

Mobility, citizenship, and inequality: analyzing the cycling infrastructure of Rio de Janeiro

Mobilidade, cidadania e desigualdade: analisando a infraestrutura cicloviária do Rio de Janeiro

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Abstract

In this paper, the concept of citizenship is related to that of urban mobility, which unfolds in bicycle mobility. To this end, the distribution of the cycling infrastructure in the city of Rio de Janeiro, Brazil, is analyzed. The aim is to relate the socio-spatial distribution of the population in the territory to the available cycling infrastructure. The extension and quality of such infrastructure is investigated in two neighborhoods that are different both in territorial and social terms (Bangu and Copacabana). The results show a concentration of cycling infrastructure of greater extension and quality in Rio de Janeiro's highest-income neighborhoods (Copacabana) and of lesser extension and quality in the periphery (Bangu), and the difference in existence, extension, and quality of Rio de Janeiro's cycling infrastructures is related to greater or lesser citizenship.

Keywords: cycling infrastructure; cycle path; urban mobility; Rio de Janeiro.

Resumo

Este artigo relaciona o conceito de cidadania com o da mobilidade urbana, desdobrando-se na mobilidade por bicicletas. Para tanto, é feita uma análise da distribuição da infraestrutura cicloviária na cidade do Rio de Janeiro (RJ). Busca-se relacionar a distribuição socioespacial da população no território com a infraestrutura cicloviária disponível. O trabalho investigou a extensão e a qualidade dessas infraestruturas em dois bairros distintos territorial e socialmente: Bangu e Copacabana. Apontou-se a concentração de infraestrutura cicloviária em extensão e qualidade nos bairros de maior renda no Rio de Janeiro (Copacabana) e de menor extensão e qualidade na periferia (Bangu), relacionando a distinção da existência, da extensão e da qualidade das infraestruturas cicloviárias no território carioca com maior ou menor cidadania.

Palavras-chave: infraestrutura cicloviária; ciclovia; mobilidade urbana; Rio de Janeiro.



Introduction

In recent years, Brazil has seen the emergence of a new type of crisis in its cities, especially in large and medium-sized ones: the urban mobility crisis. At the heart of this crisis is socio-spatial segregation, the result of the accelerated and unequal urbanization process¹ that characterizes Brazilian territory, the lack of consistent planning policies, and low investment in urban mobility by the public authorities.

According to the Brazilian Institute of Geography and Statistics [*Instituto Brasileiro de Geografia e Estatística*] (IBGE, 2010), over 20% of the Brazilian population spends more than an hour commuting. This means that a fifth of the population spends more than two hours commuting every day to complete an average eight-hour day. Data from the Institute for Applied Economic Research [*Instituto de Pesquisa Econômica Aplicada*] (Ipea, 2013)² indicate that the commutes made by low-income workers are, on average, 20% longer than those made by the richest and that the number of hours spent commuting has been increasing year on year for all income brackets.

In the case of Rio de Janeiro, the scenario is even more dramatic. According to the IBGE's National Health Survey (2019), the capital has the longest home-work commute of all Brazilian capitals, with an average of 7.8 hours per week.

Based on this context, this article seeks to relate the concept of citizenship to urban mobility and its consequences. It starts by structuring the concept of citizenship from the perspective of urban mobility. Based on this reading, the article goes through an extensive analysis of the role of cycling infrastructure in

promoting the use of bicycles as a means of transportation in Rio de Janeiro. It examines the role that bike paths, bike lanes, and shared lanes – active transport infrastructures – play in the displacement of people, with special attention to the realization of the social right to mobility, amended to the Federal Constitution in 2013.

The promotion of active mobility is in line with the sustainable development goals of the United Nations 2030 Agenda and is transversal to goals 3 – Health and well-being; 7 – Clean and renewable energy; 10 – Reducing inequalities; 11 – Sustainable cities and communities and 13 – Action against global climate change.

From this, we sought to provide a broad understanding of the importance of bike paths and bike lanes in different neighborhoods and for different social strata that adopt the use of bicycles in their daily lives, focusing on two distinct neighborhoods, both in terms of spatial location and social data: Bangu and Copacabana.

Methodological aspects

This article is based on qualitative and quantitative research. The investigation was conducted from an analysis of Brazilian and foreign theoretical references, with an emphasis on the concepts of urban mobility, citizenship, bicycle mobility, and bicycle infrastructure to support the discussion. The article is also based on an extensive documentary analysis of the infrastructure maps of the city of Rio de Janeiro, as well as its urban planning laws, besides other secondary sources.

In addition, an on-site analysis was carried out during field visits in the two neighborhoods – Copacabana and Bangu – with the proper photographic record, presented in this article. Finally, a quantitative analysis of the cycling infrastructure is made based on georeferenced maps generated in the QGIS software from the public databases available on the Data Rio website.³

As a last step, a thorough survey of the official records and the on-site observation were carried out for the production of the qualitative and quantitative maps in this research.

