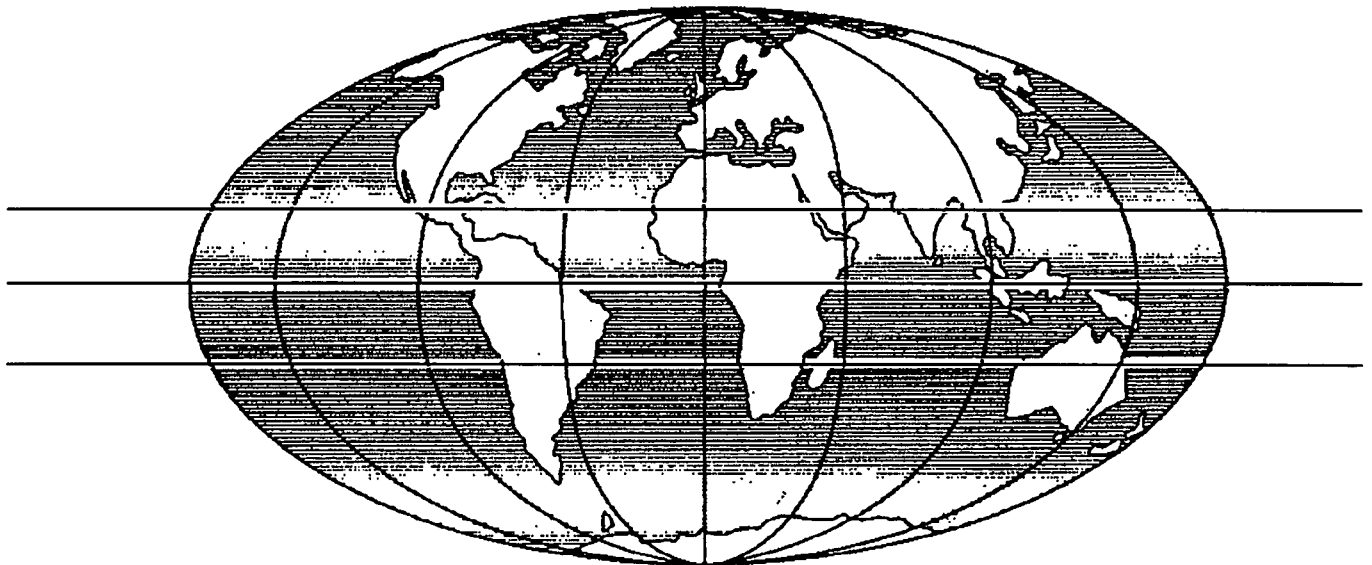




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The travel behaviour of households in Pune

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THE TRAVEL BEHAVIOUR OF HOUSEHOLDS IN PUNE

ABSTRACT

This paper reports on the income-related findings of a household travel behaviour survey undertaken in Pune during 1996. Individuals were placed into one of three income bands on the basis of their families' per-capita income. The results of the survey show that each of the income bands has its own particular set of travel characteristics with respect to modal choice for general travel, as well as specifically for work, shopping and education trips. The paper also reports on inter-group differences in attitudes towards public transport.

The differences between income bands are discussed in the context of Pune's growth as an industrial town, and also in the context of social/cultural issues. The aim of the study is to inform the transport planning process in order that future plans for Pune may consider and meet the needs of the entire population rather than just a section of the community.

1. INTRODUCTION

In many cities in developing countries rapid population growth has meant that housing has developed in areas inadequately served by public transport services. This can have an effect on the quality of life of the residents of these areas in terms of access to employment, shopping and medical facilities.

Before further resources are allocated to the development of transport infrastructure and increasing public transport provision in areas inhabited by the urban poor, it is necessary to discover what improvements need to be made to the network. This can be achieved by undertaking surveys of residents on travel demand using a questionnaire to obtain data on frequency and mode of travel, problems incurred when making journeys etc. In addition, it is also necessary to obtain background information on the area studied and the culture of the society being examined, as these factors can have a major influence on travel behaviour.

