

AN APPROACH FOR IDENTIFYING TRANSPORT GAPS:
A SOUTHWEST-SYDNEY CASE STUDY

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ABSTRACT: *Transport gaps exist whenever there is a disparity between travel demands and transport availability. Along with aspects of the immediate residential environment (i.e. problems with the house itself and disturbances, such as traffic and noise pollution, which impinge upon the household from surrounding areas), transport gaps contribute to the locational stress experienced by individuals and households. While attention has been focussed upon the former (site) component of locational stress in the past, this paper concentrates on the impact of situational and associated transport factors. However, the process of measuring locational stress, whatever its source (site or situation), has been inhibited by the lack of suitable data collecting techniques. As a consequence, there is a scarcity of information of the nature, causes and effects of locational stress in specific residential environments. The search for an appropriate approach to bridge this information gap resulted in the development of a game technique for identifying the nature and degree of locational stress experienced in individual households. This technique, and its application to a survey of families in the MacArthur growth centre area on Sydney's metropolitan fringe, is described. Results of the survey are discussed with particular emphasis being given to the way families adjust their travel behaviour in order to cope with the characteristic remoteness of transport deficient new residential estates.*

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Increasingly, a citizen's real standard of living, the health of himself and his family, his children's opportunities for education and self-improvement, his access to employment opportunities, his ability to enjoy the nation's resources for recreation and culture, his ability to participate in the decisions and actions of the community are determined not by his income, not by the hours he works, but by where he lives (our underlining)

E.G. Whitlam
Prime Minister's
policy speech,
December 1972

LOCATIONAL STRESS AND THE THREE GAPS

Between 1972 and 1975 successive Whitlam Australian Governments sought to counter poor access to community facilities and jobs in outer suburbs by encouraging the establishment of metropolitan 'growth centres' in selected corridors with public transport and freeway spines. Sites for these centres were designated at Gosford-Wyong, New South Wales; South-West Sector of Sydney (Holsworthy-Campbelltown), New South Wales; Monarto, South Australia; and Salvado (north of Perth), Western Australia -- the metropolitan counterparts of 'regional' growth centres established at Albury-Wodonga, straddling the New South Wales-Victoria state border; and Bathurst-Orange in New South Wales (Stilwell, 1974; Logan et al., 1975; and Neutze, 1977). Each centre was to have a development corporation modelled on the National Capital Development Commission in Canberra with power to develop land for residential, industrial and commercial purposes. Armed with Federal Government funds for purchasing land it was thought that the development corporations in the metropolitan growth centres would overcome the lag between residential growth and provision of amenities. However, there was little appreciation of the time required to build up community facilities as is shown in this study of the Macarthur Growth Centre located in the South-West Sector of Sydney some thirty-five kilometres from the central business district. (1)

1. The responsibility of the Macarthur Development Board is to plan, co-ordinate and implement the Macarthur Growth Centre and, in particular, to develop publicly-owned lands. Control over private land continues to be exercised by local councils in the area (Campbelltown City Council, Camden Municipal Council, and Wollondilly Shire Council). Co-ordinated planning of private and public lands is undertaken within the framework of broad policies and plans approved by the State Minister of Planning and the Environment. As well as the two State and Federal representatives on the Board each of the local councils and the adjacent Liverpool City Council can nominate a member. Set out in the Growth Centres (Land Acquisition) Act, 1974 the Board's area of operation includes assisting local councils to strengthen their organisations to cope with the increased demands of being a growth centre.

Attempts by the Macarthur Development Board, established in 1975, to provide amenities and employment to this rapidly growing residential area (population of 100,000 in 1980) have proved -- from the viewpoint of recent arrivals -- to be scarcely better than if the process had occurred without government intervention. The lag in providing facilities and the shortage of local job opportunities created four major problems in Macarthur: time spent in private and public transport to reach central business district locations; inadequate public transport connections to dispersed non-central job locations; poor public transport facilities for working women wanting to travel to jobs in off-peak periods; and housebound women and children in an environment which necessitates a level of mobility that only a private car can provide. The disruption caused to Macarthur households by this disparity between the needs of individual members and the availability of transport is a prime cause of what Moore (1972) terms locational stress.