Urban mobility and citizenship

The precariousness of urban mobility and spatial segregation are two problems that directly harm the quality of life in Brazilian cities and have worsened over the years. Ermínia Maricato (2013) points out that mobility is a central issue in the urban problem faced by Brazilian metropolises. According to the author:

[...] It is the transportation conditions in cities that end up demanding the greatest dose of sacrifices from their residents. Although the decline in mobility is general – in other words, it affects everyone – it is the lower-income strata that will pay the greatest price in immobility. [...] That is, part of life is spent in transportation, whether it is a luxury car, a bus, or an overcrowded train – which is more common. (p. 41)

Although it is a more crucial problem for the lower classes and residents of more peripheral and less infrastructured

neighborhoods, urban mobility restrictions affect society as a whole, hence the urgency of addressing the issue in Brazil from a new perspective. This approach is already endorsed, for example, by the Universal Declaration of Human Rights when it points out the relationship between mobility and social well-being. Since Article 13 states that people have the right to freedom of movement, "many studies accept the axiom that increased spatial mobility reflects the process of democratization and freedom of movement and, by extension, increased social mobility and equality in general" (Kaufmann and Montulet, 2008, p. 38). In addition to the increase in qualifications for mobility, there is an inseparable increase in freedom, social mobility, and greater equality.

Although they are directly related – since increasing mobility does not necessarily mean increasing equality altogether – the expansion of urban rights involves expanding the right to mobility, and this right is a possible path, but not the only one, towards a more democratic, inclusive, and therefore more equitable city (and society). For Herce (2009), urban mobility has become so fundamental nowadays that it has transcended urban discourse and has come to formulate the "territorial articulation and economic development" of cities (p. 15).

Thus, the relationship between urban mobility and citizenship in Brazil is recent. Although Brazilians have been protected by the Federal Constitution since 1988, it was only in 2015 that the right to transportation⁴ became a social right, with the approval of Constitutional Amendment No. 74 of 2013 (Brasil, 2013). For Marshall (1967), citizenship is called a "tripod of rights", which are political, civil, and social:⁵

Citizenship requires a bond of a different nature, a direct sense of belonging to a community based on loyalty to a civilization that is a common heritage. It comprises the loyalty of free men, imbued with rights and protected by a common law. Their development is stimulated both by the struggle to acquire such rights and by the enjoyment of them once acquired. (p. 84)

Civil rights, regulated through legislation, "are the fundamental rights to life, liberty, property, and equality before the law" (Carvalho, 2002, p. 9). These are the rights that "unfold in the guarantee of coming and going, of choosing one's work, of manifesting one's thoughts, of organizing oneself [...]. Its touchstone is individual freedom" (ibid.). Political rights are those that organize the lives of citizens through the political representation that takes place, in Brazil, through voting.

Social rights, on the other hand, are those that allow the population to participate in collective wealth, beyond income. Collective wealth, here, is placed as a heritage of the city, of its infrastructure available to all, where access to collective goods in an equitable way is a premise of citizenship and can be directly related to the concept of "right to the city" (Lefebvre, 2011; Harvey, 2012) or what Milton Santos (2007) called the "right to the environment":

Social rights enable politically organized societies to reduce the excesses of inequality produced by capitalism and to guarantee a minimum of well-being for all. The central idea on which they are based is that of social justice. (p. 10)

For Carvalho (2002, p. 10), "the full citizen would be the one who is the holder of the three rights. Incomplete citizens would be those who possessed only some of the rights. Those who did not benefit from any of the rights would be non-citizens". At its core, citizenship presupposes that the assimilation of the importance of a certain social aspect, such as mobility, needs to be recognized and put into effect. This is how the timeliness of the relationship between urban mobility and citizenship is established.

At the same time that, within the concept of citizenship, civil rights limit the duty of the State to ensure the protection of citizens, social rights enshrine what must be done to ensure the well-being of the population from the social understanding of the fundamental issues of society. In this sense, there is a great achievement in the transformation of urban mobility into a social right.

For François Ascher (1995, p. 5), to understand the history of the contemporary period is also to understand it as the period of urban mobility, so that "it is not limited to a simple displacement in space. It is a continuous process, which begins at the level of economic structures and ends at the level of social relations." Therefore, urban mobility has, among its components, the apprehension of social rights, corroborating the statements of Marshall (1967) and Carvalho (2002).

For these authors, the expansion of social rights is vital for a "general reduction of risk and insecurity" (Marshall, 1967, p. 94), to seek equality:

The expansion of social services is not primarily a means of equalizing incomes. In some cases, it can, in others, it cannot. The question is not of much importance; it belongs to a different sector of social policy. What matters is that there should be a general enrichment of the concrete substance of civilized life, a general reduction of risk and insecurity, and an equalization between the more and the less fortunate at all levels – between the healthy and the sick, the employed and the unemployed, the old and the active, the single and the father of a large family. Equalization does not refer so much to classes as to individuals who make up a population that is considered, for this purpose, as if it were a class. Equality of status is more important than equality of income. (Ibid.)

The importance of social law as an instrument of equalization in the sense of collective participation is highlighted. In the case of Brazil, where inequality is large and territorialized, dealing with mobility means dealing with citizenship in a way that enriches the "concrete substance of civilized life" (ibid.). The idea of equalization deals with the possibility of the mobility of conferring a certain equity to territories that are so disparate from each other. Providing accessibility to leisure facilities, services, and culture is the first step to be taken so that citizens living in places where these facilities do not exist can enjoy them.

Urban mobility deals with the connection and approximation of places of absence with places of abundance, configuring itself in a kind of retraction beyond the idea of displacement of workers between their homes and workplaces. This kind of retraction symbolizes a counterpart of social justice in the increase of mobility, allowing the most

harmed subjects, due to their condition in the social space (income, schooling, etc.) and in the physical space (the place where they live), a broader access to the entire city, to its heritage, to its surroundings (Santos, 2007), culminating in a greater right to the city, that is, the full right of citizenship.

However, it is not enough just for the *access to exist*, it is also important to pay attention to the qualitative aspects of mobility. It is necessary to think about mobility as citizenship broadly, beyond physical displacement. This includes safety, comfort, adequate rates, speed, and efficiency, among others.