As part of an Overseas Development Administration funded Technology Development and Research (TDR) programme, the Transport Research Laboratory (TRL) has undertaken studies of urban travel behaviour in three developing country cities: Accra in Ghana, Medellín in Columbia and Pune in India. Pune was selected as a case study for the project as a large number of residents presently use motorised two wheelers, e.g motorcycles and motorscooters and historically used cycles. In addition, as public transport services comprise suburban rail, stage bus, taxi and autorickshaws it was thought that the residents would have a wide choice of travel mode from journeying on foot to train services. During the 1980's as well, a cycle network was established to encourage the use of cycles within the urban agglomeration. The network was planned to consist of lanes where cycles would be segregated from motor vehicles. Therefore the low income groups of Pune have access to a wide range of public transport services as well as traffic lanes dedicated to cycles should they own and operate one.

The aim of the research is to discover which factors influence travel demand in low income households. The results of the research will provide policy makers with an improved understanding of travel constraints, and will therefore enable them to formulate better

transport developmental projects which will in turn, provide improved accessibility to the transport network for low income households in developing countries.

2. PUNE METROPOLITAN REGION

Pune is an important regional centre of the State of Maharashtra and is situated 177 km south east of Bombay and covers around 810 square km. The population is now around 2.5 million, compared to 800,000 in 1971, representing an increase of over 200 per cent over the twenty-five year period.

The importance of Pune as an industrial centre has grown rapidly since the 1960's when industrial expansion in Bombay was banned. Consequently Pune has become a major centre in the state, having attracted heavy engineering industry such as motor vehicle manufacturing plants (buses, cars and motorcycles). Much of the industry is concentrated along the main Pune-Bombay highway, probably because this enables manufactured goods to be dispatched and supplies given to the factories without having to access the more congested centre of Pune.

Rural to urban drift and the immigration of people from other regions of India has occurred because of the employment opportunities created by rapid industrialisation; this has also led to an acute housing shortage and an increase in slum settlements which are poorly served by transport infrastructure and services.

3. TRANSPORT PROVISION

3.1 PUBLIC TRANSPORT

Rapid population growth and industrial expansion have placed heavy demands both on the transport infrastructure and public transport services, so that the present transport infrastructure in the city is unable to keep pace with population increases.

Bus services are supplied by Pune Municipal Transport (PMT) and Pimpri-Chinchwad Municipal Transport (PCMT). PMT currently operates 818 buses and PCMT 248 buses. In developed countries, bus travel is increasingly viewed as a way of easing congestion in town and city centres, and therefore there has been an increase in the number and variety of bus priority measures in use. However, in Pune, little thought has been given to bus priority measures, and due to the present road layout and driving behaviour, implementation of such measures would be problematic.

However, financial constraints have made it difficult for the bus companies to expand their fleets, replace ageing vehicles and generally provide an efficient service. Bus operations are further hindered by congestion, shortage of road space and a lack of road discipline. Because of a lack of public transport provision, a number of major manufacturing companies have begun providing commuter services for the sole use of their employees thereby guaranteeing that their workforce arrive on time for their shifts. There are around 4000 company buses in Pune, which is over four times the number of public buses, and therefore suggests that there is considerable under-provision in the public sector service at the present time.

There are currently 2515 taxis in Pune (of which 1900 are tourist cars); these taxis tend not to provide services within Pune; rather they serve inter-city routes from Pune to Bombay, Thane, Nasik, Ahmednagar, Kolhapur and Aurangabad.

Auto rickshaws have replaced horse drawn tongas as the major form of intermediate public transport in Pune. They operate anywhere within Pune and are the major operator of taxi services within the city. Autorickshaws tend to serve areas with poor bus service provision and offer a relatively cheap source of transport; for example, they are used to transport groups of children to school. The growth in the number of auto rickshaws along with other vehicles is shown in Table 1. The data illustrates the dramatic increase in the number of auto rickshaws which has occurred over the last 25 years.

