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Cycling promotion using financial incentives

A pilot design to inform public policy in São Paulo, Brazil

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Final Essay

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Resumo

Ana Yoon Faria de Lima. **Política de bonificação a ciclistas: *Uma proposta de projeto piloto para fundamentar uma política pública em São Paulo, Brasil***. Monografia (Bacharelado). Instituto de Matemática e Estatística, Universidade de São Paulo, São Paulo, 2023.

A bicicleta é um meio de transporte sustentável que pode contribuir para a melhoria da qualidade de vida urbana em diversas dimensões, como a redução da poluição ambiental, a melhora da saúde pública e a diminuição dos custos sociais e individuais do transporte. Nesse sentido, políticas públicas que incentivam o uso da bicicleta são cada vez mais importantes para o planejamento de transporte urbano. Entre as iniciativas existentes está o incentivo monetário a ciclistas, que já existe em alguns países, principalmente na Europa. Em 2016, a prefeitura de São Paulo aprovou uma lei para implementar essa política na cidade por meio do programa Bike SP. No entanto, a política ainda não foi colocada em prática, devido à falta de implementações anteriores em um contexto semelhante ao de São Paulo e de evidências científicas que orientem o seu desenho e execução. Diante disso, este projeto tem como objetivo elaborar e preparar a implementação de um projeto piloto que possa gerar dados empíricos e recomendações para o programa Bike SP e definir seus principais aspectos, como critérios de elegibilidade, valor do incentivo e métricas de avaliação. Este estudo utiliza uma abordagem multidisciplinar que integra ciência de dados e técnicas econométricas com teorias das ciências sociais sobre mobilidade e justiça de dados, e é realizado em parceria com especialistas em mobilidade cicloviária e com a Prefeitura de São Paulo. Seguindo um plano de pré-análise, este trabalho propõe uma metodologia de pesquisa que pode ser generalizada e aplicada a outras políticas públicas inovadoras que, assim como o Bike SP, demandam avaliação e testes rigorosos devido à ausência de precedentes. Os resultados indicam que o programa Bike SP pode ter um impacto que vai além do aumento da participação modal do ciclismo, por meio da geração de dados e da formação de uma comunidade de ciclistas. O estudo também conclui que o programa deve ser acompanhado por outras medidas que aumentem a segurança e a qualidade do ciclismo na cidade, em um esforço conjunto para criar um ambiente cicloviário inclusivo.

Palavras-chave: Promoção de Ciclismo. Bonificação a Ciclistas. Justiça de Dados de Mobilidade. Computação Urbana. Bike SP.

Abstract

Ana Yoon Faria de Lima. **Cycling promotion using financial incentives: *A pilot design to inform public policy in São Paulo, Brazil***. Capstone Project Report (Bachelor). Institute of Mathematics and Statistics, University of São Paulo, São Paulo, 2023.

Bicycle transportation is a sustainable mode of mobility that can benefit society in various ways, such as reducing environmental pollution, improving public health, and saving economic costs. Consequently, public policies that promote bicycle use have become increasingly relevant for transportation planning. A policy option that has been implemented in some countries, mainly in Europe, is financial incentives for cyclists. In 2016, the City Hall of São Paulo approved a law to introduce this policy in the city through the Bike SP program. However, the policy has not been operationalized yet, owing to the scarcity of previous implementations in a context comparable to São Paulo and of scientific evidence to support its design and execution. Therefore, this project aims to design and prepare the implementation of a pilot project that can provide empirical data and insights for the Bike SP program and define its key aspects, such as eligibility criteria, incentive amount, and evaluation metrics. This study adopts an interdisciplinary approach that combines data science and econometric techniques with social science theories on mobility and data justice, and it is conducted in collaboration with cycle mobility specialists and with the City Hall of São Paulo. Drawing on a pre-analysis plan, this work proposes a research methodology that can be generalized and applied to other emerging policy domains that, like Bike SP, require rigorous evaluation and testing due to the lack of precedents. The findings suggest that the Bike SP program can have an impact that goes beyond increasing the mode share of cycling, through the generation of cycling data and the development of a cycling community. The study also concludes that the program should be complemented by other measures that improve the safety and quality of cycling in the city, in a joint effort to create an inclusive cycling environment.

Keywords: Cycling Promotion. Financial Incentives. Mobility Data Justice. Urban Computing.

Abreviation List

IME	Institute of Mathematics and Statistics
USP	University of São Paulo
SMT	São Paulo Municipal Secretariat of Mobility and Transit
CET	São Paulo Traffic Engineering Company
CSV	Comma-separated Values
SP	São Paulo
FAQ	Frequently Asked Questions

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Chapter 1

Introduction

1.1 Research Background

The promotion of cycling as a mode of transportation has been recognized as a key strategy for achieving sustainable urban mobility and improving public health. Regardless, cycling remains a marginal mode of transport in many cities around the world. In São Paulo, Brazil's largest city with more than 12 million inhabitants and 24 million trips daily, only 0.9% of all trips were made by bicycle in 2017 (Metrô São Paulo, 2017). Recently, the City Hall of São Paulo set the ambitious goal of raising the mode share of cycling to 3.2% by 2028 (São Paulo's City Hall, 2022).

As an effort to promote cycling in São Paulo, the City Hall approved the "Bike SP" Program in 2016 (Municipal legislation, 2016), an innovative legislation aimed at encouraging cycling by granting mobility credits to individuals who use bicycles as a means of transportation. The law specifies that these mobility credits will be given to the users registered in the Bilhete Único system[1]. Additionally, the law defines encouraging the use of cycling for commuting and promoting the integration of cycling with collective public transportation as some of the goals of the policy.

However, the implementation of the Bike SP Program has been delayed due to the lack of a regulatory decree that specifies practical aspects of the policy, such as the eligibility criteria, the value of the benefit, the method of measuring cyclists' travel distances, etc. In light of these challenges, and aiming to inform the development of the decree on a scientific basis, the City Hall sought the assistance of the INCT InterSCity research group[2], a Brazilian research project that has been conducting various studies on cycling mobility in urban environments. This capstone project is part of InterSCity, and it plays a central role in fulfilling this demand from the City Hall. The work was carried out in partnership with cycle mobility experts and with the Technology, Innovation and Science department of the Eindhoven University of Technology (TU/e).

[1] The Bilhete Único is a card system that is used for payment on public transportation in São Paulo. It is managed by SPTrans, the city's bus transportation authority, and can be used on buses, the metro, and CPTM trains (SPTrans, 2023).

[2] https://interscity.org/.

Across all stages of the research, we adopt an interdisciplinary approach that combines data science and econometric techniques with social science concepts on mobility data justice and cycling cities. To ensure this interdisciplinarity, in addition to the primary supervisor, professor Fabio Kon[3], this work had the guidance of three other supervisors from diverse fields: cycling activist Flavio Soares[4], and social scientists professor Frauke Behrendt[5] and professor Ruth Oldenziel[6]. Furthermore, this research was supported by the expertise of economist Tainá Souza Pacheco[7] and computer science professor Higor Amário de Souza[8].

1.2 Problem definition

Financial incentives have been used to encourage cycling in other cities (see Chapter 3), but mostly in European contexts and not on a large scale in a metropolis like São Paulo. Due to this lack of previous information, the decision was made to provide scientific support for the public policy in São Paulo through the implementation of a pilot project. This thesis focuses on designing and preparing for the execution of this pilot.

A pilot project is a small-scale experiment that can test the feasibility and effectiveness of an intervention before scaling it up to a larger population (Pearson *et al.*, 2020). The choice of a pilot project as the means to guide the implementation of Bike SP is motivated by the need for precise, real-world data. Traditional survey methods, while beneficial, often fail to capture the complexity of actual behavior, as there can be a significant divergence between what individuals claim they will do and what they actually do (Rundle-Thiele, 2009). This discrepancy is particularly noticeable in this case, given the lack of precedents for this policy in São Paulo.

In this context, a pilot project is a suitable methodological choice. The pilot will simulate the actual policy by compensating participants for their cycling trips, thereby providing data on how such a policy might perform in reality. Moreover, the generation of original data in a controlled setting facilitates the evaluation of the impact of the policy as an isolated variable. Thus, this approach enhances the validity of the findings and provides a robust foundation for future policy decisions.

