

Non-Motorized Urban Transport, Pune City, Maharashtra, India

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Introduction

Bicycles are an important means of transport in almost all urban areas in India. The high rates of ownership of bicycles, their low cost and their ease of use make them an attractive mode of transport for students and low income workers. However, time trend analysis in various cities shows a sharp decline in cycle trip shares during the 1980s and 1990s due to several factors such as high exposure to accidents, lack of adequate infrastructure and lack of policies for cycling (Tiwari et al, 2008). Yet, a substantial number of people are often captive users as they cannot afford even the highly subsidized fares of public transit.

Although cycle trips might be as low as 6–8 per cent in mega cities, their absolute numbers are about a million bicycles. In most of the large cities in India, cycle trips are estimated to be about 0.70 to 1.0 million and 0.2 to 0.4 million in medium size cities. In medium size cities, 35–65 per cent of households own one or more bicycles. Despite the high ownership of bicycles in urban areas in India, the typical modal share in large cities is comparatively low. The average trip length for all vehicles (excluding walking) in medium and large cities varies from 4.2 km to 6.9km. Trip length frequency distributions show that 56–72 per cent of trips are short trips (below 6 km, the typically cycle-able distance). This can be partly explained by the high residential density, mixed land use developments and poly-nucleated city structures present in Indian cities. Hence, it can be argued that there is a substantially large latent demand (of potential users) in Indian urban communities, who may use bicycles if safe circumstances prevail.

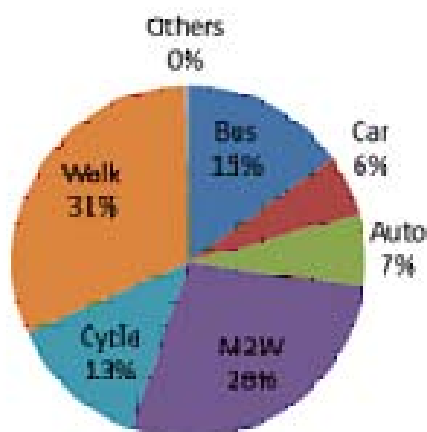
To understand these issues in some depth, this study examines the trends, conditions and challenges of cycling in Pune city, India. Based on data collected at the Transportation Research and Injury Prevention Programme at the Indian Institute of Technology (Tiwari et al, 2009), it reviews the infrastructural, traffic and land use constraints that make the bicycle an undesirable mode of transport for its users.

Background

The city of Pune is located 160km from Mumbai, the capital city of Maharashtra. The city has an area of 250 sq. km with an estimated population of over 2.55 million. The establishment of the Maharashtra Industrial Development Corporation in 1961–1962 considerably facilitated industrial development in the area. Pune is situated near the western margin of the Deccan Plateau on the leeward side of the Sahyadri ranges and Western Ghats, 560m above sea level, on the banks of the rivers Mula and Mutha.

Pune has always been known as the bicycle city of Maharashtra and has a history of high bicycling modal share. A report published in 2003 shows a modal share of 13 per cent cyclists in Pune (Span Travers Morgan, 2004). Another study shows that there is a declining trend in bicycle mode share from 35 per cent in the 1980s to 30 per cent in the 1990s and 17 per cent in the 2000s (Tiwari et al, 2008). Even though the mode share has declined, a huge number of trips are still made by bicycles. Almost 0.75 million trips are bicycle trips in the city (Tiwari et al, 2008). Figure 1 shows that the highest mode share in Pune is non motorized transport (44 per cent) followed by motorized traffic (34 per cent) and public transport (22 per cent).

Figure 1. Mode share in Pune



Source: Span Travers Morgan, 2004.

Pune has had Bicycle Master Plans since 1982 and dedicated bicycle tracks since the 1980s. Figure 2 shows the existing layout of cycle tracks in the city. They have been built mostly in the suburban areas/ new extension areas and not in the inner city.

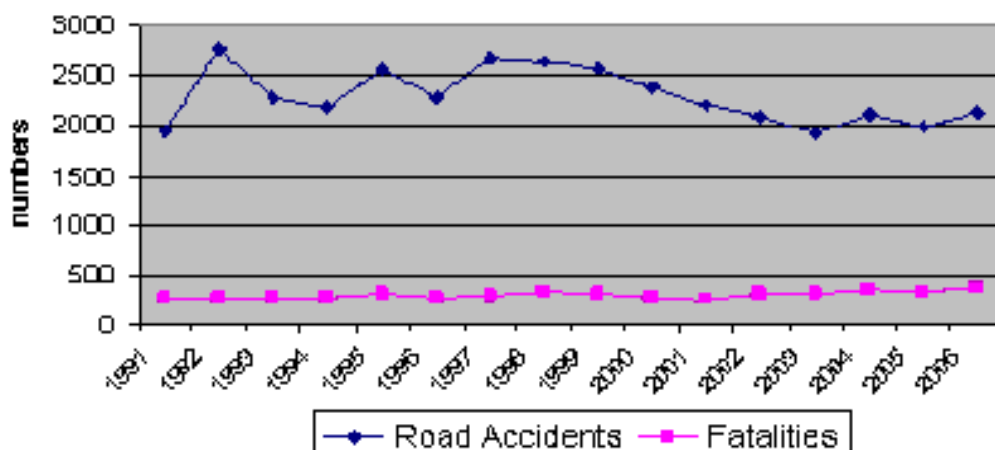
Figure 2. Map of Pune showing current layout of cycle tracks



Source: Span Travers Morgan, 2004.