Therefore, the unequal consumption of mobility in the territory creates barriers to the extension of citizenship for all, since the restrictions on the mobility of the less favored, added to the unequal and deficient distribution of infrastructure throughout the territory, interfere with the social rights of all, subjecting people to the condition of less citizens than others.

In his works, *The Divided Space* (2004) and *The Citizen's Space* (2007), Milton Santos investigates the category of "mobility", relating it to the territory and the financial and social possibilities of the subjects. Poorly located subjects with few resources are threatened by immobility, or in the words of José Murilo de Carvalho (2002), become "non-citizens". For Santos (2007), one of the most striking characteristics of citizenship, and also one of the most hidden, is its relationship with the territory and with the valuation of individuals according to their spatial location, clearly elucidating the importance of place in the issue of mobility:

Each man is valued by the place where he is: his value as a producer, consumer, and citizen depends on his location in the territory. His value changes incessantly, for better or for worse, due to differences in accessibility (time, frequency, price), regardless of his condition. People with the same skills, the same education, and even the same salary, have different values depending on where they live: the opportunities are not the same. For this reason, the possibility of being more or less of a citizen depends, to a large extent, on the point of the territory where the person is. (p. 107)

Insofar as income, class, and place value individuals based on their spatial location, another relationship based on the territory stands out: the characteristic of man as producer, consumer, and citizen. This aspect often goes beyond place when considering parameters on a global scale, although citizenship is not a deterritorialized value, as is the case with production and consumption. In short, "residents who have the means to move around thus have easier access, while whose mobility is limited or non-existent must pay more locally, and sometimes, for this very reason, renounce their use" (*ibid.*, p. 116).

Corroborating the disadvantages of poor location and precarious access to transport systems, "geographical distance is doubled by political distance" (*ibid.*, p. 118) so that information is economic and territorialized, that is, it is geographically concentrated. In this way, transport infrastructure – which induces mobility – is also a producer of information, enabling or restricting, based on its contexts, the citizenship of the inhabitants of the cities.

Urban and bicycle mobility in Brazil and Rio de Janeiro

The reality of urban mobility in Brazil presents great challenges to be overcome in the coming years. At the beginning of the 2010s, the country saw a virtuous growth in investments in transport infrastructure, followed by a total decline in recent years. The result for Brazilian cities has been a slight (albeit questionable) improvement in urban mobility,⁶ accompanied by a large amount of uncoordinated and unfinished projects.

Rio de Janeiro, arguably the most iconic and representative city in Brazil, presented some of the most dramatic examples of unfinished mobility projects by hosting the 2016 Olympic Games. It was in this city that the largest Bus Rapid Transit (BRT)⁷ system in Brazil was implemented, and which, until the middle of 2023, was still inconclusive, precisely on its most representative line for the connection between the periphery and the center: the BRT Transbrasil, planned to connect the Planning Area (PA) 5 – PA5 (West Zone) to PA1 (Downtown).

Added to this picture are the implementation of the Light Rail Vehicle (LRV),⁸ the reformulation of bus lines (Rodrigues and Bastos, 2015), the expansion of the subway system to Barra da Tijuca, the renovation of the Galeão – Tom Jobim international airport, the implementation of the public system of shared bicycles and the expansion of the city's cycling system, among other initiatives.

In addition to investments being concentrated in certain areas of the capital of Rio de Janeiro, the metropolitan region

of Rio de Janeiro achieved the longest intra-urban and metropolitan travel time among all capitals and metropolitan regions in the same period.⁹ In the same vein, territorial policies in recent years have contributed to reinforcing longer commuting movements, especially for the poorest, given the greater concentration of jobs in the central districts (and greater infrastructure in these places) and the maintenance of the poor population on the outskirts of the city.

Especially in this city where urban structure and population distribution are so unequal, the ability to move around takes on a special nature. Through it, part of the territorial inequalities can be alleviated as it creates the possibility for an individual to move from a place without resources or little infrastructure to another where the opportunities for access to urban equipment and jobs are higher (Santos, 2007). Therefore, understanding the dynamics of the distribution of people and infrastructures in the territory of Rio de Janeiro is central to understanding the social importance of this theme.

In urban commuting, several variables are present to collaborate or prevent trips from being successful or not. In general, the most important of these variables is the existence of infrastructures that support these displacements through low, medium, and high-capacity means of transportation, with different configurations and different travel times and costs.

In this context, another type of mobility has gained prominence in Rio de Janeiro: bicycle mobility. This modality, presented as "new" – despite having more than a century

of history in Brazil alone – has become the object of analysis in the field of urban studies, due to its various potentialities in cities. And, following this discussion, it is also appropriate to ask questions about the role of cycling infrastructure in the promotion and daily performance of this means of transportation.

This article is presented in the context of advances in the promotion of active mobility in Brazilian cities, the expansion of the public debate on this means of transportation, and the visibility it has acquired. It is also possible to observe a symbolic valorization of the bicycle in Brazilian society. According to the National Association of Public Transport (*Associação Nacional de Transporte Público – ANTP*), social actors:

[...] are beginning to call for a new culture of mobility that prioritizes forms of collective circulation, walking and cycling, integrating the various modes of transport into a network, and ensuring safe and comfortable accessibility to all points of the cities. (ANTP, 2017)

Contradictorily, although the emergence of a valorization of the bicycle as a means of transportation is evident, data from the Institute of Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada – Ipea*) indicate that there are, in Brazil, more bicycles than cars: "respectively 50 million against 41 million" (Coelho Filho and Saccaro Junior, 2017, p. 5). Estimates from the Urban Mobility Information System¹⁰ indicate that the percentage of trips by bicycle, in municipalities in Brazil with more than 60 thousand inhabitants in 2018, is approximately 3.0%.