Furthermore, the Bike SP program has the potential to integrate the social justice and environmental agendas, by reducing the mobility costs of lower-income groups and increasing fairness in transportation. Sustainable mobility policies and social justice agendas may not always be aligned in their objectives and outcomes (Vanoutrive and Cooper, 2020, p. 113). However, in the context of Bike SP, citizens can use the public transportation credits that they earn by cycling to pay for their other trips (by bus, subway, or train). This way, the policy can not only increase the mode share of cycling, but also enhance the

[3] Professor of the Department of Computer Science at the University of São Paulo (USP).

[4] Researcher at Ciclocidade - Urban Cyclists Association of São Paulo.

[5] Professor in Transitions to Sustainable Mobility at the Eindhoven University of Technology (TU/e).

[6] Professor in The History of Technology at Eindhoven University of Technology (TU/e).

[7] PhD in applied economics at the Autonomous University of Barcelona (UAB).

[8] Professor of the Department of Computing at the São Paulo State University (UNESP).

equity of mobility in São Paulo.

Therefore, in designing the pilot project, this thesis needs to take into consideration that a sustainable perspective on mobility requires not only an environmental dimension, but also a social one that aims to eliminate existing disparities (Jeekel, 2017, p. 4298). It is not sufficient to provide mobility options or build cycling infrastructure, without considering the factors that affect people's mobility, such as their financial and time constraints, their geographical location, and their access to opportunities (Bek, 2022, pp. 172–173).

Finally, the outcomes of cycling innovations, such as Bike SP, vary depending on the maturity of the cycling environment (if cycling has a high or low share of the modal split) (Nikolaeva *et al.*, 2019). Consequently, the design of the pilot project should consider the specificities of São Paulo and how it differs from other contexts with similar policies that reward cycling with financial benefits.

Chapter 2

Research design and methods

This chapter delineates the research design and methods that will be employed to guide the future implementation of the policy. First, the primary objective of the research is explained, followed by the methodology for designing and preparing the implementation of the pilot project.

2.1 Objective

The main objective of this research is to design a pilot project that can generate relevant information and insights for the future implementation of the policy. The intention is to prepare all necessary elements for the pilot's execution and identify the key questions that the analysis of the pilot project should address.

The execution of the Bike SP program as a public policy requires the answer to the following questions, which we have formulated and will refer to as Implementation Questions (IQ):

- IQ1: How does the number of bicycle trips vary with different remuneration values?
- IQ2: Which demographic and socioeconomic groups, and which geographic areas, are most likely to benefit from the Bike SP program?
- IQ3: What strategies can be employed to maximize the impact of Bike SP on improving the equity of mobility?

Therefore, this thesis focuses on designing and preparing the implementation of a pilot project that can answer these three questions. The thesis does not encompass the actual execution or evaluation of the pilot, which will be required in the future to provide answers to these questions.

2.2 Methodology

Our research methodology consists of four steps: (1) literature review and data analysis for the research foundation; (2) design of the pilot project; (3) formulation of questions and

recommendations for post-implementation analysis; and (4) preparation of requirements for the pilot's execution. Figure 2.1 shows a visual overview of the research design.

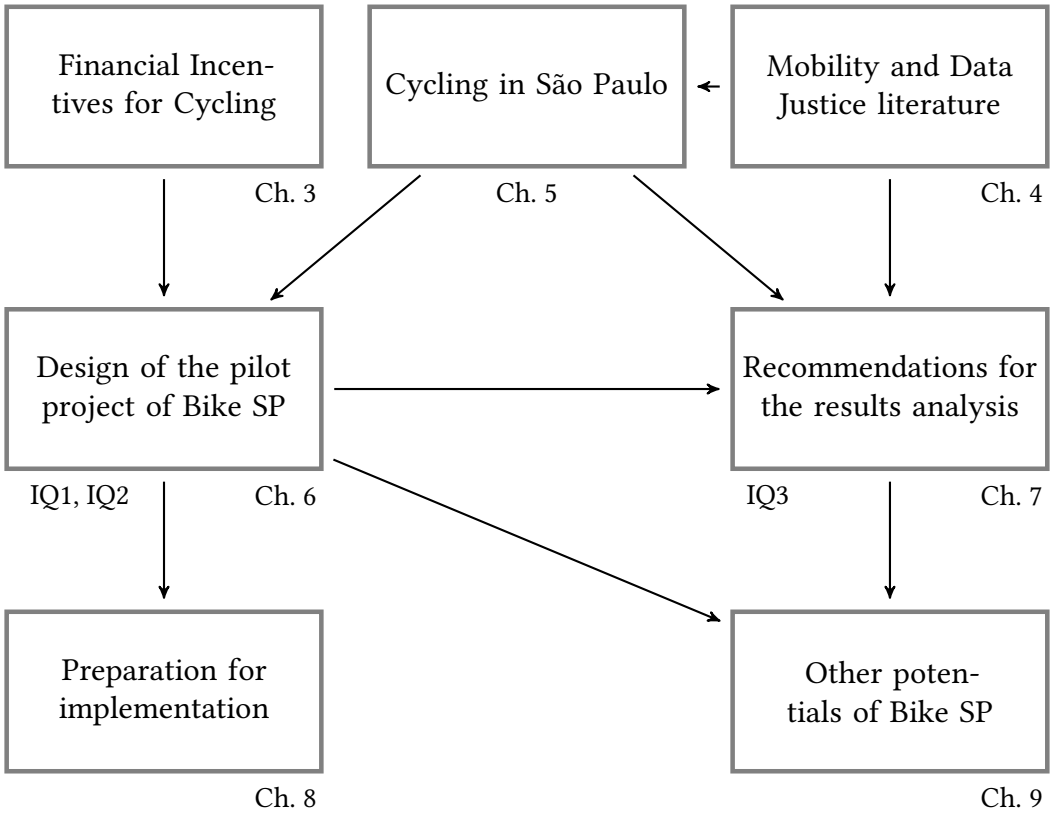

Figure 2.1: *Visual overview of the research design with the corresponding chapters and the implementation questions they address. The arrows represent the interconnections among the components. Own work.*

2.2.1 Research foundation

The development of this research foundation is composed of three components. The first is an investigation on the applications and impacts of financial incentives for cycling, which is summarized in Chapter 3. The second component consists in a narrative literature review on mobility and data justice (Chapter 4), which will inform the final part on the research foundation: a contextual analysis of the past and present conditions of cycling in São Paulo. This analysis is presented in Chapter 5.

2.2.2 Pilot project design

The second stage involves the conceptualization of the pilot project, ensuring it is designed to address IQ1 and IQ2. Our methodology in this stage is inspired by the structure of a pre-analysis plan (PAP). A PAP is a predetermined strategy that outlines how researchers will analyze data before they begin an impact evaluation, with the goal of increasing the credibility of the research results (J-PAL, 2023). The pilot design is delineated in Chapter 6.

2.2.3 Recommendations for the pilot analysis

The third stage, presented in Chapter 7, involves identifying the questions that the analysis of the pilot project should address and providing recommendations for implementation based on the findings. With this purpose, the design developed in the second phase will be analyzed from a social justice perspective and within the context of São Paulo to ensure that IQ3 is addressed.

2.2.4 Preparation for the pilot implementation

The fourth stage consists of preparing for the execution of the pilot project, and it was conducted in parallel with some of the other stages. It includes obtaining the necessary permissions and resources for the pilot project, and involves three components:

1. **Ethical Approval:** The pilot project has to be reviewed and approved by an ethical committee, ensuring compliance with ethical standards and principles of research.
2. **Mobile Application development:** It is necessary to coordinate the development of a mobile application for collecting data during the pilot.
3. **Coordination with the City Hall:** For the pilot project to be carried out, all the stages of the research must be aligned with the São Paulo Municipal Secretariat of Mobility and Transit[1] (SMT).

Chapter 8 details how we addressed each of these elements.

[1] Secretaria Municipal de Mobilidade e Trânsito, in Portuguese.

Chapter 3

Background on Financial Incentives for Cycling

Financial incentives can be defined as monetary or non-monetary rewards that are conditioned on performing a specific behavior or achieving a certain outcome (Keka, n.d.). They can influence behavior by increasing its perceived benefits or reducing its perceived costs. In the literature, personal economic incentives have been demonstrated to be successful in promoting several health-related behaviors, including smoking cessation, weight loss, physical activity, and vaccination (Kane *et al.*, 2004; Mantzari *et al.*, 2015; Vlaev *et al.*, 2019).