Like most of the cities in India, cyclists in Pune are vulnerable road users and are involved in fatal crashes on high speed roads and in mixed traffic with large motorized vehicles. Figure 3 shows that the number of accidents has declined and fatalities have increased marginally from 1991–2006 and during the same period the share of cycling and the number of cyclists on the road has decrease. Hence although the number of accidents may have decreased the bicyclist rate of involvement in the accidents is still high.

Figure 3. Trends of road accidents and fatalities in Pune (1991–2006)



Source: Jain et al, 2010.

The Study

The objective of this study is to understand NMT trends based on socio economic and travel characteristics and examine the constraints that make the bicycle an undesirable mode of transport for its users. The study employs the Stated Preference (SP) technique for assessing the perceptions of captive and potential cyclists of the existing and desirable road infrastructure features. The sample size of the study is 1400 households with respondents having trip lengths less than 6 kilometres and age more than 10 years. The study classifies the respondents mainly into two groups: cyclists and potential cyclists. The potential bicycle users in the present study are students and workers who can own/afford a bicycle and travel short distances (less than 6 km) and are currently using motorized modes.

The survey indicates the following detailed information on both cyclists and potential cyclists.

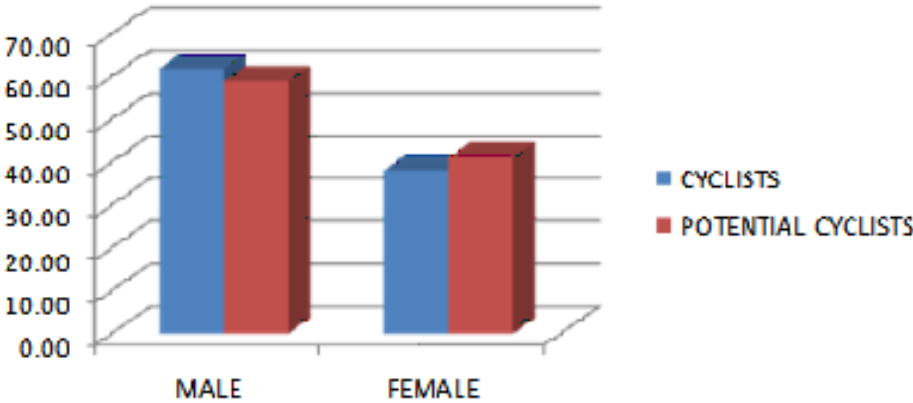
- Socio-economic information – sex, age, education level, occupation status and income.
- Travel based information – Trip length distribution, the average travel time, average travel cost the other modes of transport availability, potential cyclist's modal share on last working day and secure parking availability.
- Preference based information – problems in using bikes, safety, security, barriers and conflict issues and priority, chosen environment / condition for cycling.

Socio-economic characteristics of cyclists and potential cyclists

The survey results show that out of all the respondents, 19.40 per cent are cyclists who take the bicycle to the workplace, the school, the grocery, social places and other destinations (captive riders mostly). Most (80.60 per cent) are potential cyclists who presently do not cycle but they own/can afford a bicycle and travel short distances. Students below the age of 19 years made up 25 per cent of the total interviewed, about 57 per cent are adults (20–49 years) mostly workers or home makers, and about 18 per cent in their late adulthood (50+ years). Cyclists are mostly students and workers while potential users are other short trip makers like home makers, students and workers.

Figure 4 shows that almost 60 per cent of the potential cyclists are male and almost 62 per cent of the cyclists are male. The difference between male and female proportions is marginally high for cyclists compared to potential cyclists.

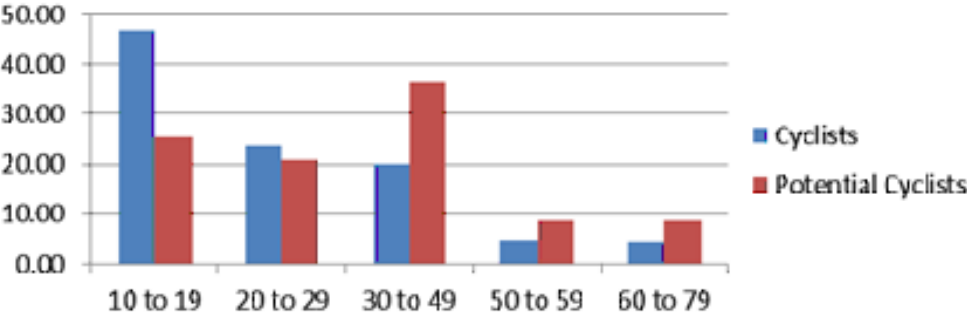
Figure 4. Gender distribution among cyclists and potential cyclists



Source: Tiwari et al, 2009.