This focus on transport gaps departs from the conventional association of locational stress with the immediate home-based environment -- problems with the house itself and disturbances, such as traffic and noise pollution, in the surrounding area (Moore, 1972:2). However, the difficulty of measuring locational stress, whatever the source (site or situation), has been held back by the absence of suitable data.

The search for alternatives to bridge the information gap resulted in the development of a game technique for identifying the degree of locational stress experienced by individual households. An evaluation of this stress game technique raises a series of questions: how can the results of applying the technique be interpreted; what relevance do the implications of this method of travel demand analysis have for policy-matters; and how can this game technique be extended to other transport related problems?

In tackling these questions the advantages of the stress game technique over conventional survey methods is discussed (Part 2). The insights derived from applying the game to families in Macarthur are detailed (Part 3). Then, the effects of substituting this technique for conventional survey methods in the identification of projects to relieve locational stress in Macarthur are considered (Part 4). The extension of the stress game technique to fill other transport-related gaps and bridge further information gaps is outlined before considering how it may be used to plug deficiencies in organisational structures that inhibit sensitive responses to changing travel demands. These institutional gaps are the ultimate barrier to the implementation of transport and non-transport options for relieving locational stress.

PLAYING THE STRESS GAME

Before the stress game technique could be applied to identifying transport problems in Macarthur three preparatory steps were

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necessary: a survey of residential areas had to be undertaken to pinpoint variations in locational characteristics in relation to community facilities; a sampling of households had to be devised to provide examples of relatively accessible and inaccessible locations; and a conventional survey had to be carried out to gather information on the history, and economic and social attributes of forty selected households.

The characteristics of families included in the sample reflected the propensity of new residential areas on the fringe to attract relatively young families at the child-bearing and child-rearing stages of the life cycle -- thirty-one families being in these two categories (Table 1). Typically, women in such families had withdrawn from the work force because either suitable employment opportunities were unavailable within easy reach of home or they had newly-acquired family responsibilities.

TABLE 1 CHARACTERISTICS OF SAMPLE IN TERMS OF FAMILY LIFE CYCLE, 1977

Family life cycle stage	Households number	Household heads		Average age of children		
		Male age	Female age	0-5 number	6-11 number	12-18 number
Pre-child	2	28.5	26.0	0	0	0
Child bearing	18	29.2	26.5	1.8	0	0
Child rearing						
two parent	9	33.9	29.1	1	1.4	0.4
one parent	4	-	33.0	1.3	1.3	0.3
Mature	6	38.5	41.3	0	1.5	2.0

(a) N=40 (one household comprising a retired couple has been omitted).

The predominance of single income families led to a high proportion of households in the lower and lower middle income brackets (Table 2). Thus, the migration of young families was a response to their preference for detached dwellings and the availability of lower-priced homes being restricted to areas like Macarthur. This economic constraint on residential choice was more acute for tenants on New South Wales Housing Commission estates -- three-quarters of the households in the lowest income bracket. As anticipated, this group made up the majority of those whose specified motive for moving to Macarthur was the availability of suitable housing at a reasonable price. Other households who conceivably could have exercised more choice opted for Macarthur because of its qualities of newness, spaciousness and environmental considerations compared with the inner western suburbs of Sydney. However, these benefits were gained only at the expense of poorer access to jobs and amenities. Pinpointing these accessibility problems was the objective of the stress game.