In the field of mobility, travel subsidies for commuting to work via private vehicles or public transportation are a widely adopted policy. Recently, some places have also started to offer financial incentives to encourage people to use bicycles as a mode of transportation. To understand the context and effectiveness of such incentives and potentially use this background as a foundation for the development of the Bike SP program, we conducted a literature review of existing policies and studies on this topic. First, this chapter presents a review of these policies worldwide in Section 3.1. Then, it discusses some aspects of the implementation of the policy in São Paulo in Section 3.2.

3.1 Financial incentives for cycling worldwide

In order to identify the existing financial incentives for cycling policies around the world, we conducted a web search, using keywords such as “financial incentives for cycling", “pay people to cycle", and “allowance for cycling", both in English and Portuguese. We found that several countries, mostly in Europe, have implemented different types of financial incentives for cycling, such as tax deductions, subsidies for the purchase of bicycles, or payments per kilometer. In this section, we will provide an overview of some of these policies, separated by country. Subsequently, at the end of the section, we will draw some conclusions about how this analysis informs our research.

3.1.1 Netherlands

The Netherlands is renowned as the most bike-friendly nation in the world, with 27% of all trips made by bike (Government of the Netherlands, 2020). In addition to having a large cycling network, with 35,000 km of cycle paths; compared to 140,000 km of road network (Tennant, 2022), the country is a pioneer in various cycling policies, and has a bicycle-centric decision-making strategy. Since 2006, employers have been encouraged to offer their employees who commute by bike a tax-free mileage allowance of up to €0.19 per kilometre (Elton, 2023). The same allowance was already available to those travelling to work by car in order to cover fuel expenses, and it was extended to cyclists.

3.1.2 Belgium

In Belgium, about 8% of all trips are made by bicycle (The World Geography, 2011). Regarding financial incentives, Belgium offers a similar program to the Netherlands, paying €0.24 per cycled kilometer. Adoption is high; it is estimated that one in five workers at small and medium-sized businesses received a bicycle allowance in the first half of 2022 in Belgium (The Brussels Times with Belga, 2022).

3.1.3 France

The French Ministry of the Environment adopted an ambitious roadmap for sustainable development a few years ago (Boschetti, 2017). As a part of this endeavor, numerous initiatives were conducted to promote a transition towards the utilization of bicycles. One of the measures adopted was the introduction, in 2017, of a kilometer allowance for commuters who choose to travel to work by bike. Individuals who use their personal bicycles are compensated at a rate of €0.25 per kilometer traveled, with a maximum annual reimbursement of €200 (Boschetti, 2017).

Between 2014 and 2015, the government launched a pilot project of the program, involving 18 private businesses employing a total of 10,000 people. In the first six months of the pilot, around 380 employees benefited from this allowance, resulting in a 50% increase in the proportion of employees using cycling as their mode of transportation. This rose to 125% after a year. Following the pilot phase, implementation began in early 2016, and until the middle of 2017, 76 businesses with over 57,000 employees signed up for participation (Boschetti, 2017)

In addition to this policy, the French government offers monetary incentives for the purchase of bicycles. In 2022, the bonuses were raised to a maximum amount of €400 for conventional bicycles and €2000 for electric bicycles. The amount of subsidy provided is subject to variation based on an individual's income level. The overall projected expenditure for the extended plan amounts to €5 million (The Local, 2022).

3.1.4 United Kingdom

In the United Kingdom, there is a scheme called "salary sacrifice" that aims to encourage the purchase of bicycles. This system allows employees to purchase bicycles through their employers and pay for them from their gross salaries, thereby reducing their taxable

income (Department for Transport, United Kingdom, 2019). Furthermore, employers are encouraged to offer a mileage allowance of around £0.20 per mile for employees who use their bicycles for work-related travel (Government of the United Kingdom, n.d.). In 2019, the Department of Transport issued a guidance document for employers to explain the financial incentives available for cycling to work (Department for Transport, United Kingdom, 2019).

3.1.5 Italy

In Italy, the incentives vary depending on the area or province. For example, in Bari, the capital city of southern Italy's Puglia region, cyclists commuting to work receive €0.21 for every kilometer they cycle to work (with a monthly maximum of €25 a month) (Chandler, 2020). Additionally, the Italian government provides mobility vouchers to commuters for the purchase of a new bicycle (Elton, 2023).

3.1.6 Brazil

In September 2021, the city of Itajaí, Brazil, launched a program that offers financial incentives for people who travel by bike, among other forms of sustainable transportation. Itajaí is a city in southeast Brazil with around 220,000 inhabitants, and was the first (and only one we found) city in Latin America to implement a system to award sustainable mobility. The program aims to encourage residents to reduce greenhouse gas emissions by choosing low-carbon modes of transportation, such as public transit, cycling, or walking, and compensates them accordingly (City Hall of Itajaí, 2021).

The program uses a mobile application called "MovItajaí", which is based on a similar Portuguese mobile application named AYR (Transport Decarbonisation Alliance, n.d.). The rewards are given in the form of a local digital currency specifically designed for the program and can be used within the network of registered local businesses and service providers. The users receive one unit of this digital currency, which has an approximate value between R$0.10 and R$0.15, for every 100 grams of greenhouse gas emissions that they avoid. To qualify for the rewards, users have to register their trips on the "MovItajaí" application (City Hall of Itajaí, 2021).

3.1.7 Conclusion

We conducted a review of the policies that offer financial incentives for cycling in different countries and identified a diversity of schemes that provide monetary rewards or benefits for cyclists. However, we also encountered a lack of empirical evidence on the effects of these policies on cycling behavior and outcomes. Most of the information we obtained about these policies consisted of news articles that announced their implementation or anticipated their results, but there was a scarcity of reports that evaluated the actual results, especially for the policies that involve a cycling allowance per kilometer. A possible explanation for this gap is that most of the policies are decentralized and implemented through private companies, while the government plays more of a facilitative role by defining the allowance and offering tax subsidies for the companies. This makes it challenging to isolate the impact of the financial incentives from other factors that may

influence cycling, such as infrastructure or cultural factors. In addition, our review did not identify any intervention that encourages cycling through offering public transport credits, which is the approach of Bike SP. Therefore, we draw the following conclusions:

1. More rigorous and systematic research on the effects of financial incentives for cycling is needed, especially in the context of São Paulo, which has a very different social and environmental setting from the European countries, where the majority of these policies are implemented.

2. A controlled experiment that can isolate the effect of financial incentives from other confounding factors, and measure the changes in cycling behavior, would be advantageous. This could provide valuable insights for policy makers and practitioners in other contexts as well.

3. The potential of partnerships with private entities should be explored, as they appear to be a common feature of many financial incentives for cycling policies that we identified. This could help to increase the scope and appeal of the incentives, as well as to distribute the costs and responsibilities of the policy implementation. We will elaborate on this in Section 9.3.

3.2 Financial incentives for cycling in São Paulo

As mentioned in Chapter 1, the Bike SP policy was approved in São Paulo in 2016, stipulating the provision of financial incentives for cycling in the city. As a motivation for the program, the law project stated that the adoption of bicycles for transportation purposes, as opposed to leisure activities, was low in the city, appointing the Bike SP program as a way to foster a change of habit regarding cycling.

The preceding section indicated that many analogous cycling policies rely on partnerships with private entities to offer financial incentives. In contrast, the Bike SP program stipulates a more direct provision of the incentives by the government. This implies that the policy demands more control and monitoring by the public authorities, as well as more resources and technological infrastructure to implement it.

Centralizing the government as the provider of the incentives has several advantages, such as producing data for public authorities to design cycling policies and increasing the accessibility and equity of the scheme for the population, rather than restricting it for employees of companies that would implement it. These aspects will be explored in more detail in Chapter 9.

However, this format also poses significant challenges for its implementation. The government needs to define the parameters of the policy, such as the eligibility criteria, the payment rates, the verification methods, and the budget allocation. The policy may also need to impose some restrictions or limitations on the public, to control the costs and avoid misuse. These issues were not specified by the Bike SP law.

In this section, we will discuss some aspects of the policy that are relevant for our research: (1) the use of public transportation credits as the form of compensation; (2) a

study of the World Bank that involved Bike SP; and (3) our choice of remunerating people per km in this research.

3.2.1 Incentives in the form of public transportation credits

The law that established Bike SP defined that the payment for cyclists in the program would be made in public transportation credits, through the Bilhete Único system (Municipal legislation, 2016). This section explores some of the possible motivations behind this choice of remuneration format.