Table 1. Growth in the number of registered vehicles

	1960	1970	1980	1994
Public Bus			434	994
Truck	1590	3628	8302	21008
L.C.V.	18	333	2506	5432
Car, jeep, taxi	2658	7565	13962	37208
Autorickshaw	207	2560	11038	22093
Two-wheeler	1315	15048	72040	295008
Other	185	844	1753	2341

3.2 PRIVATE TRANSPORT

Historically, Pune was known as the "cycle city of India", however, cycling has decreased in popularity as the ownership and use of motorised two-wheelers has increased. There has been rapid growth in the number of motorised two wheeled vehicles so that there are currently around 118 motorised two wheelers per 1000 population compared to 5.0 in 1965. The growth in motorised two wheelers is shown in Table 1. As a result of this growth, lanes dedicated for cycle users are now mainly used by motorised two wheeler users.

The growth in private car ownership has been slow due to the high cost of purchasing and operating the vehicle. In 1975 there were 7.15 cars per 1,000 population, by 1994 this had approximately doubled to 14. This contrasts with 337 cars per 1000 population in Great Britain in 1995 (Dept of Transport Statistical Services). Clearly the motorised two-wheeler is the 'motor car' of the middle income groups in India.

4. HOUSEHOLD SURVEY

4.1 METHODOLOGY

The aim of the household survey was to obtain information about individuals' travel patterns and attitudes and relate them to various household variables such as income, structure and location with respect to the central business district (CBD). Two research tools were

developed specifically for this task, both taking the form of an interviewer-administered questionnaire. The first questionnaire (general travel survey) concentrated on information about individuals aged 16 or over, the second (head of household survey) sought information about the household. These surveys were implemented in Pune by the Central Institute of road Transport on behalf of TRL.

4.2 RESULTS

4.2.1 Demographic differences

Table 2 shows the means for a number of demographic and household variables. It should be remembered that households were assigned to groups on the basis of measured per capita income, defined as income per person over the age of 16 years (not income divided by household size).

Table 2: Demographic and household variables

	Income Group		
	Low	Mid	High
Percentage of male respondents	58%	60%	58%
Mean age of respondent	35.8	36.0	36.9
Percentage of male household heads	95%	90%	81%
Age of head of household	45	43	43
Household size **	6.3	4.7	4.3
Household income (Rs) **	3211	5956	18389
Per capita income (Rs)**	742	1755	5801
Transport expense (Rs)**	446	815	2031
Transport expense as % of household income	15.5%	14.0%	13.5%

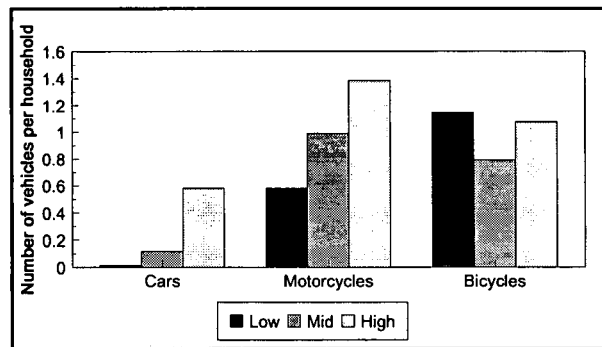
** indicates significance better than 0.1%

Household size decreases from low through mid to high income households. This is as one would expect in the developing world. It is interesting that there is a higher percentage of female household heads in the high income group than there is in the low income group. This could be related to either household size or household income. Large households are perhaps more likely to be able to provide a suitable male replacement in the event of death or other absence. In relation to the latter, having significant wealth is likely to allow a female rather more independence or respect, and thus the ability to run the household without the need to find a male replacement.

Whilst it is not statistically significant (because of a large data spread for all groups), the final statistic - percentage of household income spent on transport - is interesting and the finding that lower income households spend proportionally more on transport is consistent with the findings of a number of other studies of households in India (e.g Maunder, 1984). It should be noted that these figures have been calculated using data pairs (income and expenditure) for individual households, rather than using group means.

Vehicle ownership varies greatly between groups. This can be seen in Figure 1 which shows the mean ownership rates for cars, motorcycles and bicycles for households in the three income bands. All three groups have a level of bicycle ownership at around one per household. Ownership of both cars and motorised two-wheelers follows the predicted relationship with rising household income; these are expensive items to own and operate.