TABLE 2 RANGE AND MEAN ANNUAL INCOMES OF SAMPLED HOUSEHOLDS, 1977

Range of incomes \$A	Households number	Mean incomes (a) \$A
3,744 - 10,000	21	8,014
11,000 - 15,000	12	13,458
16,120 - 20,500	6	18,183
	39	11,254

(a) Mean Australian income in 1977-78 (based on 'employed male unit' was A\$10,894 and the equivalent mean Sydney income was A\$11,096.

The application of the game in Macarthur involved five stages. First, the interviewer located the residence on the gaming board and then familiarised all members of the household with the representation of Macarthur's major landmarks and significant features of the immediate neighbourhood. Second, individual members of the household were asked to record, with the aid of an inventory of primary trip purposes, individual trips over the past month by indicating their location on the gaming board, mode of travel and frequency; particular attention was paid to trip linkages at this stage. Third, individual members were asked to specify destinations, not on their current itinerary, which they would like to visit but were prevented from doing so for various reasons. Fourth, the household was asked to rearrange trip destinations in a way that minimised locational stress; the exercise was constrained by a 'play-money' budget which limited the degree to which they could rearrange destinations. Fifth, the play budgeting constraint was relaxed to allow the household an opportunity to see how closely the situation represented at the conclusion of the game matched their real preferences.

A prime advantage of the game technique was that it facilitated communication not only between respondent and interviewer but also between individual members of the household concerned. The resultant clarification was strengthened by participants being able to visualise travel patterns on the gaming board and to remind themselves of any omission as they cumulatively compiled their trip records. This interactive quality avoided the tedious repetition inherent in the catechetical-like character of conventional surveys.

Another advantage of the game technique was that it enabled participants to appreciate the full implications of alternative arrangement of destinations. Trading-off the location of destinations on the gaming board within budget constraints not only simulated the restriction of choice in the real world but also forced respondents to assess their priorities. The technique demonstrated that this assessment had to be made within the context of total household organisation of

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activities. Thus, the technique emphasised the need to take account of trade-offs between individual and household priorities.

Some of these advantages are inherent in a similar gaming technique developed by Oxford University's Transport Studies Unit (Clarke *et al.*, 1980; Jones *et al.*, 1980) which focused on comparing the benefits of various transport options. However, the game technique employed in Macarthur emphasised the locational constraints on accessibility rather than the restrictions on travel. Such an emphasis was particularly attuned to the needs of household women and children in isolated outer suburban locations as is shown by responses to the game in Macarthur discussed in the next section.

THE RESPONSES

Any attempt to identify transport gaps must be based on a detailed understanding of the locational stress experienced by families located on the urban fringe and their strategies for alleviating this condition. Insights into these problems can be gained by examining the responses of the sample of Macarthur residents to the stress game. Major sources of stress were reflected in the frequency with which specific destination locations were changed by households during the game. Table 3 ranks these destinations accordingly. The five highest ranking destinations were husband's work, hospital, specialist shopping centre, doctor's surgery and relatives. Prominence of the husband's work stemmed from the longer journey-to-work inherent in the shift to Macarthur and the disruptive effect of decreased availability of the family vehicle to other members -- particularly pronounced in twenty-three of the twenty-eight single car families in which longer journeys to work were experienced. The high ranking of the hospital was attributed to the absence of the facility in Macarthur at the time of the survey and the innate fears of carless women with young children (a hospital has since been provided but without maternity and paediatric facilities). A specialist shopping centre figured prominently because of the limited range of goods available in Macarthur and poor public transport facilities to Campbelltown -- the main shopping complex (since augmented by the completion of the first stage of the Macarthur Square development). Doctor's surgery was in high demand echoing the vulnerability of carless women requiring frequent medical attention for their children. The desire to be closer to relatives reflected the disruptive effect of distance on hitherto closely knit kinship systems.

