# POTENTIAL DEMAND FOR CYCLING IN BRASILIA: A STUDY AMONG UNIVERSITY STUDENTS

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## ABSTRACT

The research has the purpose of identifying the potential demand for bicycle use in Brasilia, a city that has its design based on automobile use and road infrastructure organizes the space. Primary data collected by a questionnaire applied to the target population of a major destination, the university, identified factors and motivations to use the bicycle. The results show that students have a positive image about bicycle use and that the existence of bicycle infrastructure would stimulate people to change their way of commuting to cycling. Complementary study based on land use, distances and trip time shows that 10% of the total trips to the center of Brasilia could be made by bicycle. As conclusion, discussion and recommendations are offered.

*Keywords: Bicycle, Brasilia, Non-Motorized Transport, University Students, Mobility Management, Transport Demand Management*

## INTRODUCTION

Brasilia urban plan (Costa 1957) is result of a national architecture competition and the political will to develop Brazil. The urban project was strongly influenced by the modernist principals: strict zoned use areas divided and connected by highways. The author of the urban plan, Lucio Costa, describes it as a city planned for the “orderly and efficient” work, conceived and structured along two perpendicular main axes.

The plan had the purpose to apply highway engineering principals, with hierarchical division of roads for speed circulation, for freight, and for local traffic, including the elimination of intersections (on level). In addition, an autonomous pedestrian circulation network was predicted after determining the road structure.

Nevertheless, while roads play an important role in integrating the different parts of the city for cars, they are the main barrier for non-motorized modes. In fact, the residential sectors in

the central area have a comfortable pedestrian network, but it is limited by the road system. Moreover, spaces for pedestrians are segregated and distances for commuting by walking are not attractive. As a result, Brasilia's population is more car dependent than expected (Pires-Lammers, 2012). Bicycle as a way of transport was not considered in the original plan and a specific infrastructure for it was not predicted.

Bicycle as a way of transport is being recognized as a feasible alternative to mobility in cities, since it is clean, cheap and brings quality to public space. Its use depends of physical-spatial factors of a city (Jensen, 2000), and of economic-social characteristics of the population[1] (Vasconcellos, 2005). Bicycle has the potential to integrate the different parts of the city that are far for pedestrians or not directly connected by bus.

This paper reports on a Master research[2] (Pires, 2008) conducted to investigate the potential of bicycle as a way of transport in a modernist city that did not consider its use. The research type is exploratory since it aims to investigate a situation where little is known about its potential outcomes. The research is based on primary data – questionnaire applied to university students; complemented by observation and secondary data used to estimate the potential for Brasilia. At the end discussion about the results are done and recommendation is offered.

# METHODS

With the purpose of identifying the potential demand for bicycle use in Brasilia[3], the research is divided in two parts. In the main one, primary data was collected by questionnaire applied to a target population of a major destination: the university students – 264 respondents. The university was chosen as a sample because of its central location in the city and its relative high importance in trips' generation. Complementary, the second part of the research estimated the potential demand for bicycle use in Brasilia Administrative Region.

The questionnaire had the purpose of identifying bicycle users' demands and the potential bicycle user considering real and hypothetic facts. The real data was related to respondents' profile and travel patterns, while the hypothetic data was based on the existence of bicycle infrastructure, preferences regarding to trip time, and motivations.

The questionnaire was applied to 264 graduation students, corresponding to a little more than 1% of total University population, in the main common areas of the campus: The Central Institute of Science, Faculty of Technology, Faculty of Medicine and Health Science, Faculty of Law, Anisio Teixeira Pavilion and Central Library.

The questionnaire had two parts: the first one was the same for all interrogated, and the second part was distinct for bicycle users and for non-bicycle users. In the common part, the

[1] Physical-spatial factors are the characteristics of a city: density, size, topography, infrastructure and existing transportation facilities. Economical-social factors are culture and history, income, gender and age.
[2] This paper is based on a master degree dissertation conducted by the author (Pires, 2008) in the University of Brasilia, FAU-UnB, under the supervision of Prof. Dr. Frederico de Holanda.
[3] In this research, Brasilia refers to the Administrative Region of Brasilia, and not to the Federal District.

questions were about gender, age, place of residence, mode of transport used to go to university and its frequency, and travel time. To guarantee objectivity, the questions about transportation all refer to trips from place of residence to university, therefore origin and destiny were pre-established.

There were two versions of the second part of the questionnaire. The one that was applied to cyclists or to those that used the bicycle with medium frequency (verified in the common part of the questionnaire) had the objective of identifying routes and travel time, as well as opinions and preferences regarding to bicycle and other modes of transport.

The version that was applied to the ones that did not cycle had hypothetical questions that aimed to identify the potential of bicycle use depending on the main conditions appointed by the specialized literature (Heinen, Maat & Wee, 2011; GEIPOT, 2001; GEUS, 2007; Jensen, 2000; Sully, 2000): infrastructure and distance/time. In addition, opinions and preferences were collected to compare the students' perception about bicycle and their most used mode of transport.

The questions' sequence and crossing variables allowed inferences, identification of potential situations, and identification of the competitiveness of the bicycle. It is important to highlight that the research was held when there was no bicycle infrastructure implemented, just a project for the main highways of the city. Hence, the respondents did not have any real perspective of using a bicycle lane, for example[4].