Figure 5 shows that most of the bicyclists are in the age group of 10 to 19 and most of the potential bicyclists are in the age group of 30 to 49. For the age group above 50, the proportions of cyclists are 10 per cent and potential bicyclists are less than 18 per cent. The proportion of cyclists is decreasing with the increase of age.

Figure 5. Age distribution among cyclists and potential cyclists

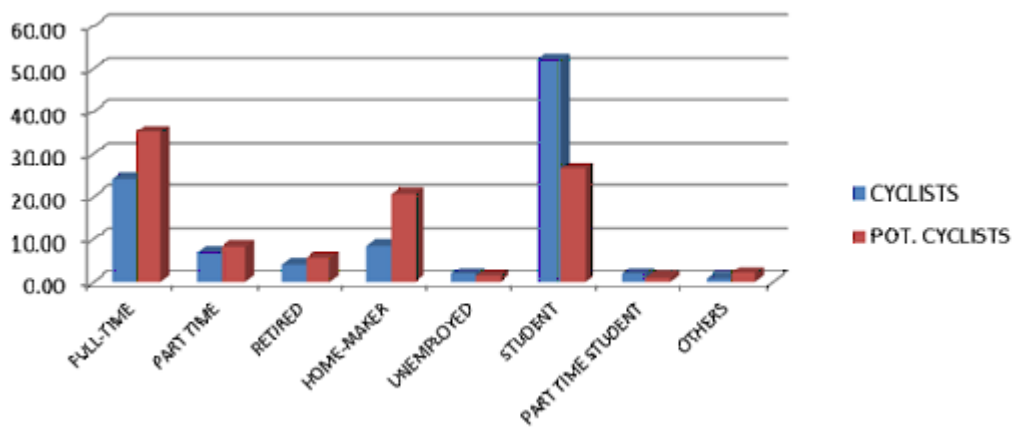


Source: Tiwari et al, 2009.

Figure 6 shows that more than 50 per cent of cyclists are students followed by 30 per cent employed either full time or part time and 8 per cent are home makers. The trend reversed for the potential cyclists with only 25 per cent of students and 45 per cent percent employed persons and 20 per cent home makers (housewives). Interestingly, most of the home makers are potential cyclists.

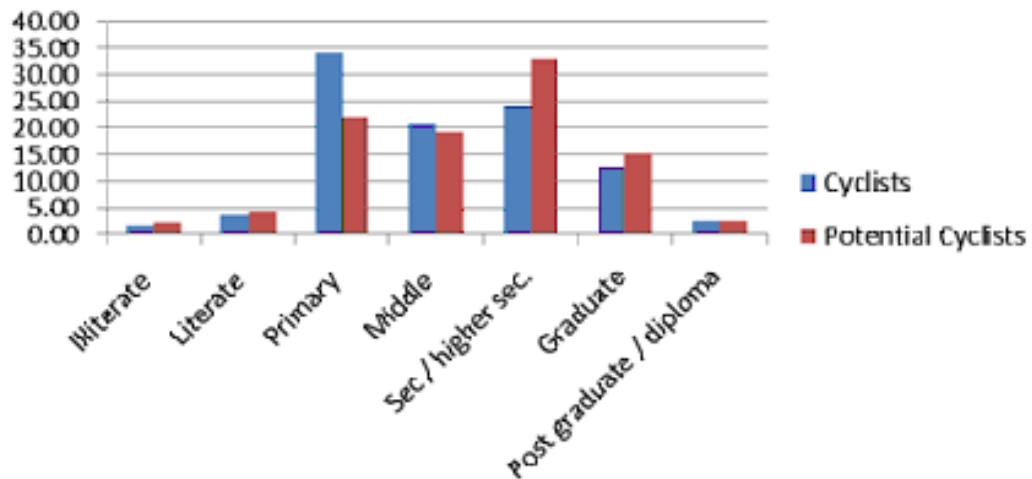
Figure 7 shows that most of the cyclists are at a primary education level and most of the potential cyclists are at a secondary education level. The proportion of both cyclists and potential cyclists below primary education level are less than 7 per cent.