These data point to two important facts about bicycle mobility in Brazil. Although there is practically one bicycle for every four inhabitants,¹¹ the share of this means of transportation is still low. That said, another important piece of information to understand the panorama of bicycle mobility in Brazil is the low income of cyclists. According to Ipea data:

[...] mobility by active modes (pedestrian and bicycle) is used by approximately one-third of men and women in Brazil, according to the health supplement of the National Household Sample Survey (Pnad), conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2008. On average, the Brazilian cyclist is low-income, young, and lives in rural areas. In the Brazilian case, the rural area can be considered the periphery of small towns or a peri-urban transition region in large cities. (Ibid., p. 7)

This information can be interpolated to Rio de Janeiro, where similar conditions are observed for cyclists. Data from the Brazilian Cyclist Profile survey, conducted in 2015 and 2017, indicate that the Brazilian cyclist has an income between one and two minimum wages.¹² The need to use bicycles is accentuated as the focus of observation moves away from the center to peripheral regions. Thus, in the capital of Rio de Janeiro, the picture is repeated as a national reflection:

[...] cyclists are mostly with an income of less than two minimum wages. Of these, 12.9% have an income of up to one minimum wage, while 30.7% have an income between one and two minimum wages. On the other hand, only 4.2% have an income higher than ten minimum wages, which by the standards

of the city and the country could be considered a high income. (Andrade et al., 2016, p. 177)

Therefore, comparing the use of bicycles between more central, high-income neighborhoods with peripheral neighborhoods of lower-income strata is essential to understand both bicycle mobility in Rio de Janeiro, as well as the place that cycling infrastructure occupies for commuting through this means of transportation. Considering that the bicycle, as a means of transportation, has the potential to play a significant role in promoting access to public goods and services, contributing, to a certain extent, to mitigating inequalities in urban territories, such an analysis can measure the possibilities and restrictions that cycling infrastructures cause to citizenship in these territories.

Distribution of population and transport infrastructure in Rio de Janeiro

The spatial distribution of the population in Rio de Janeiro, in quantitative and qualitative terms, as in other Brazilian metropolises, is quite unequal. This asymmetry can also be seen in the distribution of transport infrastructure. This can be better observed by aggregating the data in the PAs, as shown in Table 1.

It is possible to see that Rio de Janeiro is unevenly distributed, both in absolute terms of population and density. Around 80% of the population lives in the North (PA3), West (PA5), and Barra/Jacarepaguá (PA4) zones, the

Table 1 - Spatial and population characteristics of Rio de Janeiro's planning areas

Planning area	Urbanized area (HA)	Population	% Pop.	Population density/ area (HA)	Average income (R\$)	Average SDI ¹³
PA 1 – Downtown	2,556.5	308.027	0.05	120.49	1.015.39	0.98
PA 2 – South Zone	3,329.4	1,009.170	0.16	303.11	3.486.13	0.707
PA 3 – North Zone	15,904.5	2,399.159	0.37	150.85	910.65	0.583
PA 4 – Barra and Jacarepaguá	6,101.9	909.368	0.14	149.03	2.084.74	0.621
PA 5 – West Zone	14,346.7	1,767.656	0.28	123.21	678.22	0.553
Rio de Janeiro	42,238.9	6,393.380	1	151.36	1.424.96	0.601

Source: developed by the author based on information from the Data Rio website (2019).

furthest from Downtown (PA1). Only 21% of the population is located in the South Zone/ Greater Tijuca (PA2) and Downtown (PA1). Due to the high concentration of people in the South Zone, in a relatively smaller physical space, the population density is twice as large as that of the city (303.11 inhabitants per hectare compared to 151.36 inhabitants per hectare, respectively).

It is worth noting that, although PA1 has a small proportional population and the lowest population density in the territory, it is the area with the greatest transport infrastructure and also the one that suffers the greatest pendulum pressure due to the concentration of jobs, holding approximately 30% of the formal jobs in the municipality (Junior and Junior, 2011).

Concerning the sociodemographic distribution, a big difference between PA2 (where the Copacabana neighborhood is located) regards the average income and the Social Development Index (SDI) of the city.

The average income in Copacabana is 144% higher than the average of the municipality (R\$3,486.13 in the South Zone against R\$1,424.96 in Rio de Janeiro as a whole), which brings about a difference of 0.105 points in the average SDI.

On the other hand, PA5 (where the Bangu neighborhood is located) is opposed to PA2: it has 47.5% of the average income of the municipality (R\$678.22 in the West Zone against R\$1,424.96 in Rio de Janeiro) and slightly lower, with the difference between the income of PA2 and PA5 being 514%. The discrepancy in the data observed above characterizes Rio de Janeiro as a fragmented and unequal city, where the morphological aspects of the population distribution, reinforced by territorial policies, create pockets of poverty in the less dense peripheries and concentration of the higher-income population within areas with more infrastructure.

According to Ricardo Ojima (2016), "the population stock and its density in urban areas usually appear in studies as one of the main indicators of changes in urban structure" (p. 18). Summarized below, the data from the two neighborhoods surveyed in this article reveal the inequality observed in the second-largest municipality in Brazil.

This same inequality in the population distribution in the territory can be seen in infrastructure networks, particularly transport. Transport networks are key to territorial development, and their existence and distribution allow for a broad reading of the social, political, and economic dynamics at work in a given location.