If the results about the possible use of bicycle as a way of transport would be negative, it would reflect a pessimist perspective for the whole population. Nevertheless, if the result would be positive, it would suggest that special attention shall be given to the implementation of a bicycle program and infrastructure network.

The limitations were time and resources, which limited the questionnaire sample, composed by the university students. Because of its life style, and social economic characteristics, the results cannot be applied for the city's population, being necessary additional researches. Complementary surveys allow inferences and more comprehensive conclusions for the city.

Finally, as an exercise for the whole city, it was held a complementary research based on data extracted from the Origin-Destiny survey. It was compared commuting time, living and working places, and distance to estimate the possibility of using bicycle.

[4] Bicycle lanes are currently under construction in the University and in Brasilia.

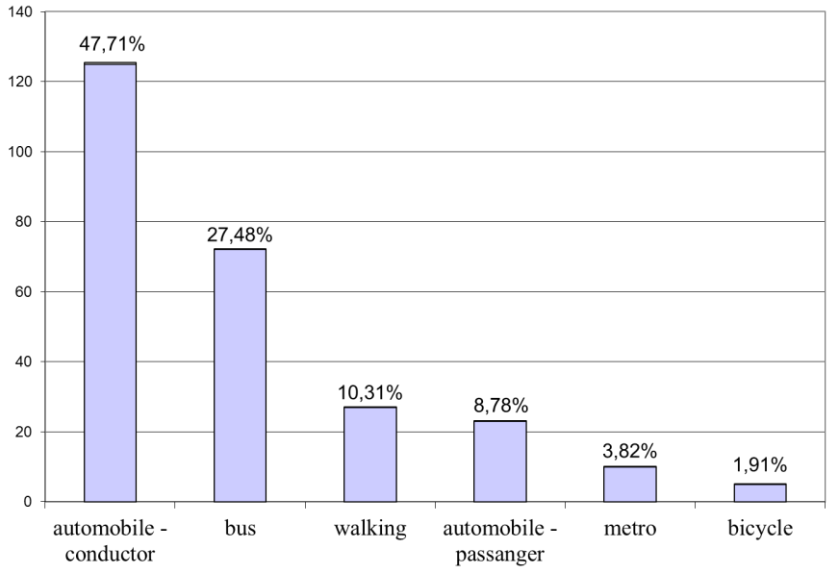
# RESULTS

## Questionnaire - Potential demand in the University of Brasilia

*Common part*

With regard to the common part of the questionnaire, students were asked to rank how often they used the different modes of transportation in a scale from 1-never to 5-always. Regarding to bicycle, 90.15% never used it, while just 0.38% always use. The most used mode of transportation per person is the automobile (47.35%), followed by bus (27.27%) and walking (10.23%). See Graph 1.

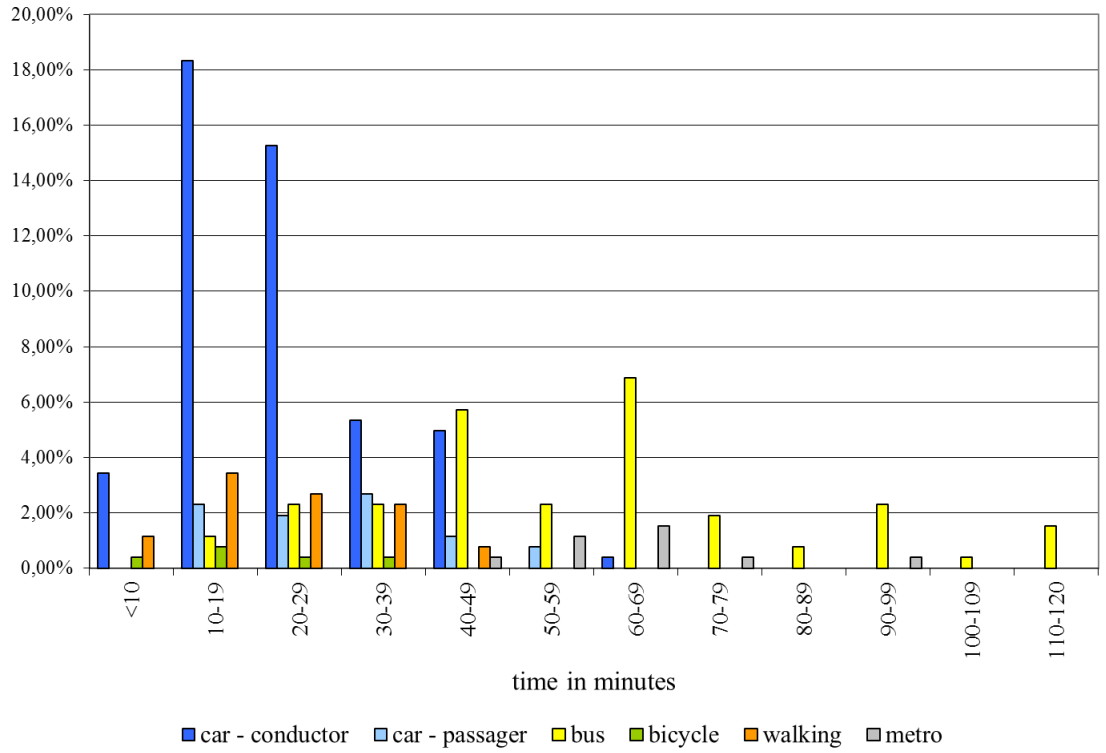
Graph 1 – Most used mode of transportation




Regarding to gender, it was not verified differences for motorized modes; nevertheless, women walk and cycle less than men. Considering the respondents who go walking, 85.19% are men.