Figure 6. Occupation of cyclists and potential cyclists



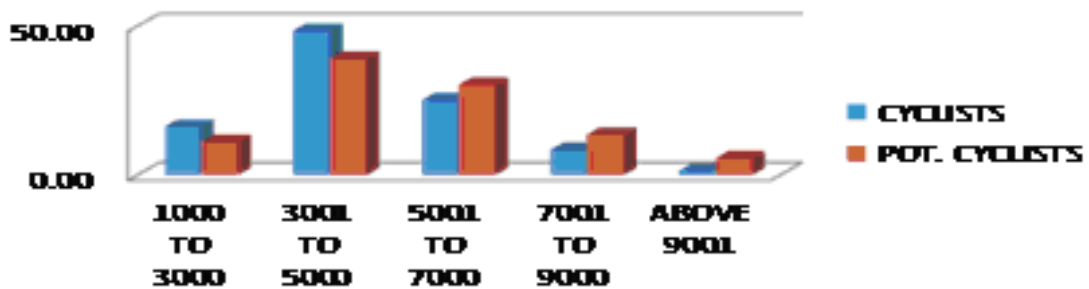
Source: Tiwari et al, 2009.

Figure 7. Education level of cyclists and potential cyclists



Source: Tiwari et al, 2009.

Figure 8. Household income level of cyclists and potential cyclists



Source: Tiwari et al, 2009.

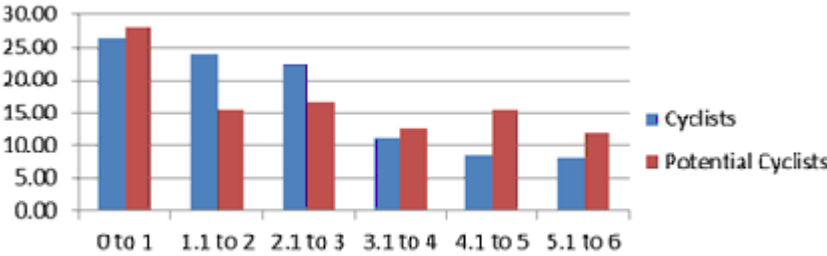
Figure 8 shows that most of the cyclists and potential cyclists fall in the income group of Indian Rupees (Rs.) 3000–5000. The number of both cyclists and potential cyclists after the income group of Rs.3000–5000 declines with the increasing of income levels. Interestingly, with income levels that are less than Rs.5000, the proportion of cyclists are more than proportion of potential cyclists and as the income level increases the proportion of potential cyclists becomes more than the proportion of cyclists. Hence, it is clear that people are shifting to motorized modes if their income levels increase. It proves the necessity of better facilities to keep them bicycling.

Travel characteristics

From the travel profile of cyclists and potential cyclists it has been observed that the average trip distance for cyclists is about 3.9km (ranging between 1.8km to 6.0 km) taking about on an average 22 minutes travel time (ranging 10–40 minutes) at a speed of 10–12 km/hr. The travel costs are seen to be negligible but sometimes in the range of Rs.2–6 per day (mainly maintenance and in rare cases parking). Potential cycle trips are mostly for short work related trips to offices, factories and shops and some other short trips are to schools and colleges. The average trip distance is 4.6km taking about 26 minutes on an average travel time, costing about Rs.10–40 per day (Rs.45 = US\$1 – approximately).

Figure 9 shows that about 70 per cent of bicyclists’ trip lengths and 60 per cent of potential cyclists’ trip lengths are less than 3kms. On the other hand, less than 10 per cent trip lengths are over 5 km in length for cyclists and the numbers of potential cyclists is over 10 per cent. The proportion of cyclists is decreasing with the increase in distance. Below 3 kilometres distance, the proportion of cyclists is more than the proportion of potential bicyclists and above 3kms the proportion of potential cyclists is more than the proportion of cyclists. Hence, it can be said that the average distance travelled by cyclists is less than the average distance travelled by potential bicyclists.

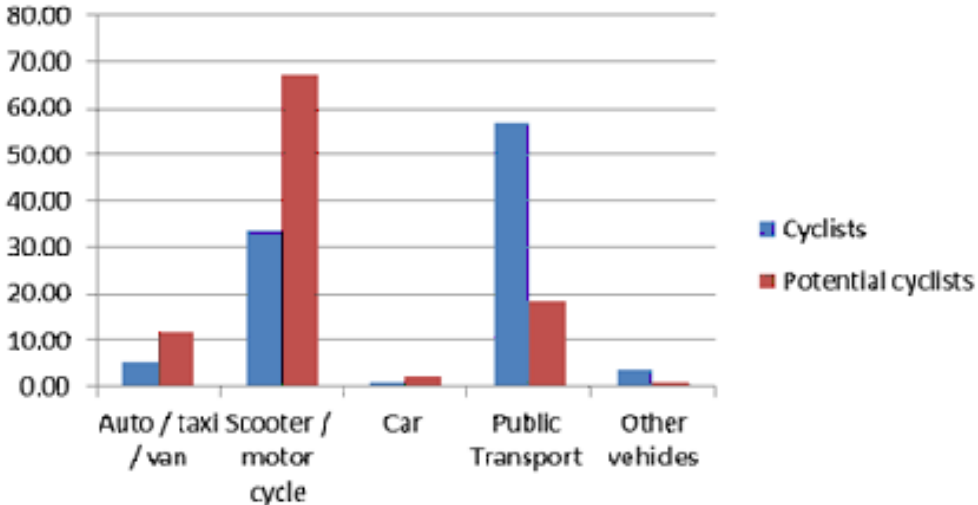
Figure 9. Trip length distribution of cyclists and potential cyclists



Source: Tiwari et al, 2009.