TABLE 3 RANKINGS OF DESTINATIONS MENTIONED IN MACARTHUR STRESS GAME RESPONSES, 1978

Rank	Destination	Total(a)	Rank	Destination	Total
1	Husband's work	24	10=	Entertainment	6
2	Hospital	17	14=	Baby health clinic	5
3	Specialist shopping centre	14	15=	Pre-school	3
4	Doctor's surgery	12	15=	Adult education	3
5	Relatives	10	17=	Child care centre	2
6=	Primary school	9	17=	Tertiary institution	2
6=	Supermarket	9	17=	Railway station	2
8=	Corner shop	8	20=	Friends	1
8=	Bank, post office	8	20=	Indoor recreation	1
10=	Wife's work	6	22=	Secondary school	0
10=	Dental surgery	6	22=	Formal social	0
10=	Outdoor recreation	6			

(a) Maximum N=40. (Source: Faulkner, 1978.)

Destinations that conversely received little attention were formal social activities, secondary school, indoor recreation, friends, railway station, tertiary education and child care centres. Limited leisure time accounted for disinterest in various social activities and higher educational facilities were not an immediate need. These findings may also be attributable to the low participation rate of people with young families and high mortgages in such activities. The railway station was not important as the mode was mainly used for CBD work trips -- not a relevant destination for most workers in Macarthur.

Looking at the sources of locational stress within this framework failed to reveal the underlying organisational implications of coping with isolated situations and limited transport resources. Thus attention in analysing the stress game is directed to the way in which Macarthur households have coped with a metropolitan fringe location.

Primary base

During the course of the stress game three sets of actual and potential adjustments based on the home -- the primary base -- were revealed. The first set hinged on the varying arrangements involving car use, the second set on alterations in the responsibilities of family members and the third set on changes in journey patterns.

Car arrangements had changed since the shift to the metropolitan fringe: there was greater dependence on the car for the journey-to-work and it was unavailable for longer periods for other household activities. Adjustments involved car pooling among a small minority of commuters and between neighbouring

housewives on non-work trips. Potential adjustments revealed by the stress game centred on moves to have work located closer to the home. Underlying this response was the assumption that either the husband would travel by public transport and release the car or alternatively the wife would take the husband to work and then use the car for daytime activities. A further possibility was that the husband would return home during the day to make the car available for other activities (e.g. lunchtime shopping) - even thirty minutes was thought important.

A common example of changes in family responsibilities on the metropolitan fringe involved the husband taking over shopping and banking by incorporating trips to these destinations in his journey-to-work. In effect, this type of arrangement was designed to bring about a closer match between the responsibilities of individual family members and available transport resources -- in direct contrast to the adjustments in car use aimed at aligning transport resources and fixed family responsibilities. However, shifts in responsibilities were not confined to families alone. For example, one housebound mother minded the children of another to allow her unhindered use of public transport for shopping trips.

The range of possible adjustments in car use and family responsibilities varied according to transport resources (Fig. 1). Within the limits imposed by public transport carless families only had three options: the husband could become responsible for certain trips, housewives could enter into co-operative arrangements with neighbours, and housewives could rely on more mobile neighbours for transport. Where the wife was unable to drive in car-owning families she had the additional opportunity of being chauffeured by her husband and he, being more mobile, could take on a further range of activities traditionally undertaken by the former. In car-owning families where the wife was able to drive but the car was still committed to the journey-to-work she occasionally had the use of the car by accompanying her husband on the journey-to-work (where its location was relatively close to home). In families where the car was available to the wife for the whole day she had greater freedom because the adjustments had been made by the husband through the use of public transport or carpool. Thus as we moved up the scale from carless families to the two car family the range of options and degree of flexibility widened.

Changes in journey patterns have involved variations in both trip frequencies and linkages. While the frequency of certain trips was fixed (e.g. school, work, etc.) others (e.g. convenience shopping) were flexible. Thus, the frequency of the latter could be reduced to minimise total travel costs in situations where distances to these destinations posed a problem. Another strategy was to link hitherto separate trips within a single journey to achieve economies in expenditure on travel time and cost by reducing the total distance travelled in visiting a set of different destinations. The less obvious advantage of this strategy was that it allowed trips to originate from a secondary base (e.g. work) which was more accessible than the primary base -- the home on the fringe.