With regard to travel time, the majority of students that go by car take until 29 minutes. Cyclists take until 39 minutes, and pedestrians take until 49. Those that take more than one hour, use public transport. Bus is the only way of transport that is used in all time ranges. See Graph 2.

Graph 2 – Travel time for different modes of transport




## *Specific Part - Cyclists*

For the second part of the questionnaire, 18 students were considered as cyclists – those that used bicycle with a medium frequency or higher.

With regard to the place of residence, 77% of the cyclists live in the same neighborhood of the university, in a radius not superior to 5 km. Considering time, most of the cyclists, 72%, take until 10 minutes in their ride. Regarding to the place of cycling, 55% use the roads in most part of their route, while 33% cycle in sidewalks.

To compare preferences between bicycle and other modes of transportation, it was first asked to the interviewed if they would go to university by bus instead of bicycle. Nobody answered “yes”, while two answered “depends”. For those who said “depends”, the reasons would be the weather and ticket exemption. The main reasons for not switching to bus are the short distance and time. Next, economy and easy riding were the most mentioned reasons. See Table I.

Table I – Reasons for not changing from bicycle to bus (respondents could cite many reasons they wanted)

| Reason | Frequency | % |
|---|---|---|
| Short distance | 8 | 22% |
| Economy | 7 | 19% |
| Shorter time | 7 | 19% |
| Easy, less complicated | 4 | 11% |
| Health | 3 | 8% |
| Pollution/Environment | 2 | 6% |

| | | |
|---|---|---|
| Time flexibility | 2 | 6% |
| Comfort | 1 | 3% |
| Convenience | 1 | 3% |
| Same time | 1 | 3% |
| **Total** | 36 | 100% |

Second, it was asked if they would go to university by automobile instead of bicycle with more frequency. In opposition to the previous question that compared to the bus, the majority (8 of 18) said “yes” or “depends” (8 of 18), while just two persons said “no”. For those who said they would not change to automobile, there was not a dominant reason, being cited “health”, “pollution and environment”, “emotional stress”, “short distance” and “flat road”.

For those who answered “depends”, the main reasons would be “weather conditions” followed by “the need to carry objects” and “day agenda”. For those that answered “yes”, the main reasons for changing to car was time and convenience, see Table II.

Table II - Reasons for changing from bicycle to automobile (respondents could cite many reasons they wanted)

| **Reason** | **Frequency** | **%** |
|---|---|---|
| Shorter travel time by car | 4 | 29% |
| Convenience | 4 | 29% |
| Weather conditions | 2 | 14% |
| Comfort | 1 | 7% |
| Security | 1 | 7% |
| Time flexibility | 1 | 7% |
| The need to carry objects | 1 | 7% |
| **Total** | 14 | 100% |

The comparison between bus and automobile in relation to bicycle shows that bicycle is more attractive than the bus, and therefore, a high tendency of bus users changing to bicycles. This competitiveness can be explained by the reasons identified, that is, freedom, convenience and time efficiency since there is no dependence on bus schedules or need to walk to bus stops. Nevertheless, automobile is more competitive than the bicycle due to the same reasons identified previously: freedom, comfort and time.

### *Specific Part - Non cyclists*

For the students that were considered non-cyclists, the questions were about their willingness to use the bicycle considering place for cycling (if segregated from the road or not), time, and its comparison to other transportation modes.

First, considering place for cycling, it was asked to the respondents if they would go to university by bicycle in the existing conditions, which is, sharing the road with automobiles. Next, the same question was done considering the hypothetical existence of a bicycle lane; and finally, if there would be a bicycle path completely segregated. Therefore, the sequence of the questions had the purpose to verify how much the specific infrastructure for cyclists and its typology – from not segregated to segregated – could influence in the users

willingness and perception. The results on Table III shows that there is a rejection to cycle on the road (71%) that drops by half when considering cycle lane (33%) or cycle path (24%), with a higher acceptance of this last one.

Table III – Willingness to cycle to the university considering infrastructure typology

| Place Typology for cycling | Yes | % | No | % | Total | % |
|---|---|---|---|---|---|---|
| By the Road | 72 | 29% | 178 | 71% | 250 | 100% |
| Cycle Lane | 168 | 67% | 82 | 33% | 250 | 100% |
| Cycle Path | 190 | 76% | 60 | 24% | 250 | 100% |