First, this decision might be a reflection of the city government's intention to incorporate cycling into the public transportation system. In 2018, a municipal law created SICLO[1], a cycling system for the city of São Paulo, with the aim of regulating and promoting the use of bicycles in the city (Municipal legislation, 2018). The law defined SICLO as part of the integrated system of collective urban transportation, and explicitly included the Bike SP program as one of the components of SICLO. This recognition is part of an effort to promote bicycles as a means of transportation, not only as a recreational instrument, and had already started in 2009, when the responsibility for the cycling agenda was transferred from the Secretariat of Green and Environment[2] (SVMA) to the Secretariat of Mobility and Transit (SMT) (Lemos, 2021, pp. 182–183). Furthermore, by defining SICLO as part of the public transportation system, the law implies that cycling investments, such as the Bike SP program, are considered part of public transportation subsidies. Paying cyclists with public transportation credits in Bike SP reinforces this integration.

Second, this payment method is a way of stimulating the combination of cycling and public transportation and the use of intermodality in the city. In fact, one of the objectives of the law that created Bike SP was to encourage the intermodal use of bicycles (Municipal legislation, 2016). By rewarding cyclists with credits that can be used for other modes of transportation, such as buses, trains, and subways, the policy incentivizes users to combine different modes. On the other hand, by using cycling and public transport together, users can benefit from the advantages of both modes and overcome their limitations, such as the limited spatial coverage of public transport (see Section 5.2.2) and the difficulty of cycling in hilly or unsafe areas. This can reduce the dependence on private cars in the city.

Third, this payment method is a way of avoiding the displacement of people from public transportation. Public transportation is subsidized by the government, and sometimes cycling is perceived as a competitor to public transportation. By paying cyclists with public transportation credits, the policy prevents the potential loss of revenue for the public transportation system. This can also be part of a strategy to increase access to public transportation for a larger share of the population by subsidizing trips for those who cycle.

Therefore, we argue that the adoption of public transportation credits as the payment method for the Bike SP program is suitable within the São Paulo context.

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[1] Sistema Cicloviário do Município de São Paulo, in Portuguese.

[2] Secretaria do Verde e Meio Ambiente, in Portuguese.

3.2.2 World Bank study involving Bike SP

Due to the challenges in assessing the impact of Bike SP as a public policy, the City Hall of São Paulo requested the World Bank to include the program as a variable in a recent study that aimed to support bicycle planning in São Paulo (World Bank, 2022). This study is the only one that we are aware of that investigates the Bike SP program. This section will review this study, its main findings, and its relation to our research.

The World Bank conducted a field survey in various regions of São Paulo and used it to analyze the effectiveness of several cycling policies (World Bank, 2022, pp. 60–67). The survey presented respondents with scenarios where they had to choose among three alternatives: their current mode of transportation, a personal bicycle, or a shared bicycle. The scenarios varied in several attributes, such as travel time, travel cost, availability of cycling infrastructure, and remuneration for cycling. The survey also collected socio-demographic and travel behavior data from the respondents.

The World Bank then applied multinomial logit models (MNL) to examine how the attributes influenced the mode choice of the respondents. MNL models are a type of discrete choice model that estimates the probability of choosing a particular option from a set of mutually exclusive alternatives, based on a linear combination of the observed features and some problem-specific parameters (Chen *et al.*, 2016; UCLA, n.d.). They enable the calculation of the marginal effects and elasticities of each attribute on each alternative, as well as of the odds ratios that compare the relative probabilities of choosing different alternatives (University of Virginia, 2020). MNL models are suitable for this context because they allow the modeling of nominal outcomes with more than two categories, such as mode choice.

The results of the World Bank study showed that the Bike SP attribute had a positive and significant effect on the choice of both bike sharing and personal bikes. They also indicated that the respondents were more likely to choose these modes when they received a higher remuneration in their scenario. In the survey, a trip with remuneration up to R$2,00 increased the probability of choosing a bicycle over the current mode by 8.7%. On the other hand, remuneration between R$2,00 and R$3,00 increased the probability by 38.4%. In comparison, the effect of the presence of bicycle lanes was 43.4%. Moreover, the study also suggested that the mode choice was influenced by the socio-economic and demographic profiles of the participants. Women exhibited a 16.4% lower probability of opting for bicycles than men, and individuals belonging to lower socioeconomic classes (C2, D, or E)[3] demonstrated a 67.2% higher probability of selecting bikes than those from higher classes (World Bank, 2022, pp. 65–66).

However, the study has some limitations that prevent us from drawing definitive conclusions about the Bike SP program. First, the survey was done with several other policies simultaneously, with scenarios that included several other variables changing along with the Bike SP, making it difficult to isolate the effect of the remuneration. This is possible from the mathematical point of view, through MNLs, but it is unclear how the combination of the variations in more than one variable affected the choice of the

[3] This class hierarchy follows the “Critério Brasil". More details about this classification can be found in Section 5.2.3.

respondents. Second, the study was based on hypothetical scenarios, so it depends a lot on the subjective perception of the respondents, which may not reflect their actual behavior in real situations.

Furthermore, despite the positive findings, this study provides limited guidance on how to operationalize the policy in practice. To address this gap and to support the regulation of the law, we are conducting a follow-up research that involves the implementation of a pilot project, as explained in Chapter 1. The aim of our research is to generate more robust evidence on the impacts of the Bike SP program and to offer practical recommendations on how to design and regulate the policy effectively.

3.2.3 Incentives based on distance traveled

The law does not prescribe a specific mechanism for determining the remuneration for each cyclist, but rather allows for flexibility in adjusting the remuneration according to the characteristics of the participants and the mode of transportation they are substituting. Furthermore, it establishes that the credits could be contingent on a minimum distance requirement and could be subject to a maximum limit per trip.

In this context, the design of the remuneration scheme involves various alternatives, such as establishing a fixed amount per trip or a variable rate depending on the mode of transportation replaced by cycling. However, in our research, we opted for considering a remuneration scheme based on the distance traveled, with a fixed amount per km. This scheme will be constrained by some factors and variations, which will be elaborated in Chapter 6.

The rationale for this decision is as follows:

1. This scheme is consistent with other cycling initiatives, as reviewed in Section 3.1. For example, the initiative in Itajaí (the only one found in Latin America) also remunerates per kilometer. Similarly, the World Bank study on Bike SP also assumed a remuneration based on the distance, with the scenarios considering either a remuneration of R$0.30 or R$0.40 per km. This information was obtained through an interview with the developers involved in the study.
2. This scheme rewards the participants for the distance they saved by using cycling instead of other modes of transportation. This facilitates an analysis of the impacts on air pollution, traffic, and health. Moreover, it incentivizes the participants to travel longer distances and thus spend more time cycling.

Additionally, we do not differentiate the remuneration according to the profiles of the participants for the pilot project. One of our objectives during the pilot, as stated by IQ2, is to understand the variation of the remuneration impact according to the profile. To achieve this, we fixed the remuneration for a certain period for a group with a diverse sample to allow for the measurement of the difference in the impact for different profiles. This can inform future variations in the policy implementation according to the participant profile. Further details on this design will be provided in Chapter 6.

Chapter 4

Literature review on Mobility and Data Justice

Sustainable mobility policies can inadvertently lead to social disparities. Measures such as imposing taxes or restrictions on polluting vehicles and providing subsidies for green transportation modes may disproportionately burden lower income groups, while advantaging middle and upper classes (Vanoutrive and Cooper, 2020, p. 113). In light of this, a more comprehensive approach to policy development is needed, that considers the complex interplay between sustainable mobility initiatives and social justice. To achieve social sustainability in transportation, it is not enough to promote environmentally friendly modes of transport, but also to challenge and transform the dominant paradigms of mobility in society (Jeekel, 2017, p. 4303).

Furthermore, for cycling initiatives to be converted for all of society in an equitable way, it is necessary to situate bike usage within a broader justice framework (Golub *et al.*, 2016, p. 2). With this purpose, this chapter reviews literature on social justice, with a focus on cycling and elements closely related to the Bike SP policy. Two main concepts emerge as relevant: Mobility Justice (Section 4.1) and Data Justice (Section 4.2). In the intersection of these two concepts lies the framework of Mobility Data Justice (Behrendt and Sheller, 2023), which will be explored in Section 4.3. Table 4.1 shows an overview of the papers used in this literature review.