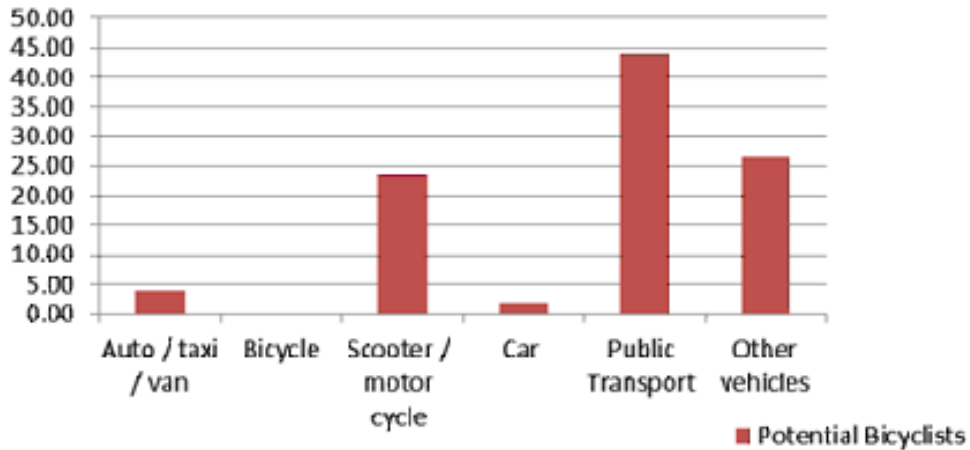
Figure 10 shows that most of the cyclists can afford public transport and motorized two wheelers while the trend is reversed for potential bicyclists. The affordability of other modes is negligible for both cyclists and potential cyclists. Thus, if proper infrastructure facilities are not provided, current cyclists may shift to public transport and motorized two wheelers.

Figure 10. Other means of transport available to cyclists and potential cyclists



Source: Tiwari et al, 2009.

Figure 11. Mode used by potential bicyclists during the last working day



Source: Tiwari et al, 2009.

Interestingly, Figure 11 shows that most of the potential cyclists (45 per cent) were currently using public transport followed by 25 per cent who walked, 23 per cent who used motorcycles or scooters. The use of public transport and motorized two wheelers for short trip lengths clearly highlights the lack of infrastructure for cycling and its impact on trip making choices of the people in Pune.

Availability of secured parking spaces is considered one of the factors affecting cycling. This factor has also been assessed in the survey. About 60 per cent of both cyclists and potential cyclists had secured parking facilities at home and at different destinations. Most of the secured parking facilities for bicyclists are available at grocery shops followed by markets and at schools/ colleges.

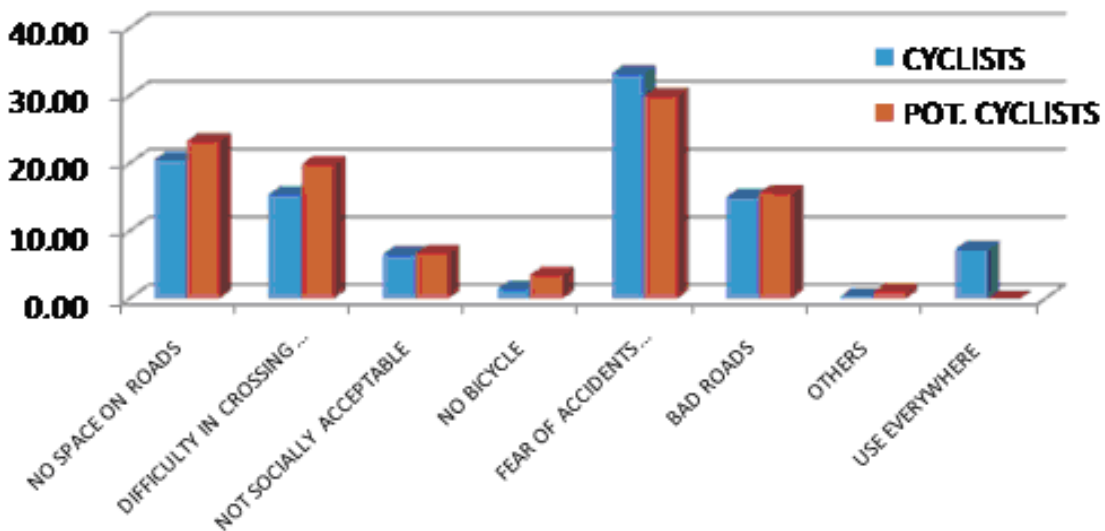
Preference based information

From the survey it has been observed that only 7 per cent of the respondents are happy with the present NMT infrastructure conditions. The rest pointed out several problems of cycling in Pune and out of every three cyclists, two have experienced some kind of accident / crash.