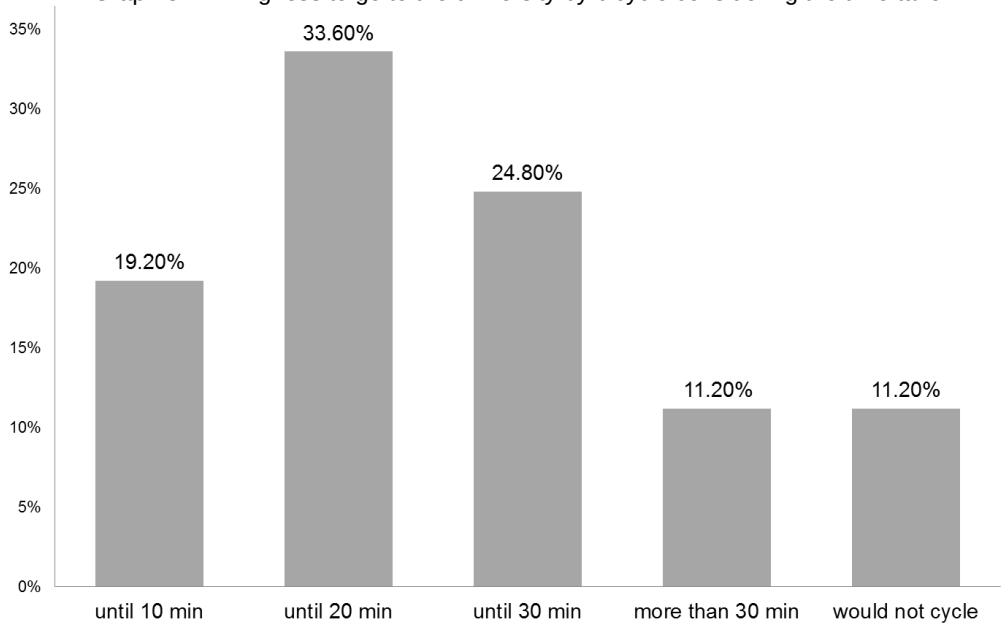
This data about place for cycling was crossed with the mode of transport most used by the respondents. The Table IV shows that automobile users are less likely to cycle in the road, while pedestrians have more willing.

Table IV - Willingness to cycle to the university considering infrastructure typology by transportation mode used

| Transportation Mode | By the Road % | | | Cycle Lane % | | | Cycle Path % | | |
|---|---|---|---|---|---|---|---|---|---|
| | Yes | No | *Total* | Yes | No | *Total* | Yes | No | *Total* |
| Automobile – conductor | 20.66 | 79.34 | *100.00* | 60.33 | 39.67 | *100.00* | 71.90 | 28.10 | *100.00* |
| Automobile – passenger | 31.82 | 68.18 | *100.00* | 81.82 | 18.18 | *100.00* | 86.36 | 13.64 | *100.00* |
| Bus | 33.33 | 66.67 | *100.00* | 69.44 | 30.56 | *100.00* | 75.00 | 25.00 | *100.00* |
| Metro | 40.00 | 60.00 | *100.00* | 70.00 | 30.00 | *100.00* | 70.00 | 30.00 | *100.00* |
| Walking | 52.17 | 47.83 | *100.00* | 82.61 | 17.39 | *100.00* | 95.65 | 4.35 | *100.00* |
| **Total** | 29.03 | 70.97 | *100.00* | 67.34 | 32.66 | *100.00* | 76.21 | 23.79 | *100.00* |

Second, respondents were asked about their willingness to go to the university by bicycle considering the time taken (hypothetical situation), in a scale from 10 to more than 30 minutes. The results, Graph 3, show that the majority would cycle if it would take until 20 minutes, followed by 30 and 10 minutes. The minority and same proportion of respondents (11.20%) responded that would cycle independent of the time taken, and that would not cycle at any condition of time (11.20%).

Graph 3 - Willingness to go to the university by bicycle considering the time taken



When crossing the results about the willingness to cycle considering time and the transportation mode used by the respondents, it is seen that the proportion of bus users and pedestrians are willing to cycle for a longer time than automobile users, see Table V.

Table V – Transportation mode per maximum time willing to cycle

| Transportation Mode | Maximum time willing to cycle | | | | | Total |
|---|---|---|---|---|---|---|
| | until 10 min | until 20 min | until 30 min | more than 30 min | would not cycle | |
| Automobile – conductor | 20,66% | 35,54% | 19,01% | 9,92% | 14,88% | 100,00% |
| Automobile – passenger | 22,73% | 36,36% | 22,73% | 4,55% | 13,64% | 100,00% |
| Bus | 13,51% | 32,43% | 33,78% | 14,86% | 5,41% | 100,00% |
| Metro | 30,00% | 30,00% | 30,00% | 0,00% | 10,00% | 100,00% |
| Walking | 21,74% | 26,09% | 26,09% | 17,39% | 8,70% | 100,00% |
| **Total** | 19,20% | 33,60% | 24,80% | 11,20% | 11,20% | 100,00% |

Third, the respondents that answered positively about using the bicycle in any of the previous hypothetic conditions given – place of cycling and time – were questioned about the possibility to change their way of transport for the bicycle to go to university, see Table VI. While more than 80% of bus users and pedestrians responded positively, less than half of automobile users said responded “yes”.