Thus, the relationship between the benefits of urbanization based on the existence of infrastructure (in this case, transportation) becomes even more evident since "the transportation sector is of fundamental importance in the functioning of the economic system, because the services it produces are practically absorbed by all productive units" (Barat, 1978, p. 4).

Based on the perspective of the importance of transport infrastructures in the territorial dynamics and resuming the current administrative division of the Planning

Area (PA) type in the case of Rio de Janeiro, it is possible to verify that the concentration of medium and high-capacity transport infrastructures varies according to the type of transport available. The mass transport that notoriously has the highest quality in this city is the subway, with 41 stations distributed in 3 lines, 28 stations in the South and Downton zones (PA1 and PA2 – 69%), 12 in PA3 – North Zone (29%) and one in PA4 – Barra and Jacarepaguá (2%). Conversely, the BRT system, still incomplete and already considered a low-quality transport due to the issues of irregular frequency, maintenance, and extension, is located in the North Zone (24 stations – 18% of the total), in Barra and Jacarepaguá (36 stations – 37% of the total) and the West Zone (72 stations – 55% of the total).¹⁴

This unequal concentration of types, quantity, and quality of transport infrastructures can also be observed in the cycling infrastructure of the city of Rio de Janeiro. This difference is strongly present in the two neighborhoods surveyed – Bangu and Copacabana – which, seen from this perspective, can be considered symbols of this unequal city, based on the reading of the quantity and quality of existing bike paths and bike lanes.

Table 2 – Population, territorial, and socioeconomic data for the Bangu and Copacabana neighborhoods

Planning area	Population	Urbanized area (HA)	Population density/area (HA)	Average income (R\$)	Average SDI
Bangu	243.125	1,746.6	139.2	653.26	0.57
Copacabana	146.392	273.6	535.03	3,768.69	0.731
Rio de Janeiro	6.393.380	42,238.9	151.36	1,424.96	0.601

Source: developed by the author from information collected at the Data Rio site (2019).

Cycling infrastructure in Rio de Janeiro

Both the population and the transport infrastructure in Rio de Janeiro are unevenly distributed throughout the territory. The same is true of cycling infrastructure. This can be attested by the absolute quantification of the bike paths and bike lanes available in the different PAs and also by their distribution among the population that can use them and by the territorial area they cover. Table 3 shows their number per capita in the PAs and the number regarding the urbanized area.

The data shown in the table confirm that the cycling infrastructure is more concentrated in PA2 (South Zone), where the Copacabana neighborhood is located. The

number of bike paths and bike lanes both per inhabitant (0.11 meters per inhabitant) and per total urbanized area (34.34 meters per urbanized hectare) in PA2 is higher than in the rest of the city.

Although in PA4 the value of the bike paths/lanes per inhabitant is the same as in PA2, the area covered by PA2 is much larger than in PA4. This explains why the cycling infrastructure is denser in PA2. In other words, although both are divided by the same number of people, there is a higher percentage of the territory of PA2 covered by this type of infrastructure than in PA4, which restricts the safety of commuting by bicycle in this region of the city – considering that the presence of infrastructure is directly related to the perception of safety for commuting by bicycle (Heinen, Van Wee and Maat, 2010).

Table 3 – Number of bike paths and bike lanes in Rio de Janeiro, divided by Planning Areas

Planning area	Population	Urbanized area (ha)	Bike paths and bike lanes (Km)	Bike paths and bike lanes per capita (M/hab)	Bike paths and bike lanes by total urbanized area (M/ha)
PA 1 – Downtown	308,027	2,557	17.38 (4.68%)	0.06	6.80
PA 2 – South Zone	1,009,170	3,329	114.32 (30.79%)	0.11	34.34
PA 3 – North Zone	2,399,159	15,905	40.6 (10.93%)	0.02	2.55
PA 4 – Barra and Jacarepaguá	909,368	6,102	99.43 (26.76%)	0.11	16.30
PA 5 – West Zone	1,767,656	14,347	99.57 (26.82%)	0.06	6.94
Rio de Janeiro	6,393,380	42,239	371.3 (100%)	0.06	8.79

Source: developed by the author from information collected at the Data Rio site (2019).

The data on the concentration of cycling infrastructure are even more dissonant when comparing the values of the PAs with the average value of the city of Rio de Janeiro, which has 0.06 meters of bike paths/lanes per inhabitant and 8.79 meters of bike paths/lanes per hectare, data similar to those of PA5, where the Bangu neighborhood is located. For comparison purposes, the three cities considered most prepared for the use of bicycles¹⁵ in the world – Copenhagen, Utrecht, and Amsterdam – in that order, have 0.599, 1.202, and 0.486 meters of bike paths/lanes per inhabitant, respectively.¹⁶