The most common reasons for not taking the shortest possible routes are designated one ways (50 per cent of cases) by the traffic police. Other common reasons being poor pavement quality (25 per cent) and high volume of motorized traffic (5 per cent).

Figure 12 shows that the biggest deterrents to cyclists are the fear of accidents (32 per cent) from other vehicles. It is closely followed by concerns like the lack of space on roads and crossing intersections (20 per cent and 15 per cent respectively). Potential cyclists too are deterred from using bicycles as a mode for fear of accidents from other vehicles. The lack of space on roads and bad roads are the most important dissuading factors for choosing bicycle as a mode of transport. Few (7 per cent) cited the reasons of socially unacceptable / poor man's vehicle status as a reason for not using bicycles.

Figure 12: Reasons for not liking bicycle



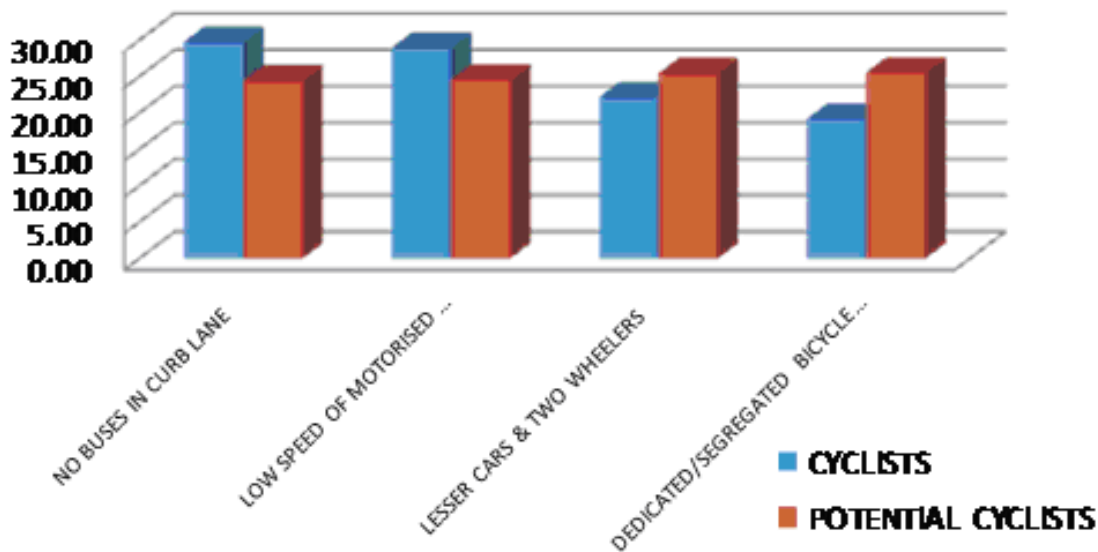
Source: Tiwari et al, 2009.

The most important requirements of cyclists are divided into four major types

1. Physical safety
2. Social security
3. Safe intersections
4. Removing barriers on the road

When asked to rank the four requirements, both cyclists and potential cyclists gave high priority to physical safety followed by safe intersection crossing (30 per cent and 22 per cent respectively). The differentiated importance of each of these parameters to both groups differentially is discussed further by detailed disaggregated analysis.

Figure 13: Preferences in safety improvement measures

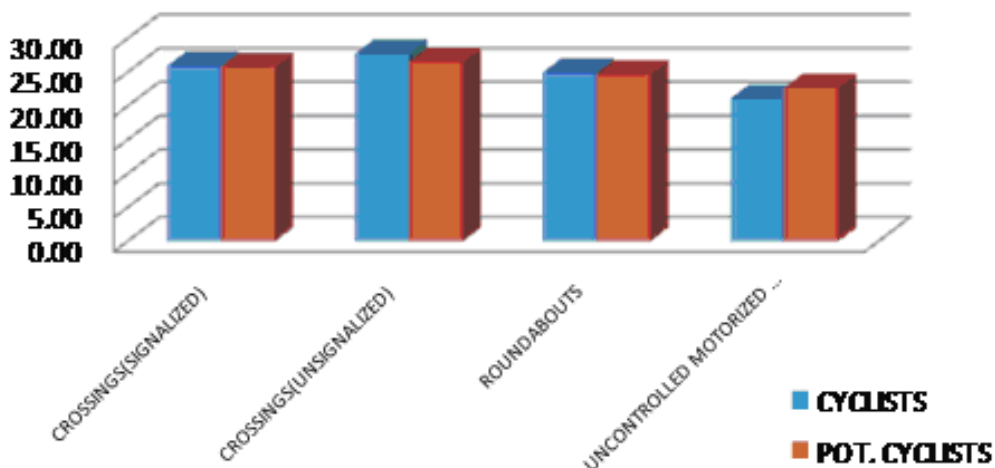


Source: Tiwari et al, 2009.