Table VI - Possibility to change used transportation mode for the bicycle to go to the university

| Transportation Mode | Possibility to change used mode for the bicycle | | | Total |
|---|---|---|---|---|
| | Yes | No | Depends | |
| Automobile – conductor | 45,45% | 24,79% | 29,75% | 100,00% |
| Automobile – passenger | 45,45% | 27,27% | 27,27% | 100,00% |
| Bus | 81,08% | 8,11% | 10,81% | 100,00% |
| Metro | 80,00% | 10,00% | 10,00% | 100,00% |
| Walking | 86,96% | 8,70% | 4,35% | 100,00% |
| **Total** | **61,20%** | **18,00%** | **20,80%** | **100,00%** |

The data about the possibility to change the way of transport used for the bicycle was crossed with the maximum time the responded would consider to cycle. The result, on Table VII, shows that those who responded that would cycle for a longer time gave more frequently a positive answer about the possibility to change for the bicycle. While the willingness to change for the bicycle declines considerable for those who answered that they would cycle for 10 minutes maximum.

Table VII **-** Possibility to change used transportation mode for the bicycle per the maximum time the respondent would consider to cycle

| Maximum time | Change | | | Total |
|---|---|---|---|---|
| | Yes | No | Depends | |
| until 10 min | 47.92% | 20.83% | 31.25% | 100.00% |
| until 20 min | 69.05% | 9.52% | 21.43% | 100.00% |
| until 30 min | 77.42% | 6.45% | 16.13% | 100.00% |
| More than 30 min | 75.00% | 3.57% | 21.43% | 100.00% |
| Would not cycle | 10.71% | 78.57% | 10.71% | 100.00% |
| **Total** | 61.20% | 18.00% | 20.80% | 100.00% |

For all users, among the declared reasons given to change the transportation mode used for the bicycle were health and economy, followed by environment and time, see Table VIII.

Table VIII – Reasons for changing for the bicycle for all users (respondents could cite many reasons they wanted)

| Reason | Frequency | % |
|---|---|---|
| Health | 82 | 25.95% |
| Economy | 76 | 24.05% |
| Pollution reduction / Environment | 36 | 11.39% |
| Shorter time | 28 | 8.86% |
| Like it | 17 | 5.38% |
| Congestion | 15 | 4.75% |
| Comfort | 10 | 3.16% |
| Easy, less complicated | 10 | 3.16% |
| Time flexibility | 8 | 2.53% |
| Bicycle lane existence | 6 | 1.90% |
| If would own a bicycle | 5 | 1.58% |
| Emotional Stress | 4 | 1.27% |
| Convenience | 4 | 1.27% |
| Bicycle is less tiring than walking | 3 | 0.95% |
| Does not like to use buses | 3 | 0.95% |
| Bicycle is more pleasing | 2 | 0.63% |
| Independency | 2 | 0.63% |
| Short distance | 1 | 0.32% |
| Security | 1 | 0.32% |
| Difficulty to park automobile | 1 | 0.32% |
| Does not have a car always available | 1 | 0.32% |
| If it would be day time | 1 | 0.32% |
| **Total** | 316 | 100.00% |

The reasons of public transport users – bus and metro – to change for the bicycle are shown on Table IX.

Table IX - Reasons for changing for the bicycle for public transport users
(respondents could cite many reasons they wanted)

| Reason | Frequency | % |
|---|---|---|
| Economy | 42 | 28,96% |
| Health | 35 | 24,13% |
| Polution/Environment | 14 | 9,65% |
| Shorter time | 12 | 8,27% |
| Comfort | 9 | 6,20% |
| Time flexibility | 7 | 4,82% |
| Like | 7 | 4,82% |
| Easy, less complicated | 6 | 4,13% |
| Congestion | 4 | 2,75% |
| Does not like to use buses | 3 | 2,06% |
| Emotional stress | 2 | 1,37% |
| Convenience | 1 | 0,68% |
| If would own a bicycle | 1 | 0,68% |
| Bicycle lane existence | 1 | 0,68% |
| If it would be day time | 1 | 0,68% |
| Total | 145 | 100,00% |

The reasons of automobile users to change for the bicycle are shown on Table X. Bicycle is especially attractive for those that take congestion and consider driving and parking stressful.

Table X - Reasons for changing for the bicycle for automobile users (respondents could cite many reasons they wanted)

| Reason | Frequency | % |
|---|---|---|
| Health | 44 | 33,33% |
| Economy | 32 | 24,24% |
| Pollution / Environment | 22 | 16,67% |
| Congestion | 10 | 7,58% |
| Like | 6 | 4,55% |
| Convenience | 3 | 2,27% |
| Bicycle lane existence | 3 | 2,27% |
| Shorter time | 2 | 1,52% |
| Emotional stress | 2 | 1,52% |
| Independency | 2 | 1,52% |
| Easy, less complicated | 1 | 0,76% |
| Emotional stress | 1 | 0,76% |
| Short distance | 1 | 0,76% |
| Bicycle is more pleasing | 1 | 0,76% |
| Difficulty to park automobile | 1 | 0,76% |
| Does not have a car always available | 1 | 0,76% |
| Total | 132 | 100,00% |

For all respondents who said “depends” for changing for the bicycle, the main reasons given were “weather conditions” and “time availability”. Next, the other reasons more cited were “laziness”, “economy”, “bicycle lane existence”, “health”, “convenience” and “security”.

Finally, the reasons given by users for not changing for the bicycle are shown on Table XI. The main one was “convenience”, followed by “laziness”, “comfort” and “time”.