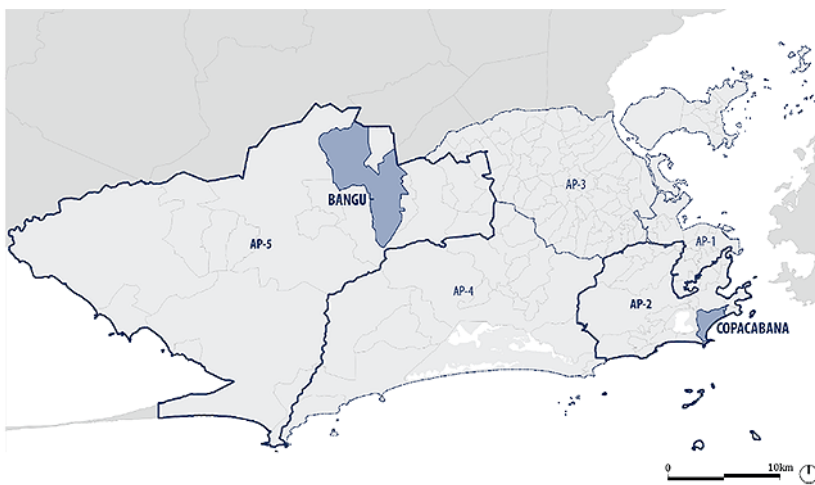
PA2 – South Zone is the region with the second highest population density (100.48 inhabitants/ha), and PA3 – North Zone, the most underprivileged in terms of the number of bike paths/lanes per inhabitant and area, is

also the one with the highest density (117.90 inhabitants/ha). Although it is an important measure to guide infrastructure planning actions in the territory, densification does not explain the concentration of cycling infrastructure; on the contrary: in the case of Rio de Janeiro, the densest PA is the one with the least amount of infrastructure.

Cycling infrastructure in Bangu and Copacabana

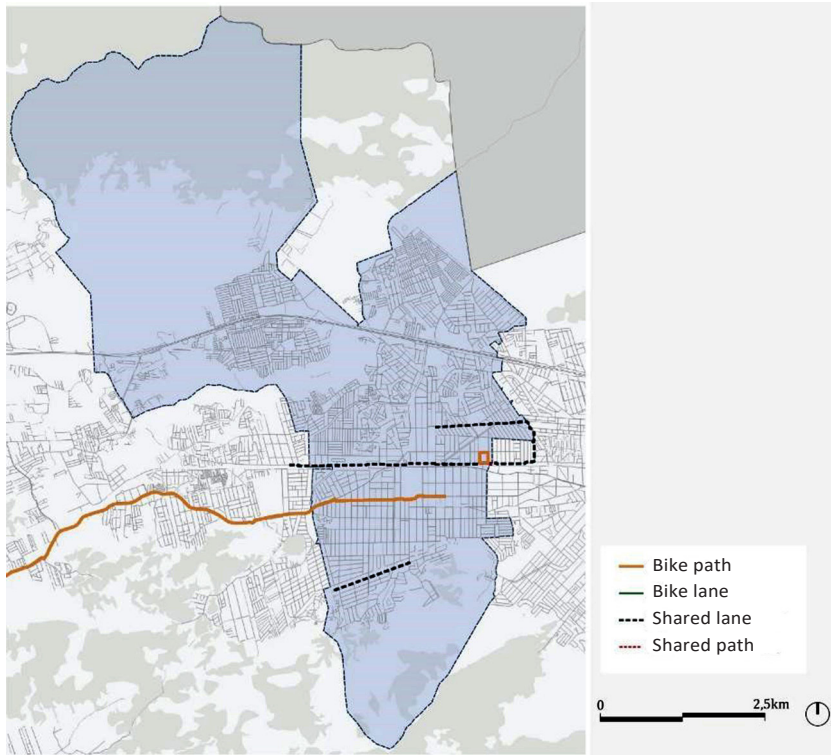
Bangu and Copacabana (Figure 1), as previously pointed out, are located in different PAs. The first neighborhood, in PA 5 (West Zone), has 5,410 meters of cycling infrastructure, of which 4,236 meters are bike

Figure 1 – Map of the municipality of Rio de Janeiro highlighting the neighborhoods of Bangu and Copacabana



Source: developed by the author in 2019.

Figure 2 – Map of the cycling infrastructure in the Bangu neighborhood in Rio de Janeiro (RJ)



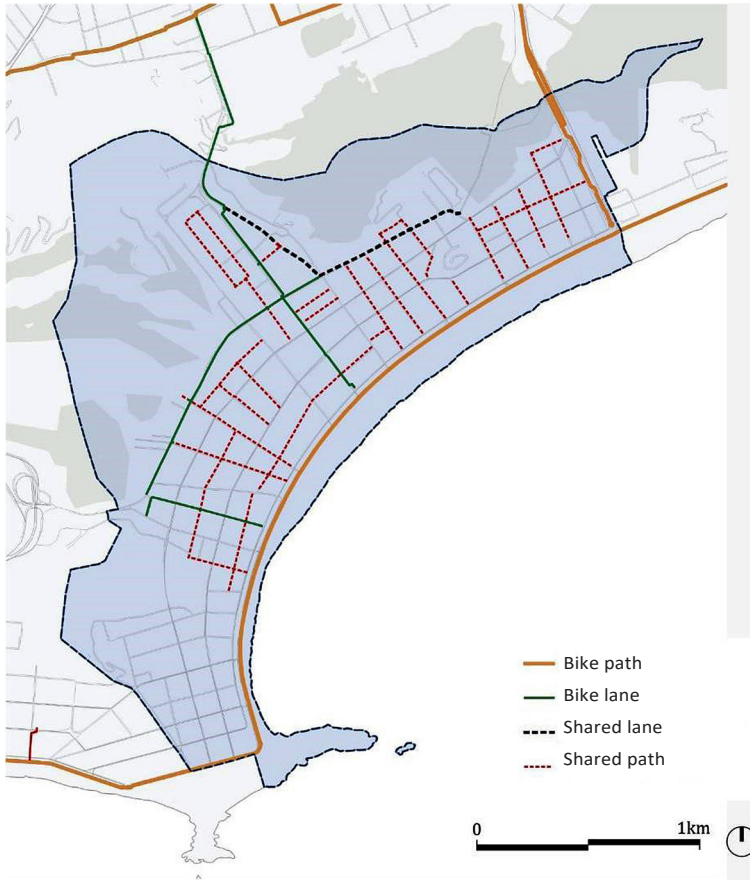
Source: developed by the author in 2019.