Figure 13 shows that there is no particular order or hierarchy with almost the same weight attached to each attribute. Slightly higher importance is attached to buses in curb lane and speed of motorized vehicles (~29 per cent) especially by current captive cyclists. Probably, experience with ill designed and ill maintained existing bicycle tracks prompted a low response to dedicated bicycle infrastructure. Potential users are more concerned with volume of motorized vehicles. Respondents identified segregation with bicycle tracks (about 25.5 per cent) as an ideal solution to deal with dangerous aspects of cycling on the road.

Since safety from accidents at intersections was an important issue flagged by the cyclists, the respondents were asked which types of intersections they rated as dangerous. Figure 14 shows that the perception of risk among captive riders and potential users does not show much difference. Crossings without signs are ranked much higher (27 per cent weight) on risk and are still considered more difficult to cross (especially while turning right in left side driving Indian context). Surprisingly, this is closely followed by the crossings with signs (25 per cent)

Figure 14: Most dangerous points of conflict (intersections)

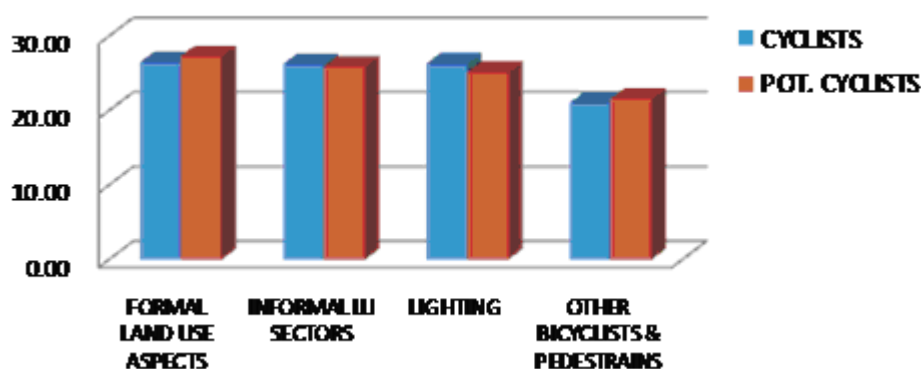


Source: Tiwari et al, 2009.

mostly without any markings, signs, priority boxes in front for cyclists etc. Roundabouts rank just higher than the uncontrolled motorized vehicles entry /exit (from properties / land use).

After safety, social security (in the present study social security is defined as safety from street crime) is an important factor for the cyclists. Considering that 41 per cent of the respondents were women, the issue of social security becomes even more important. The respondents were asked to rank the factors that they felt were important for them to feel secure while cycling. Figure 15 shows that the perception of risk among captive riders and potential users does not show much difference. To improve social security the most preferred environments are formal land use followed by lighting on streets and informal land use sector on the road side for both cyclists and potential cyclists.

Figure 15: Preferences for inducing perception of social security



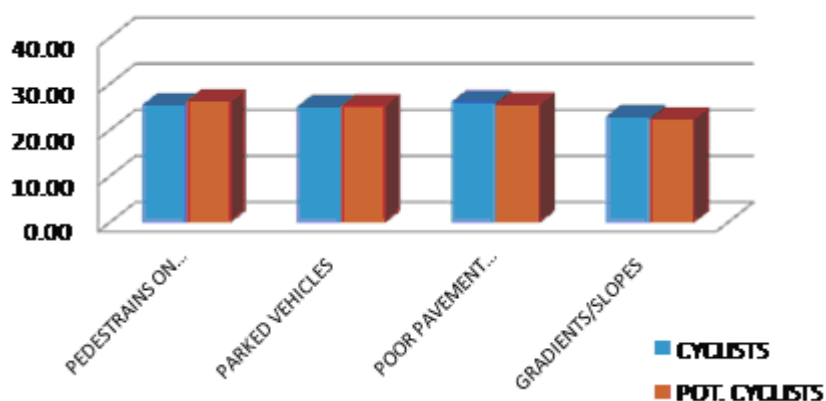
Source: Tiwari et al, 2009.

For regular cyclists, the quality of infrastructure, the way it is maintained and kept obstacle-free, is the biggest barrier or deterrent to cycling. Figure 16 shows that barriers for cycling include poor pavement quality followed by pedestrian on way and parked vehicles.