Figure 1: Vehicle ownership levels



4.2.2 General trip characteristics

Table 3 shows the mean number of (return) trips made each day by individuals from the three income bands. It can be seen that the three groups are remarkably similar.

Table 3: Daily per capita trip rates

	Income Group		
	Low	Mid	High
Number of return trips per day	1.03	1.04	1.02

Modal choice is a variable of considerable interest, since it is likely to be highly affected by income levels. Figure 2 shows the proportion of trips made by the income groups using different modes. There are obvious differences between the groups in modal choice. For instance, the use of motor cars increases with income. The same is true of motorised two-wheelers, although in all three groups a significant number of trips are made by this mode.

The modes incurring little or no cost are favoured by the low-income group which is predictable. Interestingly, a higher proportion of trips are made by autorickshaw by the lower income group than by the higher income group, despite being expensive (compared to the bus). It could be that the higher income groups simply do not like to travel by autorickshaw, and the decision is not financial. An alternative explanation - supported by the finding that the high income group also make less journeys by bus - is that high income individuals do not need to use these modes because of their high levels of motorised vehicle ownership.

Figure 2: Modal choice by income group; all trips

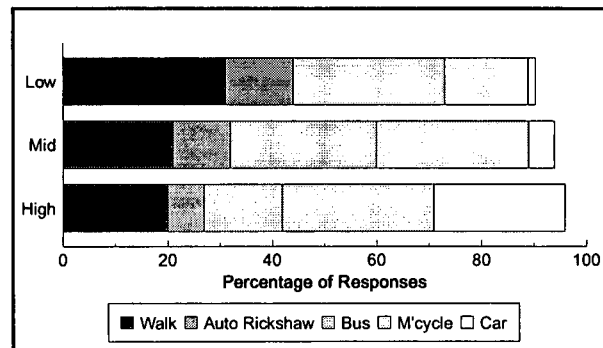


Table 4 shows the mean journey distance by mode for the income groups.

Table 4: Mean journey distance, by mode (km)

	Income Group		
	Low	Mid	High
Private car	3.5	8.0	11.2
M'cycle/scooter	6.9	8.0	8.1
Bicycle	4.3	3.9	4.2
Public Bus	7.9	9.5	10.5
Auto rickshaw	4.0	5.1	3.3
Walk	2.0	1.3	0.9
All modes	5.4	7.2	7.1

As might be expected, the low income group travel further using cheaper, more effortful modes (walk and bicycle) than the higher income groups, although for cycling the difference is only marginal. The high income group travel further by car (although the figure for low income individuals should be viewed with caution, since this is the average of only two journeys), motorcycle and bus than the low income group. This difference is reflected in differences in mean journey distance for all modes.

4.2.3 Work trips

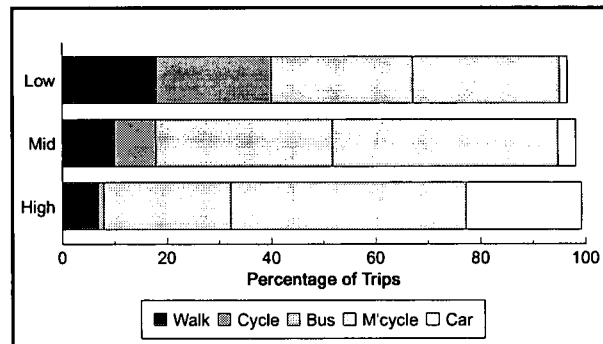
The frequency of work trips was more or less uniform across the whole population, with most people working five days per week or more.

Figure 3 shows inter-group differences in modal choice for work trips. It can be seen that walking as a mode of transport is more highly favoured by individuals from low income households. Cycling also follows a similar pattern. The opposite trend clearly occurs in relation to travel by car, and to a lesser extent to travel by motorcycle/scooter. The most

common mode of transport (the modal mode) for all three groups is the motorised two-wheeler, reflecting the rise in ownership of these vehicles.