4.1 Mobility Justice

The research area that investigates the intersection of justice and transportation has two main branches: Transportation Justice and Mobility Justice. These branches have become more connected in recent years (Verlinghieri and Schwanen, 2020). In this section, we first examine literature on transportation justice. Then, we broaden our scope to the concept of mobility justice (Sheller, 2018), which will be adopted for the rest of this work.

Reference	Title	Focus
(Bek, 2022)	No Bicycle, No Bus, No Job: The Making of Workers	Mobility Justice
(Jeekel, 2017)	Social Sustainability and Smart Mobility: Exploring the Relationship	Mobility Justice
(Karner *et al.*, 2020)	From Transportation Equity to Transportation Justice: Within, Through, and Beyond the State	Mobility Justice
(Martens, 2006)	Basing Transport Planning on Principles of Social Justice	Mobility Justice
(Oldenziel and Albert de la Bruheze, 2011)	Contested Spaces: Bicycle Lanes in Urban Europe, 1900-1995	Mobility Justice
(Golub *et al.*, 2016)	Creating an Inclusionary Bicycle Justice Movement - Introduction	Mobility Justice
(Sheller, 2018)	Mobility Justice	Mobility Justice
(Vanoutrive and Cooper, 2020)	How Just is Transport Justice: The Issues of Paternalism and Production	Mobility Justice
(Verlinghieri and Schwanen, 2020)	Transport and mobility justice: Evolving discussions	Mobility Justice
(Dencik and Sanchez-Monedero, 2022)	Data justice	Data justice
(Nikolaeva *et al.*, 2019)	Smart Cycling Futures: Charting a New terrain and Moving towards a Research Agenda.	Data justice
(Taylor, 2017)	What Is Data Justice? The Case for Connecting Digital Rights and Freedoms Globally	Data justice
(Behrendt and Sheller, 2023)	Mobility data justice	Mobility Data Justice
(Williams, 2023)	Datafication of Cycling: tensions between cycling policy and mobility justice	Mobility Data Justice

Table 4.1: *Summary of references used from the Mobility and Data Justice literature.*

4.1.1 Transportation Justice

In the literature, transportation planning often adopts two distinct framings: transportation equity and transportation justice (Karner *et al.*, 2020, p. 3). Transportation equity

focuses on quantitative analyses that show how the benefits and burdens of transportation policies and projects are distributed, while transportation justice goes beyond that and considers the underlying structures and processes that produce and reproduce inequalities in transportation (Karner *et al.*, 2020, pp. 3–5). Moreover, transportation justice recognizes its target populations not just as users categorized by their mode of transportation, but as groups marked by their historical marginalization based on factors such as race or socioeconomic status (Golub *et al.*, 2016, p. 8). In this perspective, justice is not only about allocating public resources across demographic groups in a non-discriminatory manner, but also about ensuring adequate levels of accessibility for all individuals under most circumstances (Vanoutrive and Cooper, 2020, p. 117).

Current transportation policies, which are mainly conducted by state actors, tend to adopt a transportation equity perspective, focusing on technical fixes and ways to achieve quantitative "equity" by incorporating new metrics and indicators that better capture equity or distributional issues (Karner *et al.*, 2020, p. 6). This "reformist" approach, however, often results in minor changes, without addressing the power relations and well-being of disadvantaged populations (Karner *et al.*, 2020, p. 3). Furthermore, traditional transportation planning strategies are largely driven by projections of future increases in transportation demand among population groups that are already highly mobile (Vanoutrive and Cooper, 2020, p. 113). In contrast, a transformational approach towards transportation justice emphasizes a community-based approach and prioritizes the needs of historically marginalized groups (Karner *et al.*, 2020, pp. 3–6). In the context of cycling, this representation and empowerment are essential for an emancipatory bicycle justice movement (Golub *et al.*, 2016, p. 9).

One of the challenges that transportation justice theory faces is how to avoid paternalism, which occurs when an institution assumes that it knows better than the individuals what is in their best interest, and thus imposes its decisions on them without their consent or participation (Vanoutrive and Cooper, 2020, p. 114). Another challenge is how to account for the production aspect of society, which recognizes that nothing can be created by a single individual, but rather by a system of cooperative labor (Vanoutrive and Cooper, 2020, p. 114–115).

Additionally, the transportation justice literature criticizes the use of cost-benefit analysis and performance-based planning, and suggests need-based modeling as a substitute (Martens, 2006; Vanoutrive and Cooper, 2020). It is argued that performance-based planning can provide false certainty especially when it comes to novel metrics (Karner *et al.*, 2020, p. 9). Also, while the definition of a priori standards of what is considered inequity is considered best practice in transportation planning, it is not ideal to adopt a transportation justice approach (Karner *et al.*, 2020, p. 10).

To address these issues, some scholars have proposed a society-centric approach to transportation planning, which emphasizes the engagement of the community in the decision-making process (Karner *et al.*, 2020, pp. 7–9). This approach can take various forms, such as participatory budgeting, where citizens have a say in how a portion of the public budget is allocated for transportation projects (Karner *et al.*, 2020, p. 12–13), or community-led analysis, where community leaders collaborate with planners and academics in collecting and analyzing data and designing the outcomes (Karner *et al.*,

2020, p. 13).

Therefore, the leadership role of the community in bicycle development is crucial, rather than merely being a participant in initiatives introduced by external entities (Golub *et al.*, 2016, p. 15). However, since the state plays a significant role in transportation planning and financing, the adoption of hybrid approaches that combine state and society-centric elements seems to be the most promising way forward (Karner *et al.*, 2020, pp. 18–19).

4.1.2 Mobility Justice

The book "Mobility Justice: The Politics of Movement in an Age of Extremes" (Sheller, 2018) argues for the adoption of a mobility justice perspective, which encompasses not only the transportation issues of people, but also the movement of goods, resources, and information across different spatial scales (Verlinghieri and Schwanen, 2020). This concept implies that mobility is a complex and multifaceted phenomenon that requires a holistic approach to understand and address its challenges.

One of these challenges is the promotion of urban bicycle use, which is often reduced to the construction of bicycle lanes without considering the broader cycling culture (Oldenziel and Albert de la Bruheze, 2011, p. 30). However, to achieve a significant increase in the mode share of cycling and reach the "critical mass", the building of cycle paths should be accompanied by other policies such as the provision of bike parking facilities, the limitation of vehicle speed, and the involvement of various social groups (Oldenziel and Albert de la Bruheze, 2011, pp. 30-42). Otherwise, the segregated bike lanes may remain underutilized due to the lack of a comprehensive understanding of the historical and current context of cycling (Oldenziel and Albert de la Bruheze, 2011, p. 42).

Another challenge is the individualization of the daily commute, which has been prevalent since the 1970s and places the responsibility of mobility on the workers, regardless of their proximity to their jobs or their access to mobility options (Bek, 2022, p. 172). This individualistic discourse contrasts with the current reality of mobility, where the upper and middle classes tend to be highly mobile, while the lower classes often face the scarcity or high costs of transportation, and have to endure longer travel times (Bek, 2022, p. 10). For this reason, Bek (2022) advocates for a broader view of mobility, as something that is connected to other aspects of the individual's life and that concerns the collective.

Furthermore, a mobility justice perspective on cycling initiatives also raises the issue of how bicycle investments are linked to urban renewal processes that lead to gentrification (Golub *et al.*, 2016, pp. 3–4). A study in U.S. inner cities revealed that the increase of cycling culture in the researched areas was structurally associated with the removal of low-income residents (Golub *et al.*, 2016, p. 4). Furthermore, urban data collection often favors central areas over peripheral ones, thus biasing investments toward commuters who are already privileged (Golub *et al.*, 2016, p. 5).

Thus, a bicycle justice practice that is inclusive and socially fair should address the current unequal distribution of bicycle investments (Golub *et al.*, 2016, p. 3). In developing bicycle policies, we need to reflect on the extent to which they expand or restrict the scope

of individuals who benefit from prior investments, with regards to factors such as race, socioeconomic status, gender, and nationality (Golub *et al.*, 2016, p. 7).

4.2 Data Justice

The concept of data justice emerges at the intersection of datafication and societal equity, questioning how data generation, collection, and utilization affect different groups and individuals in society (Dencik and Sanchez-Monedero, 2022). This critical perspective is motivated by the growing availability and influence of data in the decision-making process, and the potential risks of data-driven discrimination (Taylor, 2017). Based on a literature review, this section identifies and discusses some of the key concerns of data justice. They are:

1. **How to ensure fair representation of diverse groups in data?** An essential aspect of data justice is the visibility and representation of different segments of the population in the data. Data-driven decisions may be influenced by the assumptions and norms embedded in the data collection and analysis processes, which may favor the dominant groups as the "normal" and penalize those who deviate from it (Taylor, 2017, p. 5). Therefore, a data justice policy should not assume an average person, but rather consider how to address the needs and interests of marginalized and vulnerable groups (Taylor, 2017, p. 10).