Table XI - Reasons for not changing for the bicycle for all users (respondents could cite many reasons they wanted)

| Reason | Frequency | % |
|---|---|---|
| Convenience | 16 | 19.28% |
| Laziness | 8 | 9.64% |
| Comfort | 8 | 9.64% |
| Longer time | 7 | 8.43% |
| Weather conditions | 6 | 7.23% |
| Does not know how to ride a bicycle | 5 | 6.02% |
| Security | 4 | 4.82% |
| Bicycle is difficult to manage | 4 | 4.82% |
| Does not own a bicycle | 3 | 3.61% |
| Does not like to cycle | 3 | 3.61% |
| Gets sweaty | 3 | 3.61% |
| Tiring | 2 | 2.41% |
| Accustomed | 2 | 2.41% |
| Automobile is easier and more practical | 2 | 2.41% |

| | | |
|---|---|---|
| Have to care objects | 2 | 2.41% |
| Congestion | 1 | 1.20% |
| Day agenda | 1 | 1.20% |
| Clothes | 1 | 1.20% |
| Cycling is unsafe | 1 | 1.20% |
| Likes to walk | 1 | 1.20% |
| Does not consider bicycle a way of transport | 1 | 1.20% |
| Bicycle stealing | 1 | 1.20% |
| Difficult route | 1 | 1.20% |
| **Total** | 83 | 100.00% |

## Complementary estimation - Potential demand in Brasilia

To estimate the potential demand for cycling in Brasilia, it was analysed the attributes of distance, time and land use. The investigation was based on the city land use, observation, and data from the Origin Destiny Survey.

First, the analysis of land use and the distances inside the city has the purpose of identifying the reachable and accessible space for the cyclist. The bicycle is competitive in relation to other modes of transportation in distances until 5.0 km, although studies give the theoretical limit of 7.5 km as an accepted distance for urban trips, what corresponds to 30 minutes in a speed of 15km/h (GEIPOT 2001).

In Brasilia, the distance from the center to the edges is around 7.0 km, as shown on Figure 1. Therefore, most of the city is reachable from the center by bicycle in less than 5.00 km.

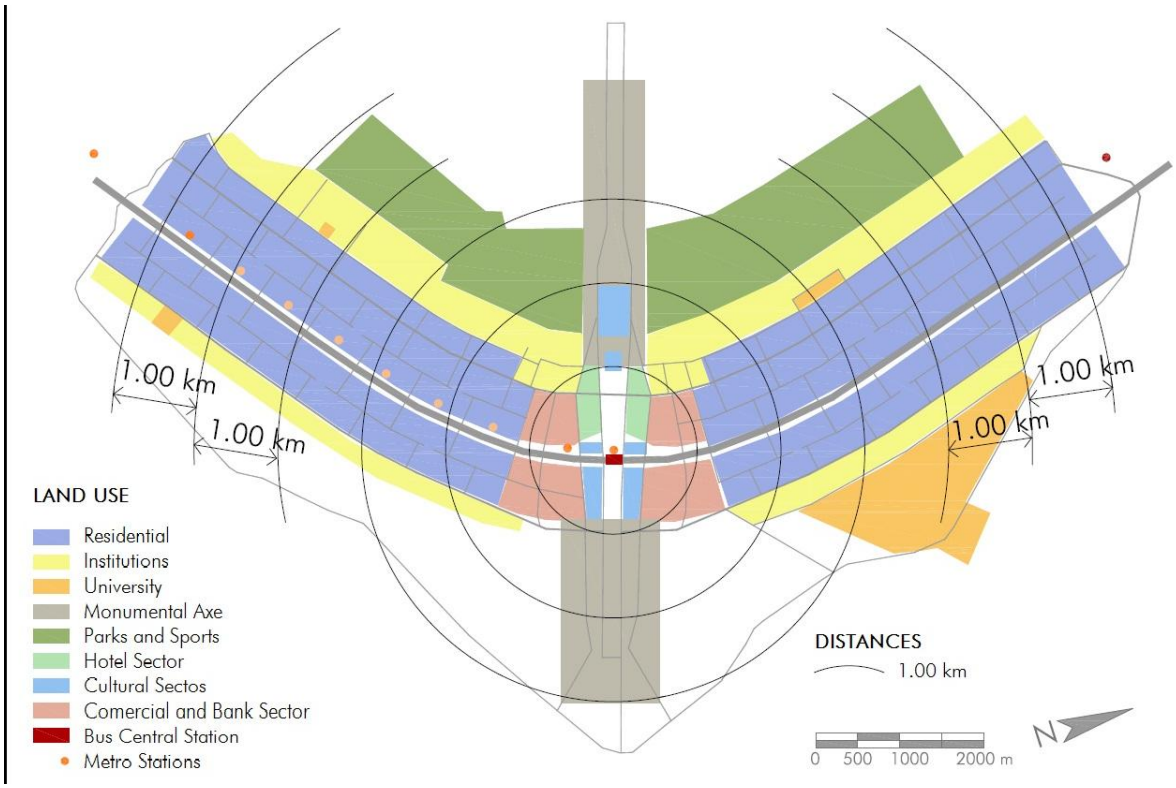


Figure 1 – Map with distances inside Brasilia

Second, it was measured the time taken by a cyclist between roads in the edges of the city. Although the time taken can vary from cyclist to cyclist, and can also be influenced by the bicycle type itself, it gives the reference about the real time taken, which is influenced by the city physical conditions – topography, infrastructure, obstacles – and also traffic conditions.