The percentage of trips made by personal motorised vehicles equates to 30 per cent, 47 per cent and 67 per cent for low, mid and high income individuals respectively. For personal non-motorised travel (walk and cycle) the figures are 40 per cent, 18 per cent and 8 per cent respectively. This relationship is probably related not only to income but also to the distance that the three groups tend to travel for work journeys (6.2 km, 9.7 km and 11.0 km respectively)

Figure 3: Modal choice by income group; work trips



Buses, both public and company owned, are utilised for a considerable percentage of work journeys: 27%, 34% and 25% respectively. Therefore, even though utilisation of local trains and auto rickshaws for work trips appears to be low, public transport carries a significant number of people to work, regardless of income group.

4.2.4 Shopping trips

Table 5 illustrates the frequency of travel of individuals for shopping purposes. A much higher proportion of the low income group (80 per cent) reported making shopping trips than either the mid (53 per cent) or the high (47 per cent) income groups. This suggests that in low income households there is more sharing of household duties between members.

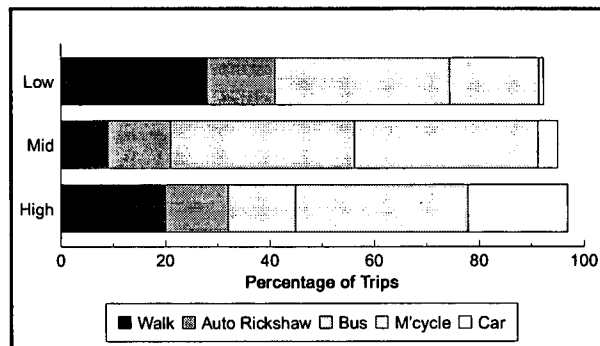
Table 5: Frequency of shopping trips

	Income Group		
	Low	Mid	High
5 times per week or more	11%	2%	6%
2-4 times per week	12%	13%	16%
Once a week	42%	38%	44%
Once a fortnight	7%	9%	12%
Once a month or less	23%	34%	19%
As required	5%	5%	4%

For all three groups the modal frequency response was 'once per week'. The pattern of responses for three groups are similar. The only finding of note is that individuals from low income families are much more likely to shop five times per week or more, compared to the mid and high income groups. This is almost certainly a case of low income individuals being unable to invest in domestic supplies for more than one day. This may be a result of being paid daily.

The pattern of modal choice for shopping trips differs from that for employment purposes, and is shown in Figure 4.

Figure 4: Modal choice by income group; shopping trips



The relationship between modal choice and income is not so distinct, especially for less costly modes. For example, both low and high income groups make a higher percentage of walk trips than the mid-income group. This is likely to be a result of differences in mean journey length, which is 4.5 km, 6.0 km and 3.8 km for low, mid and high income groups respectively.

For high-cost modes - cars and motorcycles - the expected pattern is found; usage increases with income. Public transport, in the form of buses and auto rickshaws, is used by many individuals from all three groups.

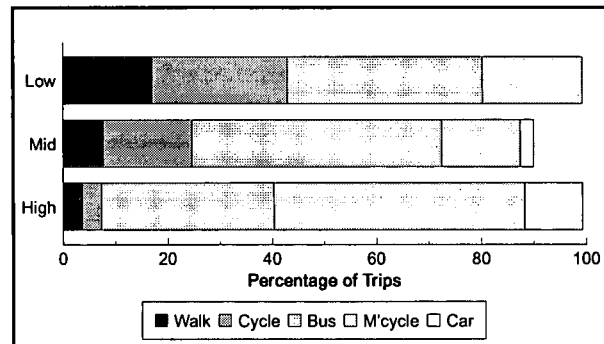
For shopping trips the three groups differ in terms of the modal mode. For the low income group it is the bus which is most frequently used (32% of journeys), whereas for mid and high income groups it is the motorcycle/scooter (35% and 33% respectively).