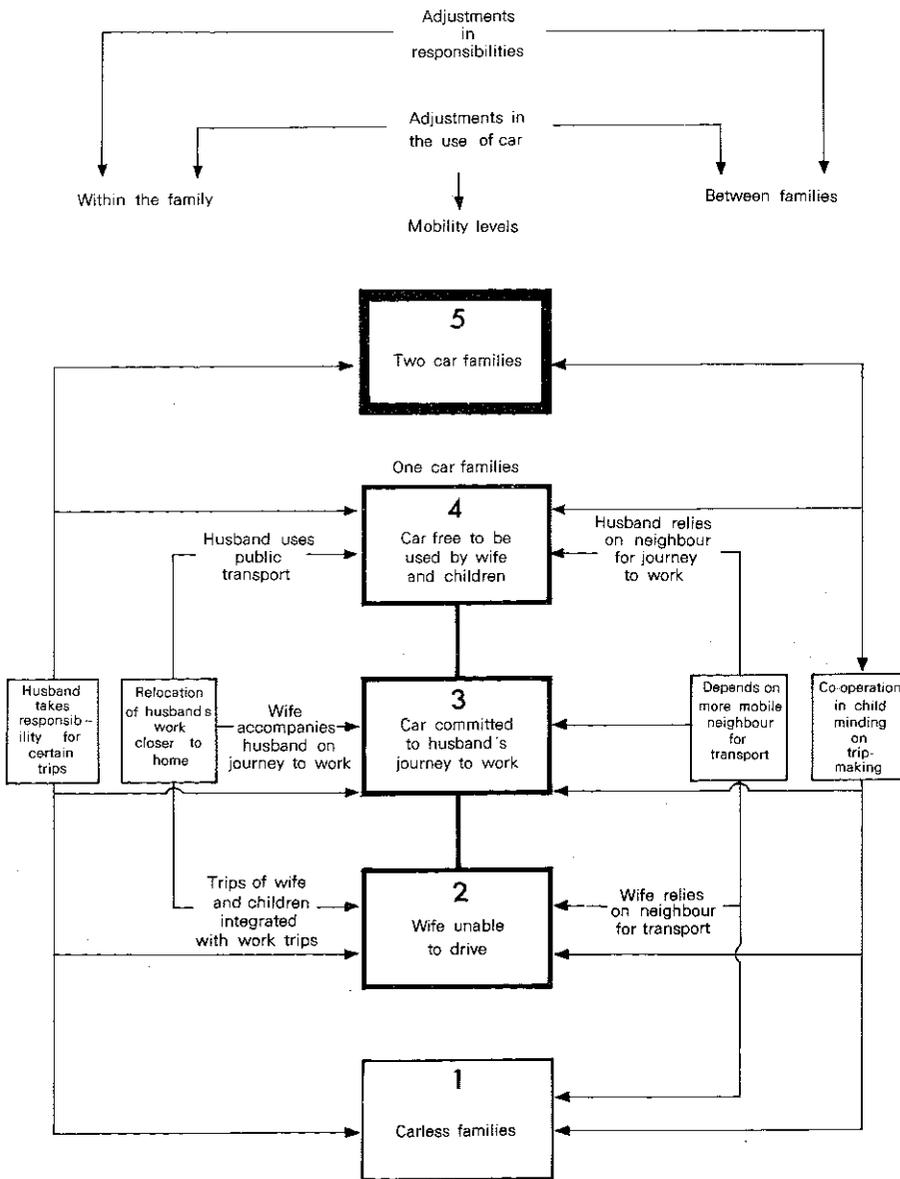


Fig. 1 Coping strategies involving adjustments in responsibilities and car use (Source: Faulkner, 1978).