2. **How to account for the collective dimensions of data?** Data justice recognizes that data injustice not only occur at an individual level but also increasingly at a collective level (Taylor, 2017, p. 4). In fact, emerging data technologies often operate on the basis of group attributes rather than individual ones (Taylor, 2017, p. 8). Socioeconomic status, gender, ethnicity and place of origin are some of the variables that impact how the data is used by policymakers (Taylor, 2017, p. 2). Furthermore, the intersectionality of these factors can amplify the issues of exclusion or discrimination for some parts of the population. The risk of facing exclusion multiplies with the number of relevant categories that one belongs to (Taylor, 2017, p. 3). Thus, a data justice approach should look beyond the individual level by, for example, incorporating the family context when analyzing an individual (Taylor, 2017, p. 8).

3. **How to adapt data justice to different contexts and cultures?** Data justice is a context-dependent concept. Different regions and countries may have different definitions and expectations of what is just (Taylor, 2017, p. 13). Therefore, a data justice definition should be adaptable to the different needs and expectations of various local contexts, avoiding imposing a universal or standardized framework.

4. **How to distinguish between voluntary and involuntary data collection?** In contemporary datafication, there is no clear separation between when the individual is aware that his data is being collected or not (Taylor, 2017, p. 3). In this context, a challenge is the conflict between the right of an individual to have privacy over their own data and the argument that the state, based on principles of the social contract, should have a claim over people's data to use it for the benefit of the collective (Taylor, 2017, pp. 7-10). This also raises the question of who can be seen in these data collection processes. (Taylor, 2017, p. 3).

5. **How to ensure the continuous improvement of data-driven programs?** Finally, when using large-scale models to inform policies, it becomes convenient to just continue using the same system that is already in use and working, without testing for its accuracy over time or recalibrating it (Taylor, 2017, p. 6). Data justice requires that data-driven programs are constantly evaluated and updated based on feedback from stakeholders, in order to retain their principles of fairness and justice.

Data justice, therefore, requires a discerning and ethical approach to the datafication of cycling. Currently, cycling remains a largely unmonitored form of transportation. There is a lack of systematic data gathering for privately owned bicycles, and no means to trace individual trips as can be done with driving, public transit, or air travel (Nikolaeva *et al.*, 2019, p. 8). However, smart cycling innovations can change this situation. Indeed, some cycling applications are already positioning data collection as a supplementary feature that can provide policymakers with information on cyclists and their journeys. While cyclists use the application for their primary function, data collection occurs subtly in the background (Nikolaeva *et al.*, 2019, p. 8).

In the context of data justice, although these innovations may contribute to the advancement and promotion of cycling, they also present challenges regarding the way to balance the benefits of datafication with the potential risks of privacy invasion, surveillance, and discrimination. For example, the social justice implications of using Strava Metro cycling data[1] in transport planning have recently been highlighted by Williams, 2023.

4.3 Mobility Data Justice

In a recent work, Behrendt and Sheller developed a comprehensive framework for mobility data justice, which aims to inform the intersection of data and mobility from a social justice perspective (Behrendt and Sheller, 2023). The framework consists of three dimensions of mobility data justice: distributive, procedural, and epistemic.

Distributive: The distributive element focuses on the distribution of benefits and burdens related to mobility and data. It questions who has access to mobility services and data resources, who benefits from them, and who bears the costs or risks. It also considers how these distributions reflect and reinforce social inequalities (Behrendt and Sheller, 2023, pp. 12–13).

Procedural: The procedural element concerns the processes and mechanisms of decision-making in mobility and data practices. It examines who has the power to make decisions, who is included or excluded from these processes, and how these decisions are made. It also assesses the transparency and fairness of these methods and the role of data and algorithms in them (Behrendt and Sheller, 2023, p. 13).

Epistemic: The epistemic element deals with the production of knowledge in mobility and data practices. It explores who has the right to produce knowledge, whose knowledge is recognized or dismissed, and how this knowledge is used. It also investigates the epistemic biases, assumptions, and exclusions in mobility and data practices (Behrendt and Sheller,

[1] https://metro.strava.com/

2023, p. 13).

Figure 4.1 summarizes the components of the framework. These three elements, together with the literature in Mobility and Data Justice, will guide our social justice analysis of the pilot project and inform the design of the pilot to answer the third implementation question (IQ3).

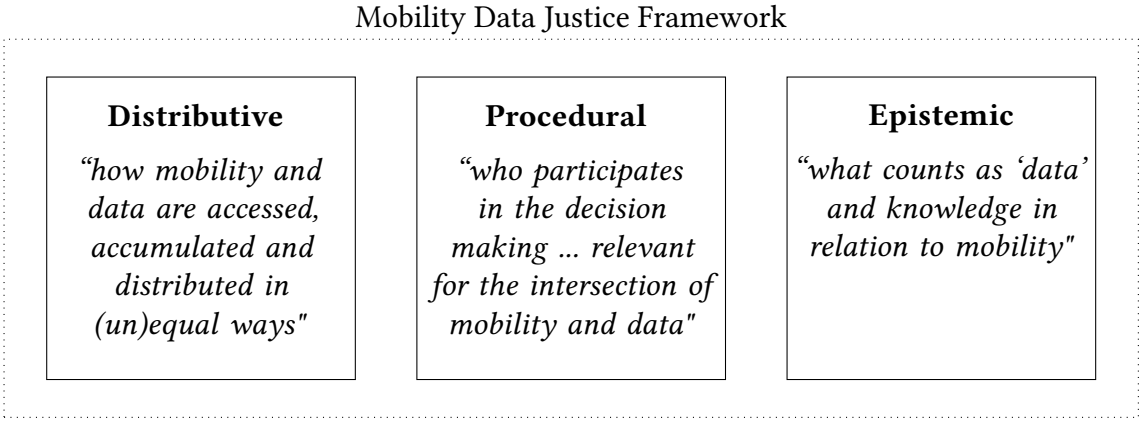


Figure 4.1: *Visual overview of the Mobility Data Justice developed by Behrendt and Sheller. Definitions are quoted from Behrendt and Sheller (2023, pp. 12–13).*

4.4 Conclusion

The literature on mobility data justice, as reviewed in this chapter, has revealed that a just cycling policy design requires a broader perspective on urban mobility. It is essential to examine how various factors, such as gender, age, and social class, influence the travel patterns of the population, particularly their bicycle trips. Moreover, a spatial analysis is needed to detect potential issues of bicycle gentrification in the city. These analyses are conducted in Chapter 5.

Finally, the literature, combined with the pilot's design presented in Chapter 6, can provide some insights and recommendations for the future implementation and evaluation of the pilot project. These recommendations will be discussed in Chapter 7.

Chapter 5

Analysis of cycling in São Paulo

In order to design a pilot project that is aligned with the needs of the city, it is essential to understand the setting in which the Bike SP program will be implemented. After discussing financial incentives and social justice as the first two foundational elements of this research, we now proceed to the third and final element. This chapter presents an analysis of the historical and current situation of cycling in São Paulo, which will reveal the existing challenges and opportunities for encouraging cycling as a sustainable and inclusive mode of transportation in the city.

To enrich the analysis, we will also draw some comparisons with the Netherlands, which is widely recognized as a benchmark in cycling culture and infrastructure (CPI, n.d.). It should be noted that the comparison is only to provide a reference point of a bicycle-friendly context, and not to imply that the two places are comparable in terms of population, area, or landscape.

Section 5.1 presents the data and the methodology used, followed by the analysis in Section 5.2.

5.1 Data sources and methods

In our study, we used two distinct datasets. The “Origin and Destination Survey" was the primary source of data for São Paulo, and the “Research on Travel in the Netherlands" provided the dataset for examining the Dutch context. Unless otherwise specified, all the analysis and data in this chapter are based on these two databases and are our own work.

5.1.1 São Paulo Origin and Destination Survey

The São Paulo Origin and Destination Survey (OD)[1] is the greatest urban mobility survey in Brazil, and investigates the travel pattern in the São Paulo Metropolitan Area (SPMA). The survey is conducted every 10 years since 1967 by the São Paulo Metropolitan

[1] *Pesquisa Origem e Destino*, in its original name in Portuguese.