paths (78.3%) and 1,174 meters are shared lanes for pedestrians (21.70%) (Figure 2). The Copacabana neighborhood, in PA2 (South Zone), has 20,513 meters of infrastructure, of which 5,325 meters are bike paths (25.96%), 2,916 are bike lanes (14.21%) and 12,274 are shared lanes (59.83%) (Figure 3). For comparison purposes, in Copacabana, only

8,241 meters were considered, and the shared lanes were disregarded because they do not properly constitute cycling transport infrastructure.

The first point to be highlighted is the quantitative difference in cycling infrastructure between the two neighborhoods. Considering only bike paths and bike lanes, the difference

Figure 3 – Map of the cycling infrastructure in the Copacabana neighborhood in Rio de Janeiro (RJ)



Source: developed by the author in 2019.

is 35% in quantity. When shared lanes are considered, the difference between the two neighborhoods rises to 74%. Although the shared paths are only indications on the pavement, it should be noted that they are non-existent in Bangu and represent 59.83% of the entire cycling infrastructure of Copacabana, which denotes the concern of the government in qualifying a greater number of roads to receive cyclists in this neighborhood than in the other.

Historically, the two bike paths have developed over the years, and the Copacabana waterfront bike path was the city's pioneer which was built in 1991 to host the United Nations Conference on Environment and Development (ECO 92) the following year. The implementation of the Bangu bike path began in 1999 with the construction of a shared lane. The latest additions are from 2016, in Copacabana, the year of the Olympic Games in Rio de Janeiro.

Figures 4 and 5 are records of the bike paths of the neighborhoods analyzed. At first glance, the surrounding relationships are clear, especially concerning the gauges and densities of the two neighborhoods. While the West Zone neighborhood is quite "horizontalized",

with low gauges and typologies that rarely exceed two floors, the South Zone neighborhood has exactly the opposite profile, almost completely verticalized, with high gauges, with contiguous multi-story buildings usually larger than 10 floors.

Figure 4 – Pavement conditions of bike paths/lanes in Bangu neighborhood



Source: recorded by the author in 2019.

Figure 5 – Pavement conditions of bike paths/lanes in the Copacabana neighborhood



Source: recorded by the author in 2019.

About the quality of the pavement, the bike paths are quite different in the two neighborhoods. In Bangu, several points were found with serious issues, resulting from the lack of maintenance, such as lifting the concrete slab by the roots of trees, lack of interlocking block floor, and breakage of the concrete floor (Figure 6). In Copacabana, bike paths generally have well-maintained asphalt pavement, and the occurrence of issues is quite rare and punctual (Figure 7).

Regarding signage, the same discrepancy was found in both neighborhoods. While in Copacabana all bike paths are signposted and with well-maintained paint, with some occasional issues of erasure, in Bangu, most of the bike paths/lanes are not easily identifiable due to the absence of signage. During the visits, points where there were traces of signage were recorded; however, due to the lack of maintenance, they are no longer visible.

Figure 6 – Pavement conditions of bike paths/lanes in Bangu neighborhood



Source: recorded by the author in 2019.

Figure 7 – Pavement conditions of bike paths/lanes in the Copacabana neighborhood



Source: recorded by the author in 2019.

One of the most important issues about signage is when it occurs in spaces shared with other modes of transport, alerting drivers that priority should be given to the cyclist on that particular road. This type of floor marking, recorded in Figure 7 (right), was only found in the Copacabana neighborhood. Regarding safety conditions, the two items above are the most important to provide good "cyclability" to users of bike paths and bike lanes. Both road quality and signage – for cyclists and drivers – are key to safe travel.

There are serious implications for the safety of cyclists in Bangu. In this neighborhood, several obstacles were also found in the bike path, and also a lack of lowering at intersections and interferences. Due to the lack of signage, it was also found that, at several points, its use is not possible due to misappropriation of the bike lane for vehicle parking and placement of tables and chairs outside bars, for example. In Copacabana, on the other hand, the presence of "turtles" (protruding concrete separators) in good condition and the aforementioned signage provide good levels of safety when traveling by bicycle.

In both neighborhoods, the infrastructure is located in the places with the greatest circulation of cyclists and, therefore, provides access to other large mobility infrastructures present in each neighborhood (Bangu railway station and subway stations in Copacabana). The South Zone neighborhood also has stations of the Bike Rio shared bicycle system, which does not exist in Bangu.

The difference in the quality of the project and the geometric design in the two neighborhoods is also quite evident, with Copacabana presenting street transitions, stops, segregation, and well-defined

continuities, with adequate distances, radii, and drawdowns. In distinction to Copacabana, cyclists, and pedestrians in Bangu share almost all the available cycling infrastructure, implying road narrowings and obstacles and, therefore, an additional risk and discomfort for users.

Despite the great distinction in the conformation of the cycling infrastructure in the two neighborhoods, its existence, and the access it allows to other mobility infrastructures, through intermodality, highlight the role that bicycle mobility has in fostering urban equity in such different contexts, presenting a potential to contribute to a more egalitarian city.