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Secondary bases

Adjustments involving secondary foci were one of the most common strategies among the families surveyed (Table 4). The opportunity and ability to adjust in this manner was however limited by organisational constraints which varied according to family life cycle, family origins, and employment status of the family head. Among those families that originated within the metropolitan area the ability to arrange trips around secondary bases lessened with advancing stages of the life cycle from the pre-child stage to the mature family as illustrated in Figure 2. In particular, once children commenced school greater restrictions were placed on the movements of the family as a whole.

TABLE 4 INCIDENCE OF ADJUSTMENTS MADE BY SAMPLED HOUSEHOLDS SINCE MOVING TO MACARTHUR

Type of change	Intra-family (N=40)	Inter-family (N=40)
Car use	10(a)	10(b)
Family responsibilities	11	3
Journey patterns	14(c)	19(d)

Note: (a) Car released; (b) car pooling; (c) reduced trip frequency; and (d) multi-purpose journey with secondary focus.

On occasions, these secondary bases had the additional significance of maintaining supportive social and kinship networks which would otherwise have been severed by relocation on the fringe (Faulkner, 1981). Frequently, the wife and children accompanied the husband on his journey-to-work and were deposited with relatives until his return. During this period the wife was able to undertake trips to shops and services (e.g. doctor and dentist) while the children were cared for by relatives. Thus, the secondary focus had a dual function -- it provided access to specific facilities and took advantage of the support of relatives.

The example of journey patterns illustrated how the various strategies involving primary and secondary bases interrelated within families. Changes in journey patterns either accompanied or facilitated shifts in responsibilities as, for instance, where husbands became more involved in shopping and banking -- the workplace itself thereby becoming a secondary focus. Inter-family relationships influencing car use by individual household members could also be re-organised as exemplified by the husband's participation in a car pool which allowed the wife to have the family car during the day.