4.2.5 Education trips

Many of the people interviewed were students. As would be expected a vast majority of individuals travel at least five times per week. Only the high income group has a notable number of individuals who travel less frequently for education purposes. The mean age of the high income group is slightly higher than that for the other groups. This fact, combined with the likelihood of this group having more disposable income, could suggest that a higher number of the high income group attend night school, which involves expense, and is unlikely to involve travel more than twice per week.

Modal choice for education trips is shown in Figure 5. The distribution of modes is similar to that found for work trips.

Figure 5: Modal choice by income group; education trips



A considerable number (59 per cent) of trips are undertaken by personal motor vehicle by the high income group, presumably a result of parents giving a lift to other young adults. The bus is a popular mode with all three groups, but especially the low and mid income groups. The bicycle is predominantly used by the low income group. Mean journey distances are 6.7 km, 7.3 km and 10.5 km respectively.

4.2.6 Attitudes towards private vehicles

In addition to being asked about their behaviour, individuals were asked a number of questions regarding their attitudes to three modes of transport: the bicycle, the motorcycle/scooter and the car. The results are given below.

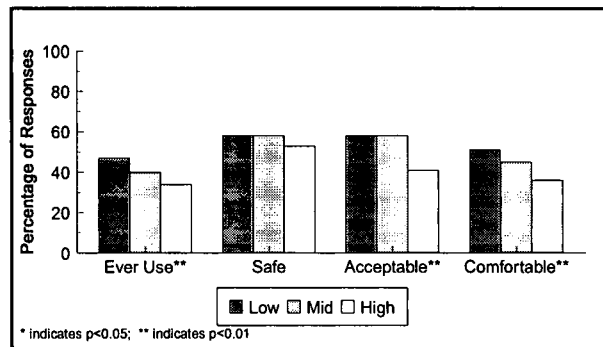
For each mode respondents were asked four questions:

- whether or not they ever use the mode
- whether they regard the mode as a safe form of travel
- whether they generally find it an acceptable mode to use
- whether they believe the mode to be a comfortable means of travel

Figures 6 to 8 show the responses given to these questions by the three income groups. In each case the percentage of responses given in the affirmative is shown.

Figure 6 shows the responses for bicycles. It can be seen from the Figure that there is a clear relationship between income group and the percentage of people using a bicycle, and also that similar relationships exists in terms of perceived acceptability and perceived comfort of the mode. Low income individuals view bicycles more positively than the other groups in each of these respects.

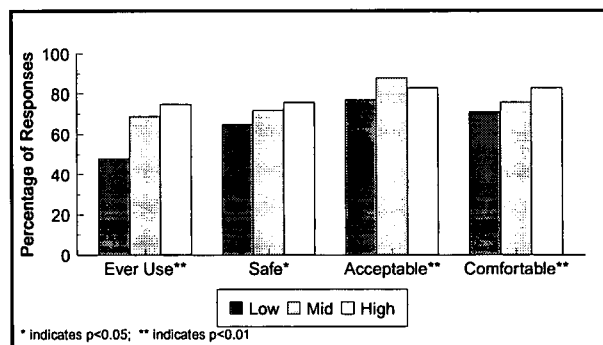
Figure 6: Attitudes towards bicycles by income group



There are equally strong, but reverse patterns in the trend of attitudes with respect to motorcycles and scooters, as shown in Figure 7. Only 48% of the poorest group ever make a journey by motorised two-wheeler, as compared to 75% of the highest income group. The pattern of responses for safety and comfort are similar in nature, with the high income group rating motorcycles/scooters higher than the mid income and low income groups.

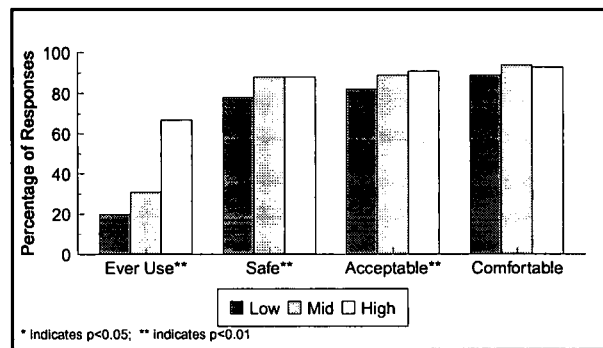
In terms of acceptability it is the mid income group and not the high income group who rate this mode highest. This could be because some of the high income group are used to travelling by motor car and thus regard two-wheelers as a sub-standard mode of travel.

