCLUSION

Two survey methods have been developed and tested for obtaining information on the effects of parking conditions on time taken to access to final destinations. The park and visit survey provides a cost-effective means of measuring search times for parking spaces and search plus walk times to and from the destination. It can also provide information on travel times and parking space availability in the area of study. Until more is known about the ways in which individual drivers search for parking spaces it would be appropriate to employ the same drivers throughout such surveys. The vehicle following survey provides information on the actual search processes adopted by drivers.

As developed in London the survey method performed well, but more information is needed on appropriate samples sizes for survey design. The surveys in Mayfair, where meter occupancy averaged 92% (Kimber, 1984), indicated mean search times throughout the day for legal meter spaces of around 5 minutes. Search plus walk times averaged 13 minutes, and search, walk and return times 21 minutes. These represent very substantial increases in the normally identified costs of car use, and must play a large part in the decision of the majority of the Central London's on-street parkers to park illegally. There is a clear justification for applying the survey methods described more widely in order to understand the true extent of these costs.

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