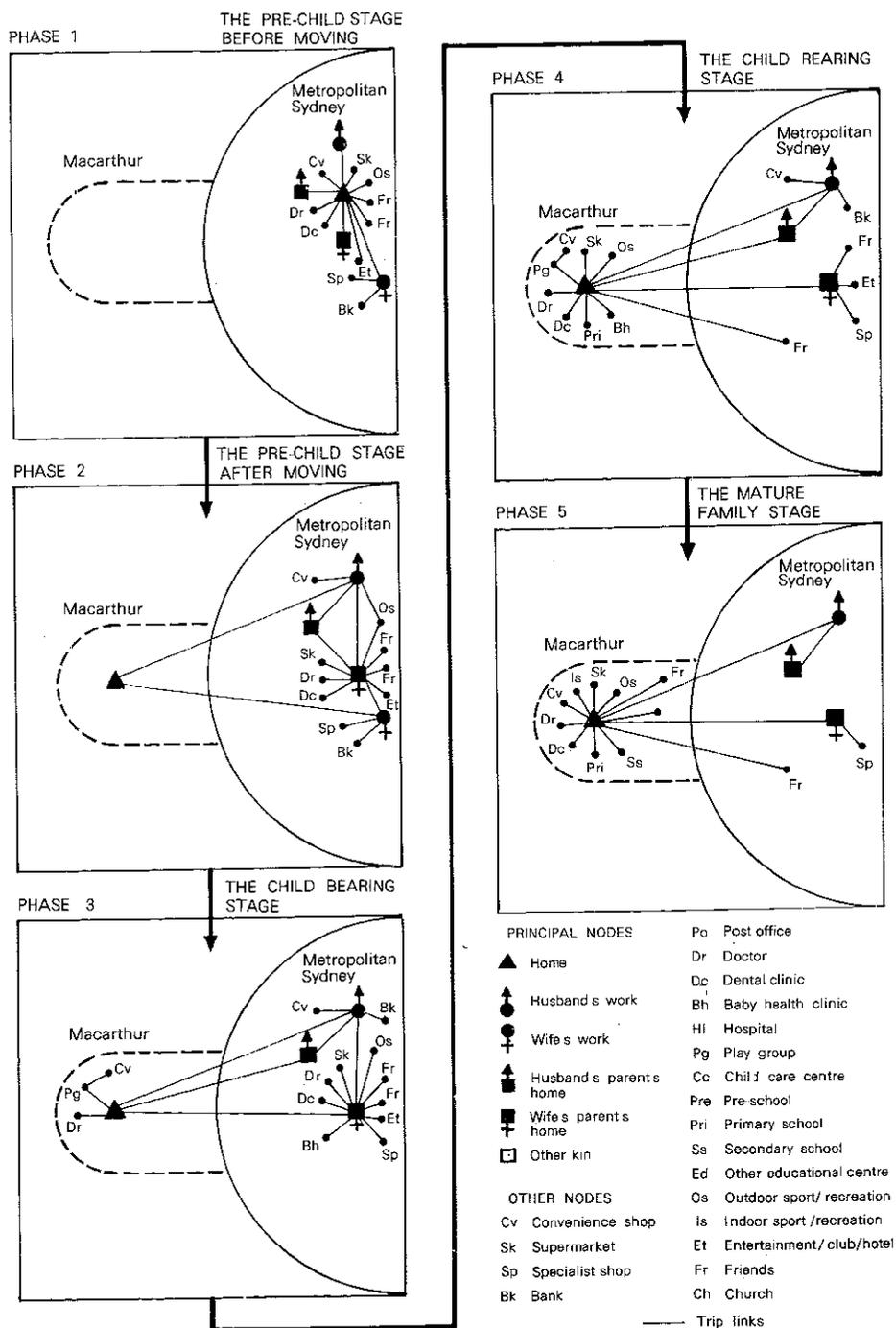


Fig. 2 Journey pattern responses to relocation on the metropolitan fringe by life cycle stage (Source: Faulkner, 1978).

IMPLICATIONS

Traditionally, data collected in urban transportation studies -- as illustrated by SATS Sydney Area Transportation Study -- has related to trip-making by individual members of sampled households (vehicle types, number of passengers, origin and destination, time and trip purpose). These data were coupled with information on land use characteristics and population projections as input to the conventional four stage model -- trip generation, trip distribution, modal split and traffic assignment -- to project passengers up to the year 2000. Although conventional transport planning studies are valid for strategic planning -- the 'eye-on-the-future' exercise -- the shortcomings of their data collection and their models have been widely criticised. In the case of SATS, Richard Davis (1977) has drawn attention to sampling anomalies and, in particular, the difficulty of drawing conclusions about outer suburban areas which are in the process of being transformed from rural to urban areas. However, these warnings have been ignored and SATS has been used for purposes other than that for which it was designed. Such misuse raises the question of how useful for social inquiry are data drawn from conventional transportation studies.

SATS data have been used legitimately to shed light on locational stress. For example, unpublished data from the home interview survey have been used by the Commonwealth Bureau of Roads (1976) to rank Macarthur among the fifteen most 'transport disadvantaged' areas in the Sydney region in terms of transport costs in relation to income.⁽¹⁾ Similarly, John Black (1976a, 1977) has used the same data to demonstrate that commuters living in areas such as Macarthur are unlikely to get much relief from SATS proposals for freeways, railways extensions and express buses because less than 1:5 suburbanites will benefit directly from freeway schemes, less than 1:15 from railway extensions and less than 1:25 from express buses. Further use of SATS data by Black (1976b) has highlighted the plight of working women, particularly those employed part-time, in travelling to dispersed job locations.

This emphasis on trip-making and locational considerations recognised that the accessibility of individual household members to facilities was a function of both location and transport resources. However, by looking at the single trip in isolation, not only were linked trips ignored but also the way in which trips were integrated with the organisation of household activities.⁽²⁾ The breakdown of household organisation is a

1. Manning (1978:91-2) noted that from among residents of all Sydney local government areas those of Macarthur had the longest average journeys to work at the Census in 1971 -- 18.7 km.