Figure 7: Attitudes towards motorcycles/scooters by income group



In terms of the usage of cars there are considerable differences between the groups (see Figure 8). For the other factors the trends are not quite so distinct, this being mainly the result of 'ceiling' effects. Nevertheless, all the trends except for comfort ratings are statistically significant.

Figure 8: Attitudes towards cars by income group



4.2.7 Attitudes towards public transport

A separate section of the general travel survey asked questions regarding the problems that individuals experience in using public transport, and the improvements that they would like to see implemented. Both the problems and the improvements quoted are the first that respondents gave, and it is assumed therefore that the responses reflect the subjects' biggest complaint/most needed improvement.

Table 6 shows the nature of the problems experienced by individuals from the three income groups. Overcrowding is the modal response for all three groups. After overcrowding the most common complaints are "waiting too long", that "the buses are too irregular" and that "there are not enough buses".

Table 6: Problems of using public transport as perceived by income groups

	Income Group		
	Low	Mid	High
Overcrowding	33%	42%	37%
Rude/cheating staff	6%	10%	3%
Too expensive	2%	3%	2%
Not enough routes/buses	11%	9%	11%
Have to wait too long	22%	15%	14%
Irregular	17%	13%	13%
Other	9%	8%	20%

It appears that the inconvenience of having to wait for irregular and infrequent buses is felt more strongly by the low income group than the other two groups, perhaps suggesting that the provision of bus services into low income neighbourhoods may be poorer than into higher income neighbourhoods. Only a very small percentage of respondents (even from the low income group) complained about the cost of using public transport.

Suggested improvements are always likely to be closely linked to perceived problems. Table 7 shows the improvements suggested by the three income bands.

Table 7: Improvements to public transport suggested by income groups

	Income Group		
	Low	Mid	High
Improve regularity	42%	34%	27%
Better staff behaviour	4%	9%	3%
More buses	25%	21%	25%
Improve punctuality	12%	14%	20%
Make cheaper	4%	7%	2%
Other	13%	15%	23%

Just as the modal complaint for the three groups was "overcrowding", the modal improvement is an "increase in bus frequency" (the most obvious way of reducing overcrowding). To compliment this, the second most favoured response was "to increase the number of buses", although this can also be interpreted as a call for "more bus routes".

5. CONCLUSIONS

The rapid development of Pune has lead to considerable demand for travel both within the CBD and between residential areas and manufacturing centres. Despite a considerable expansion of public transport services the fleet has not kept abreast of demand. Thus large numbers of charter buses and private buses are operated by the leading manufacturers in Pune, to ensure that their workforce arrives on time and production is not halted.

Additional surveys undertaken in Pune (Palmer et al., 1996) suggest that patterns of travel behaviour differ between males and females, with the latter generally walking or travelling by bus. Females perceive the bus as being inferior to the local train services, and recommend that more buses should be provided to ensure improved service regularity and comfort. Personal security of females would be improved as less crowded travelling conditions would prevail.

Distances travelled throughout Pune are comparatively short hence the high percentage of all trips undertaken on foot. As personal incomes increase, ownership of motorised two wheelers will continue to rise, and therefore transport plans need to accommodate such growth. The use by motorised two wheelers of the once dedicated cycle network is a positive flexible safety response to the needs of such modes and ensures vehicle separation at key locations in the city and thereby allows all modes to travel freely.

The research has shown that the transport infrastructure in Pune is unable to meet the increasing demands of the population. The results of the attitudinal questions to both private and public forms of transport have given indications of the types of improvements that could be implemented to allow increased mobility. It is hoped therefore that the findings will be

of use to transport planners in Pune in the formulation of future plans for transport infrastructure and services within the city.

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7. ACKNOWLEDGEMENTS

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