Two paths with two ways each were covered: A-B-A and C-D-C. The route was done in a working day in collective roads that give access to residential blocks, and in residential roads. See Figure 2.

In the longest path to the center (AB), the average speed was 13.5 km/h (A-B) while the way back was 19.5 km/h (B-A). The difference of 7 minutes was due to the topography influence, which is higher in the city center. In the shorter path (CD), the average speed was 6.4 km/h in one way (C-D), and 14.6 km/h in the way back (D-C). The difference of 9 minutes was also due to topography and obstacles as road crossing, which makes cycling very slow to the West direction.

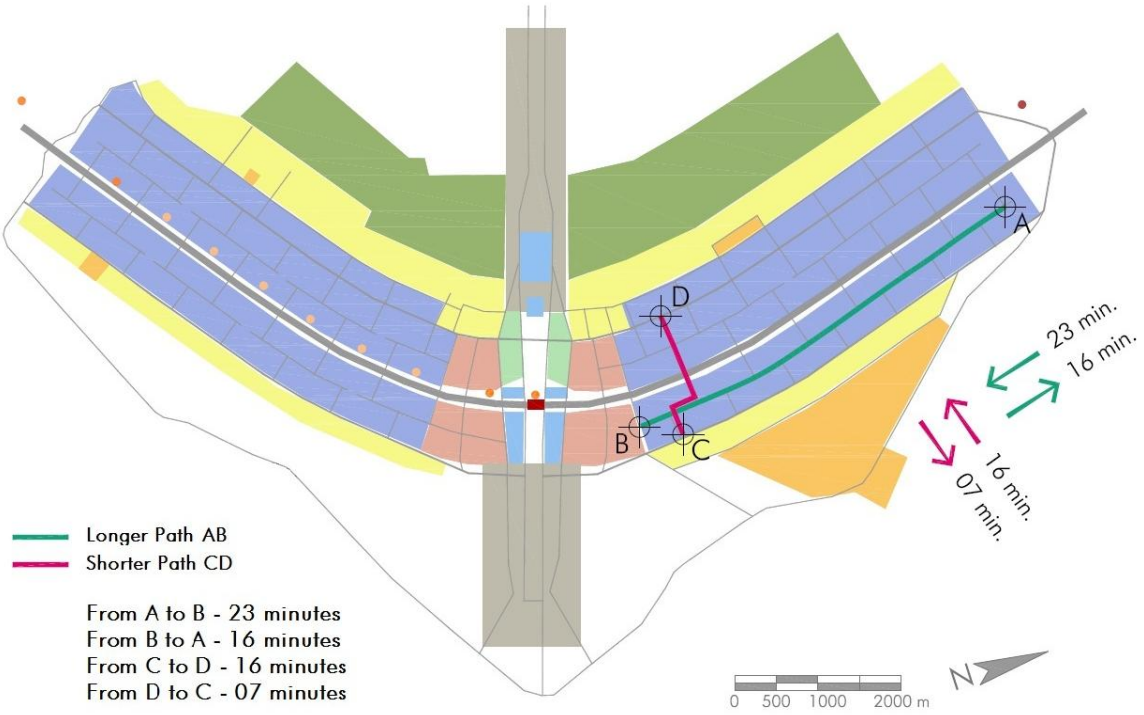



Figure 2 – Time taken by a cyclist between point ABA and CDC

Third, considering data from the Origin Destiny Survey, it was estimated the percentage of people that could use the bicycle to go to work, considering time taken to go to the center for each transportation mode.

In the Federal District, Brasilia center accommodates 82% of the formal jobs and 44% of total jobs, while just 15% of the households live in the radius of 10 km around it, resulting in great commuting distances for the majority of the population (Tenorio & Júnior 2009).

Nevertheless, in the central area called Brasilia Administrative Region - AR, 91.5% of its inhabitants work inside it (CODEPLAN, 2012). Considering the trips that have origin in the central Administrative Region, 62.85% of the automobile trips and 25.65% of bus trips occur inside it. In pick hour, 86.05% of total trips for all modes occur inside the region.

In Brasilia AR, commute trips – work and study – represent 76.01% of total trips, while trips for work represent 50.97% of total (Secretaria de Transportes do DF, 2009). In the center are located federal and local institutions that concentrate around 50.000 jobs.

To estimate the hidden potential for bicycle use, it was considered the number of trips that occur inside the influence zone of the center, reachable for each mode. The Table XII shows trip time for each transport mode in the central area.

For motorized modes, it was considered trips until 30 minutes for buses, and until 10 minutes for automobiles. For bus' trips, the time is from door to door, considering walking and waiting time: 5 minutes walking from origin to bus stop, 5 minutes waiting for the bus, 12 minutes traveling (7,5 km at 40 km/h), and 5 minutes walking from bus stop to destiny. For automobile, since the reachable distance for bicycle of 7.5 km is traveled in 7.5 minutes at 60 km/h, it was considered trips time shorter than 10 minutes. Therefore, 9.99% of the population that travels to and from the center by motorized transport could use the bicycle.