2. Jones (1980a) suggests that better use could be made of existing conventional travel data sets by analysing them as out-of-home activity patterns; they contain much little used data on the timing and sequencing of trips.

symptom of locational stress on the urban fringe and points to gaps in the transport system. Thus, new surveys will have to extend coverage to latent trip potential -- the trips people cannot make because they lack the necessary transport resources or are too distant from potential trip destinations. If all forms of locational stress are to be explored SATS data will obviously have to be supplemented by further methods which investigate the organisational basis of travel behaviour within the family and identify the root causes of difficulties -- the stress game is an obvious candidate.

Of the two problems identified at the outset of the study -- burdens associated with the journey-to-work and difficulties experienced by housebound women and children in reaching local amenities -- the stress game shed more light on the latter. It revealed the tendency of conflicts involving the use of the family car to be resolved in favour of the journey-to-work. With resources being allocated to the journey-to-work major problems were experienced in coping with local trips. The issue can be resolved by encouraging alternative means of transport for work trips. Since conventional public transport systems are evidently inadequate -- poor frequency and route coverage -- para-transit options, such as car pooling, would be more appropriate for providing the desired level of comfort, flexibility, and reduction in travel time. Steps also can be taken to improve the transport services available to the housebound population. However, the inadequacies of conventional public transport for journeys to work are compounded for women and children which suggests that another para-transit option -- a demand-responsive bus service -- is apposite.

The stress game approach reveals aspects of transport problems not normally considered in conventional urban transportation studies. However, the stress game is not without limitations. The major constraint is the amount of time required for each interview and consequently the resources needed to mount surveys which encompass reasonable sample sizes. Thus, these surveys encounter aggregation problems in extrapolating from the sample to the metropolitan level. The potential of the stress game, therefore, would seem to be as a supplementary aid to conventional urban transportation studies because it is no longer acceptable to concentrate solely on strategic planning and ignore the needs of special groups and areas. Otherwise the problems of housebound women and children, in particular, will continue to be ignored.

EXTENSIONS

The game technique is a simple and effective approach for identifying sources of locational stress -- and therefore transport gaps -- associated with particular residential situations. While the physical equipment used with the game facilitates the description of household travel behaviour, the game itself provides insights into the level of satisfaction achieved by such behaviour by enabling respondents to describe

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preferred travel arrangements. In this respect, however, the game is somewhat limited because the preferred trip pattern can only be achieved by manipulating location of destinations. Consequently, even though this approach enables gaps in the transport system to be identified, it provides few insights into the nature of improvements to the transport systems required to plug these gaps. A useful elaboration of the stress game technique might be to combine it with Peter Jones' (1980b) HATS (Household Activity-Travel Simulator) technique by allowing participants to also modify the transport system operating within their area. The game framework and the physical model of their travel arrangements would then enable households to visualise the impact of various transport options on the organisation of their activities.

The Macarthur study focused on the household unit and, in particular, on housebound women and children. In another area there is no reason why a different group, such as the single parent family, should not be the prime focus. In extending the game it would be possible to shift the centre of interest to community and special interest groups. For example, it would be feasible to apply the game technique to locational stresses experienced by pre-school groups and transport disadvantaged groups, such as the handicapped (a study has been proposed for Canberra). Although there are dangers in over-extending the game technique it could be a powerful tool for investigating other activities, such as urban goods movement, particularly the stresses experienced by the truck driver in grappling with fixed and limited loading and unloading times. Before the stress game's full potential can be realised it may however have to be packaged like Peter Jones' (1980b) 'HATS' so that it can be used for role-playing by decision-makers to study, for example, the likely repercussions of escalating costs or staggering working hours. The results of the game should make them conscious of the institutional changes necessary for relieving locational stress.

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