Final remarks

This article related the concept of citizenship to urban mobility. From a commuting perspective, access to goods and services guaranteed by infrastructure is seen as fundamental to ensure greater equity in the urban environment. In this way, pointing out the unequal distribution of the population and transport infrastructure becomes a prognosis for the finding that the distribution of cycling infrastructure in the municipality of Rio de Janeiro is also unequal.

This city, which has undergone recent investments in infrastructure due to the 2016 Olympic Games, boasts the worst rate of time spent on mobility among Brazilian capitals. If, on the one hand, this data does not necessarily explain the differences found in the analysis, on the other hand, it clarifies the challenges related to intermodality that could favor the optimization of travel by capillary means of transportation such as cycling.

It is observed that the population is unevenly distributed in its territory, and differences in income, schooling, density, and social development indicators are pointed out as factors that, to a certain extent, directly influence the distribution of transport infrastructures. Thus, the concentration of cycling infrastructure in Rio de Janeiro is not only confirmed by the quantity in the areas with higher income but also by their quality.

The differences found in the two neighborhoods analyzed – Bangu and Copacabana – allow us to affirm that the provision and maintenance policies in the two locations are quite different, and Copacabana offers cyclists an infrastructure that, although limited in extension, has good quality. In Bangu, on the other hand, there are issues of design, extension, and maintenance, which can result in losses of various natures to its users.

In addition, the discrepancies presented in the cycling infrastructures of the two neighborhoods analyzed allow us to infer

that, in the case of essential equipment for commuting by bicycle, the citizenship of the inhabitants of Copacabana is more assured than that of the inhabitants of Bangu concerning urban mobility by bicycles.

As a consequence, those who use bicycles for their daily commutes find better conditions in more central neighborhoods of the city, such as Copacabana, while the inhabitants of more peripheral neighborhoods, such as Bangu, find greater restrictions to exercise their citizenship when they move around the territory by bicycle.

This work sought to show the importance of understanding the differences that are expressed from the analysis of the cycling infrastructure of Rio de Janeiro. Focusing on its power to give its inhabitants greater or lesser citizenship, the city-built environment is a portrait of the possibilities and constraints that Cariocas face according to the place in which they dwell, expressed in the physical form of its infrastructures, such as the cycling infrastructure.

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Notes

- (1) According to Silva (2013, p. 9): "At the height of the urban expansion process in Brazil, the logics devised to understand the transformations that had taken place and the social inequalities that were increasingly crystallizing in space involved dimensions related to exploitation, segregation, marginalization, exclusion, such as the concepts of 'urbanization by the logic of disorder' and 'urban 'urban spoliation' coined by Lúcio Kowarick (1980)".
- (2) See Pereira and Schwanen (2013).
- (3) Data Rio is a website run by Rio de Janeiro's city hall that organizes data on the city's municipality. The shapefile files used in this research are available at: <https://www.data.rio/datasets>.
- (4) The Federal Constitution treats transportation as a right, differentiating it from the idea of urban mobility, a broader term.
- (5) The author points out that rights emerged in different stages in modern societies: first, civil rights (18th century), followed by political rights (19th century), and, finally, social rights (late 20th century). According to him, citizenship has only become a tangible concept since the 21st century.
- (6) In the last 15 years, the great urban growth of Brazilian cities, accompanied by the growth of income and employment, has created, in the words of Raquel Rolnik (2013), citizens "lacking a city", where one of the most urgent aspects deals with urban mobility restrictions.
- (7) BRT is a segregated bus rapid transit system implemented in the city in return for hosting the Olympic Games (see Dossier..., 2009).
- (8) Information available at: <https://www.vltrio.com.br/#/historia>.
- (9) According to the Federation of Industries of Rio de Janeiro, 2 hours and 21 minutes are spent daily in this metropolitan region commuting from home to work, the highest national average (Freitas, 2016).
- (10) See: <https://observatoriodabicicleta.org.br/percentual-antp/>.
- (11) According to the IBGE, the population estimate for Brazil in 2017 was 207.7 million inhabitants. Available at: <http://www.brasil.gov.br/cidadania-e-justica/2017/08/populacao-brasileira-passa-de-207-7-milhoes-em-2017>. Access on: June 27, 2020.
- (12) Available at: <http://www.ta.org.br/perfil/ciclista.pdf>. Access on: July 1, 2020.
- (13) Rio de Janeiro's Social Development Index – SDI (Índice de Desenvolvimento Social – IDS) is an average calculated based on income, schooling, and life expectancy data. Available at: <https://www.data.rio/documents/fa85ddc76a524380ad7fc60e3006ee97/about>.
- (14) The classification of transport systems was based on user reports and media evaluations of the city's available transport systems. See Marino (2019).
- (15) Data obtained from the Bike Citizens organization for 2017. Available at: <https://www.bikecitizens.net/25886/>.

(16) Amsterdam has 400 kilometers of bike paths and 821,752 inhabitants, with 0.486 meters of bike lanes per inhabitant; Utrecht has 402 kilometers of bike lanes and 334,176 inhabitants, for a total of 1.202 meters of bike paths per inhabitant; Copenhagen has approximately 350 kilometers of bike paths and 583,525 inhabitants, for a total of 0.599 meters of bike paths per inhabitant. Data were obtained from the websites of these municipalities. Copenhagen: <http://denmark.dk/en/quick-facts/facts>; Utrecht and Amsterdam: <https://www.citypopulation.de/php/netherlands-admin.php?adm2id=0344>. Accessed on: 14 Aug 2023.

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Translation: this article was translated from Portuguese into English by Tereza Marques de Oliveira Lima, email: tmolima@centroin.com.br

Received: August 15, 2023
Approved: October 17, 2023