While the potential cyclists also have similar responses, according to the potential cyclists pedestrians / bus commuters waiting (about 27.4 per cent) at the curb side lane are considered as predominant barriers by potential riders. They see pedestrians as bigger obstacles than the regular cyclists. Hence, it is observed that current captive cyclists are more tolerant to them. Gradients / undulating topography are also considered to be barriers especially amongst captive riders.

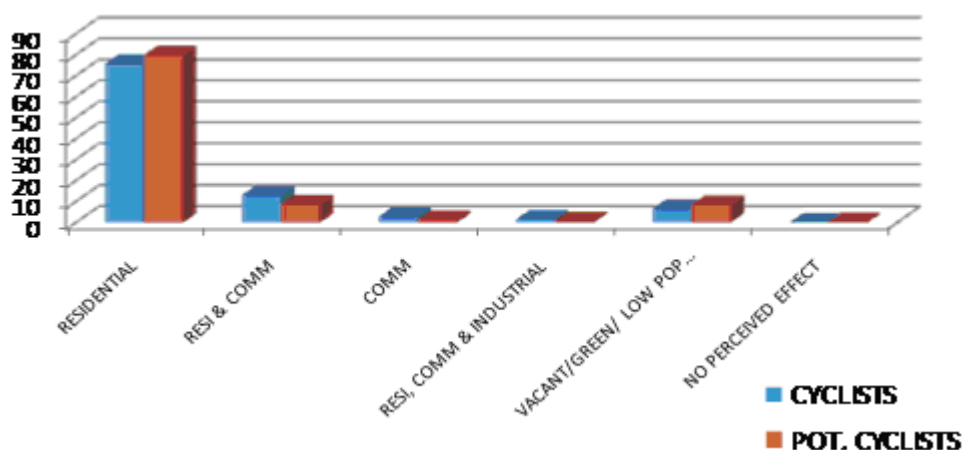
Cyclists prefer to cycle in certain environments. The respondents were asked to rank the type of environments they would like to cycle in. Figure 17 shows that current cyclists (captive riders) preferred residential areas (71 per cent) as routes; followed by a mix of commercial activities in the residential areas (10 per cent). Few preferred purely commercial (3 per cent) areas as well as extremely low density areas for regular bicycle routes. Potential cyclists prefer residential environments even more than the regular cyclists. They find green belts more attractive than the regular cyclists. Captive cyclists and potential users see purely commercial areas and increasing mix of commercial and manufacturing activities as non attractive for cycling. This shows that they find the busy roads of the commercial areas an unattractive cycling environment.

Figure 16: Priorities of reducing barriers to cycling



Source: Tiwari et al, 2009.

Figure 17: More preferred environment for bicycling



Source: Tiwari et al, 2009.

The preference based information study clearly highlights the need for proper dedicated cycle tracks with safe crossing, good lighting, passing through residential areas as a solution for arresting the decline and realizing the potential for cycling in Pune.

Conclusions

According to the study the following points are concluded:

1. The proportion of cyclists is decreasing with increase in age, income and trip length.
2. At low income levels, at low age groups and at low trip lengths the proportion of cyclists is more than the proportion of potential cyclists. Hence, it can be said that the average age, the average trip length and the average income levels of potential cyclists are higher than those of cyclists.
3. Most of the cyclists are students followed by workers and the order is reversed for potential cyclists.
4. Most of the potential cyclists are presently using public transport followed by two wheelers, and the most affordable mode for cyclists is also public transport followed

by motorized two wheelers. Hence, if proper infrastructure for cyclists is not provided most of the cyclists may shift to public transport and motorized two wheelers.

5. From the survey it has been observed that only 7 per cent of the respondents are happy with the present conditions of NMT infrastructure.
6. The reasons for cyclists not liking bicycling and the potential cyclist's not using bicycles are fear of road accidents. The other important reasons are lack of space on the roads and the difficulty in crossing large roads. All these reasons point to lack of safe infrastructure for cycling on the road.
7. Contrary to expectation, the study shows that few (only 6 per cent) respondents felt that cycling is socially unacceptable.
8. Among the four requirements for cycling, physical safety and intersections are assigned high weights respectively both by captive and potential users. Social security on the roads is considered an important issue by captive cyclists and potential users alike.
9. There is no particular order for all the four attributes under physical safety. Quite surprisingly, among the four attributes, less weight is given to dedicated bicycle tracks. Probably, experience with ill designed and ill maintained existing bicycle tracks prompted a low response to dedicated bicycle infrastructure.
10. The perception of risk at intersections among captive cyclists and potential users does not show much difference. Crossings with or without signs are ranked high on risk by both groups, closely followed by the roundabouts.
11. Captive cyclists are more tolerant of pedestrians than potential bicyclists.
12. In terms of social security, the most preferred environments are formal land use followed by lighting on streets and informal land use sector on the road side for both cyclists and potential cyclists.
13. The most preferred environment for both cyclists and potential cyclists are residential areas. Purely commercial areas and an increasing mix of commercial and manufacturing activities are seen as non attractive for cycling.

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