Company (Metrô)[2] and its last complete version was made in 2017 (Metrô São Paulo, 2023). The survey collects data on the modes of transportation, origins, and destinations of the trips, as well as the socioeconomic and demographic characteristics of the travelers and the purpose of the trips.

The 2017 edition involved more than 150 thousand people in the 39 municipalities that comprise the São Paulo Metropolitan Region. The data collection consists of interviews carried out in households, highways, airports, and bus terminals. The sample was designed using statistical techniques to obtain a reliable estimate of all the trips made in the region (Metrô São Paulo, 2019, p. 13). To extrapolate the results to the entire population, the survey provides expansion factors for the trips and individuals interviewed. Table 5.1 shows the database column and the expansion factor considered for each variable examined in this study.

The databases of the surveys conducted from 1977 to 2017 can be found in the Transparency Portal of the Metrô company[3]. The analyses for São Paulo presented in this work were made using these data.

Variable	Column considered	Expansion factor
Mode share	TIPVG	Trip
Age	IDADE	Person
Social Class	CRITERIOBR	Person
Bike ownership	QT_BICICLE	Person

Table 5.1: *The database columns and the corresponding expansion factors utilized in this study for each variable in the analysis of the OD 2017.*

In addition, the OD survey delineates “Origin and Destination Zones" (OD zones). These zones are determined prior to the data collection and characterize areas with comparable urban conditions in terms of infrastructure, population, and environment (Metrô São Paulo, 2019, p. 33). Our spatial analysis in Section 5.2.2 uses these zones as a reference for dividing the city.

5.1.2 Research on Travel in the Netherlands

The Research on Travel in the Netherlands (OViN) is a survey that investigates the travel behavior of the Dutch population. It was initiated in 2010 and carried out annually until 2017. The data collection method involves either an online questionnaire, a telephone interview, or a face-to-face interview at the respondent’s residence. The 2017 edition of the OViN survey had a sample size of 37,016 respondents (Centraal Bureau voor de Statistiek, 2017). Similarly to the OD survey, OViN also provides expansion factors for the trips and individuals interviewed.

In 2018, the OViN survey was replaced by the Dutch National Travel survey (ODiN), which introduced some changes in the data collection methodology (Centraal Bureau

[2] https://www.metro.sp.gov.br/

[3] https://transparencia.metrosp.com.br/dataset/pesquisa-origem-e-destino.

VOOR DE STATISTIEK, 2023). The latest available data from the ODiN survey is from 2022. However, for the purpose of this study, we opted to use the OViN survey data from 2017, as it corresponds to the same year of the most recent data from São Paulo (OD 2017).

The data source for the OViN 2017 survey was obtained from the Statistics Netherlands institution (CBS), and it's accessible through the DANS (Data Archiving and Networked Services) website[4].

5.1.3 Technologies

The data analysis conducted in this chapter was performed using the Python programming language. To isolate functionalities and facilitate their reuse, the code was modularized and structured into classes according to the principles of object-oriented programming.

Inside the Python domain, we employed some well-known libraries for data science, including Pandas[5] for data manipulation, Seaborn[6] and Matplotlib[7] for data visualization, Numpy[8] for array-processing, and Geopandas[9] for geoprocessing. Additionally, we applied some modules of the BikeScience tool to generate the maps for the spatial analysis presented in Section 5.2.2. BikeScience is an open-source tool to analyze cycling mobility, developed within the InterSCity project. The modules we used from this tool rely on the Folium[10] library for map plotting.

The data analysis was executed using Jupyter notebooks, structures that facilitate interactive data analysis and allow for the combination of computer code with text elements. Also, Python scripts were developed to invoke the data treatment modules.

The GitHub platform was used for code versioning during the entire development process. The repository for this project can be found at https://github.com/anayflima/bikesp-analysis[11]. Finally, the TikZ package[12] was used to generate the graphic elements of this chapter in LaTeX.

5.2 Cycling in São Paulo

According to an estimation from the OD 2017 survey, 42 million trips were made daily within the São Paulo Metropolitan Area in 2017. Out of these, approximately 23.9 million trips occurred within the city of São Paulo (i.e., both the origin and destination of the trip

[4] https://ssh.datastations.nl/dataset.xhtml?persistentId=doi:10.17026/dans-xxt-9d28

[5] https://pandas.pydata.org

[6] https://seaborn.pydata.org

[7] https://matplotlib.org

[8] https://numpy.org

[9] https://geopandas.org

[10] https://python-visualization.github.io/folium

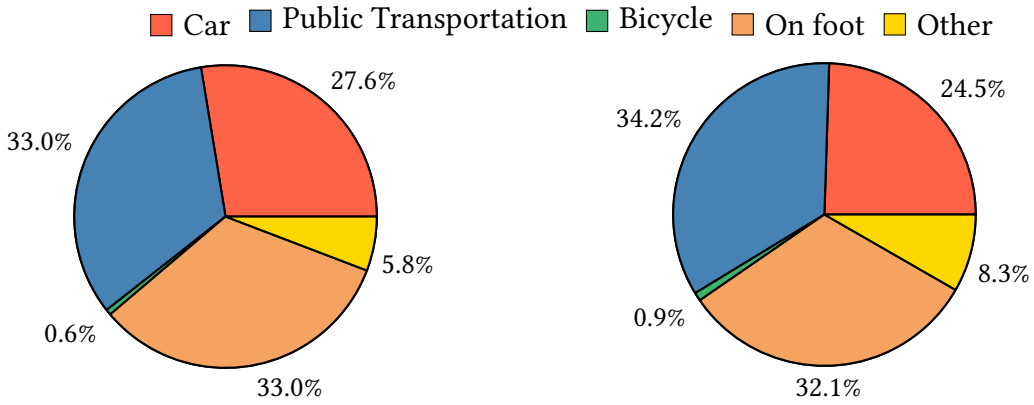
[11] This repository also includes the code used for Section 6.4.

[12] https://ctan.org/pkg/tikz-page

were in the city). This study focuses on the intra-city trips, as they are the main target of the Bike SP program.

Figure 5.1 shows the mode share of trips within the city of São Paulo for the years 2007 and 2017. Public buses, trains, and subways are grouped under the public transportation class, while private cars are in the car group. Bicycle and on foot trips each have their own segment. The remaining modes, such as taxis, motorcycles, chartered buses, school transport, etc., are classified under the 'Other' category.

The comparison between 2007 and 2017 does not show a significant change in the modal distribution. It is interesting to notice that the categories of public transportation, car, and on foot have similar percentages, i.e., are quite balanced between each other. On the other hand, cycling accounted for only 0.9% of all trips in São Paulo in 2017. Although there was an increase compared to 2007, when this number was 0.6%, this figure indicates the still low use of bikes as a mode of transportation in the city, and it is far below the potential demand for cycling estimated at 17% by a recent study (Freire *et al.*, 2023). This study introduced a novel Cycling Potential Index (CPI) that evaluates the cyclability of trips based on the distance and slope level of the route, applying their index to the trips collected by the OD 2017 survey to estimate the proportion of trips in São Paulo that have a high cycling potential.



(a) *2007* **(b)** *2017*

Figure 5.1: *Modal distribution of the trips made in the city of São Paulo in 2007 and 2017, based on data from the Origin and Destination Survey. Own work.*

Next, we will examine cycling in São Paulo from five main perspectives: (1) history, (2) cycling infrastructure, (3) cyclist profiles, (4) bike ownership, and (5) multimodality.

5.2.1 History

Cycling policies and practices in São Paulo have evolved through a multifaceted interplay of governmental policies, private sector initiatives, activism, and societal transformations. This section provides a historical and political overview of this process, highlighting the role of each actor, the main challenges and opportunities they faced, and the implications for urban mobility and sustainability in the city. The section draws mainly on the

work of Lemos (2021), supplemented by the contributions of Malatesta (2014) and the São Paulo Cycling Federation[13] (Federação Paulista de Ciclismo, 2020).

Based on the work of Lemos, we will divide the history of cycling in São Paulo into four main periods: (1) the emergence of cycling as a counter-hegemonic agenda until the 1980s; (2) the institutionalization of cycling within the state apparatus in the 1990s; (3) the resurgence of cycling activism and the environmentalist agenda in the 2000s; and (4) the expansion of cycling infrastructure and services in the 2010s. Each phase reflects the changing dynamics and interactions among different actors, as well as the shifting political and social contexts that influenced the cycling policies and practices in the city. Figure 5.2 shows the mode share from 1977 to 2017, based on the OD data[14].