Table XII– Trip time per transportation mode for trips that have Brasilia center as origin and destiny: Monumental Axe, Commercial Sector, Bank Sector and Autarchy Sector

| **Trip time in minutes** | Automobile - conductor | Automobile - passenger | Bus | Bicycle | Walking | Transp. Fretado | Total |
|---|---|---|---|---|---|---|---|
| **<10** | 2.77% | 0.32% | 0.19% | 0.02% | 0.13% | 0.00% | 3.43% |
| **10-19** | 25.28% | 3.24% | 3.17% | 0.00% | 0.40% | 0.07% | 32.16% |
| **20-29** | 17.77% | 1.87% | 2.73% | 0.03% | 0.40% | 0.13% | 22.95% |
| **30-39** | 8.89% | 0.98% | 3.63% | 0.05% | 0.12% | 0.13% | 13.80% |
| **40-49** | 3.98% | 0.54% | 6.36% | 0.00% | 0.03% | 0.29% | 11.20% |
| **50-60** | 1.67% | 0.24% | 8.37% | 0.00% | 0.02% | 0.46% | 10.75% |
| **>60** | 0.34% | 0.03% | 5.13% | 0.00% | 0.00% | 0.20% | 5.70% |
| Total | 60.70% | 7.22% | 29.58% | 0.10% | 1.11% | 1.28% | 100.00% |

Source: CODEPLAN. *Pesquisa Domiciliar Transporte – 2000*. Brasília: CODEPLAN, 2002

Additionally, two important facts must be considered. First, traffic and congestion can enlarge motorized trips time, especially in pick hours, increasing travel time that is considered potential. Second, the difficulty to park in the center stimulates drivers to change their cars for bicycles.

# DISCUSSION AND RECOMMENDATION

The results of the questionnaires showed that the existence of bicycle infrastructure – bicycle lane or bicycle path, would stimulate the majority of the students to consider commuting by bike, since the minority would do it if no infrastructure is in place. The result suggests that security is a determinant factor since sharing the road with automobiles had less acceptance than segregated typologies, in accordance to studies conducted by (Winters, Babul, Becker et al. 2012; Greig, 2012; Hopkinson & Wardman, 1996; Winters, Davidson, Kao & Teschke,

2011), especially for automobile commuters. Therefore, investments in bicycle infrastructure and safety must be considered if there is the intention to stimulate this mode.

Regarding to time, most respondents declared that they would commute by bicycle if it would take less than 20 minutes. This result corresponds to 5 km at 15 km/h, being in accordance to the length of bicycle trips that is considered realistic by specialized literature (Heinen, Maat & Wee, 2011; Ministério das Cidades, 2007; Sully, 2000).

With regard to the motivations, the fact that health and environmental concerns appear as reasons to change for the bicycle shows that qualitative motivations seem to have the same importance of quantitative pragmatic reasons such as time efficiency and economy. Also, ideological reasons alike personal and environmental wellbeing, as well as the pleasure to cycle seem to encourage bicycle use. Nevertheless, it is important to highlight that the reasons given to change for the bicycle differ of the reasons given by the real cyclists to use the bicycle. While for non-cyclists qualitative motivations have a great importance, the main reasons given by cyclists are quantitative pragmatic – distance, economy and time.

Although the questioner result suggests that bicycle infrastructure and facilities stimulate cycling, studies show that facilities should be combined with other measures to have more effective results to reduce automobile use and dependency (Broaddus, Litman & Menon, 2009; Tight, Site & Meyer-Rühle, 2004; KpVV, 2005). This is confirmed when it was analysed the competitiveness between bicycle and the different modes, while the majority of the respondents who use public transport (more than 80%) would change for the bicycle, just 45% of the car users would do so. The results show that automobile users are less likely to switch to bicycle and that the existence of bicycle facilities is not enough to discourage automobile use. Consequently, complementary measures are necessary to make driving less attractive.

Based in the results of the questionnaire, it is possible to conclude that there is potential for bicycle use as a way of transport for the target population. Considering the willingness to change for the bicycle, 61.20% manifested they would do it considering bicycle infrastructure and time. In addition, the results showed that students have a positive image about bicycle as a way of transport. Just a few respondents manifested a negative perception about bicycle use. Nevertheless, university students are a specific group and their perception and motivations to use the bicycle, such as environment and health, may not be the shared by the whole population.

Finally, for Brasilia, the estimation of the potential demand for cycling analysed by distance and time showed that a great part of the territory is reachable from the center. Most of the residential sector is 5 km distant from the center, and the longer path towards the center takes in average 23 minutes cycling. Furthermore, the analysis of land use showed that the concentration of work places in the city center is a positive factor for commuting by bicycle for a considerable portion of the population that live close. It was estimated that approximately 10% of the total trips that have origin and destiny in the center could be made by bicycle.

In conclusion, based on the questionnaire and the demand estimated for Brasilia, it is recommended that policies to stimulate bicycle use have a special focus on universities and schools in a first moment. Those target places could perform as pilot projects to be monitored, adapted, and expanded with time.

For future research, since bicycle paths are under construction in Brasilia and in the University, it is suggested the investigation about how students perceive and use the implemented infrastructure. Such study would allow comparisons with the previous data, to validate or refuse the potential detected, and would give support for improving the bicycle program.

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