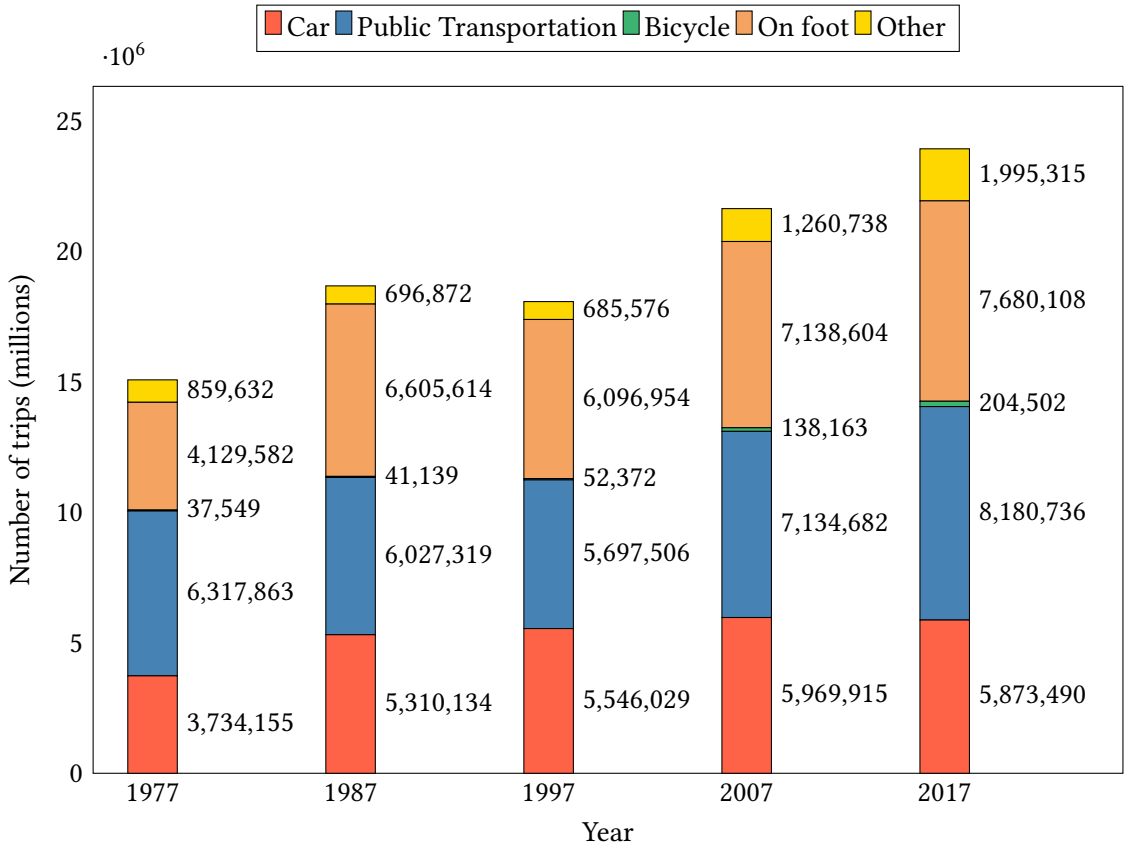


Figure 5.2: *Mode share of transportation in the city of São Paulo through the years. Own work based on the databases from OD 1977 until OD 2017.*

The first period began with the introduction of bicycles in the last decade of the 19th century (Federação Paulista de Ciclismo, 2020). Unlike Europe, where bicycles were already a common mode of transportation before the advent of cars, Brazil experienced the arrival of both modes of transport around the same time. Moreover, this period was marked by rapid urban growth, driven by the widespread adoption of the automobile. This distinctive circumstance, coupled with a strong influence from car-centric policies in the United States, shaped the urban development and transport planning of São Paulo,

[13] Federação Paulista de Ciclismo, in its original name in Portuguese.

[14] The OD survey started at 1967, but the first version did not collect information about bicycles (Lemos, 2021)

favoring private cars over public transport and non-motorized modes. The attempts to build cycling infrastructure were thwarted for being perceived as an obstacle to the optimal speed of automobile traffic (Lemos, 2021, p. 21). In the 1970s and 1980s, pressure from the global context of the Oil Crisis and the 1972 United Nations Conference on the Human Environment in Stockholm resulted in the formulation of the first cycling plans for the city and the construction of the first cycle path. Furthermore, Brazil was experiencing a re-democratization process after two decades of military dictatorship, resulting in the increase of the participation of civil society in the decision process (Almeida, 2014). In this scenario, some cycling enthusiasts started to challenge the dominant regime of automobility and demand more space and recognition for bicycles in the city. However, as Lemos states (Lemos, 2021, pp. 33–55), both public authorities and cycling activists prioritized the promotion of cycling as a recreational or sportive practice rather than as a transportation alternative.

The second period was characterized by the incorporation of cycling into the state structure, as a result of increased awareness of the environmentalist agenda in Brazil, fostered by the 1992 UN Conference on Environment and Development in Rio de Janeiro, Brazil (RIO-92) (Lemos, 2021, pp. 59–60). In 1994, a working group named Cyclist Project was created within the Secretariat of Green and Environment. This group, composed of public officials and activists, devised and executed cycling policies in São Paulo, such as the development of a cycling network, the provision of bike racks, and the encouragement of cycling education and culture (Malatesta, 2014, p. 27). These efforts were still limited and fragmented, facing opposition from other segments of the government and society, but according to Lemos (Lemos, 2021, pp. 88–89), they were crucial for paving the way for the progress of the cycling agenda in the subsequent period.

The third period witnessed a revival and consolidation of cycling activism and a new wave of environmentalism in São Paulo. In the early 2000s, inspired by the global movement of Critical Mass, a group of cyclists started to organize monthly bike rides, the so-called "Bicicletadas", to reclaim the streets for bicycles and other forms of sustainable mobility (Lemos, 2021, pp. 94–101). They also engaged in creative actions such as installing bike racks and signs without official permission, painting bike icons on the asphalt, and distributing flyers to drivers with messages about cycling benefits and rights. The internet and social media facilitated communication with other cyclists and citizens, as well as the organization and documentation of the activities (Lemos, 2021, pp. 102–116). Nevertheless, despite the empowerment of the cycling agenda inside the state and in civil society and the approval of cycling policies in the legislation, they were not implemented during this period (Lemos, 2021, p. 132).

The fourth period was marked by a substantial expansion of cycling infrastructure and services in São Paulo. In the 2010s, both the state and private companies started to incorporate bicycles as an element of propaganda, supporting bike-sharing systems and operational leisure bike lanes (Lemos, 2021, pp. 139–177). From 2013, a shift in societal and governmental attitudes towards cycling is evidenced by the administration of Mayor Fernando Haddad, which invested heavily in the construction of bike paths. Unlike previous policies that focused on building bike paths in parks and leisure areas, Haddad's administration implemented a policy of removing car parking spaces on the streets, along with the implementation of programs to reduce car speeds on marginal roads (Lemos,

2021, pp. 221–263). This not only physically transformed the urban landscape but also symbolically challenged the dominance of automobiles in urban mobility. However, this investment in cycling policy was associated with Haddad's political party, and encountered opposition and criticism from car drivers, business owners, and media outlets (Lemos, 2021, pp.248-263, 276–284). When the administration changed to a mayor from another party (João Doria), he began to reverse measures that had been implemented, based on values of freedom, speed, and power associated with cars (Lemos, 2021, pp. 316–357). Despite these setbacks, the succeeding mayor, from the same political party as Doria, maintained efforts made by Haddad, approving a cycling plan and further expanding the cycle path network. Sequentially, the 2020 elections also demonstrated a change in the context of cycling policy: all the main candidates for mayor included cycling in their plans (Lemos, 2021, pp. 386–387). This indicates that cycling has become a mainstream issue in urban politics, transcending party lines and individual administrations.

The history of cycling in São Paulo shows that cycling is not only a mode of transport, but also a political and social practice that involves multiple actors, interests, and conflicts, and it is affected by the broader historical and political context of the city and the country. Cycling policies and practices have an impact on the distribution of space, resources, and power among different transport modes and users. Moreover, these policies also reflect and challenge the dominant regime of automobility, which has been hegemonic in São Paulo for decades, but has been contested and transformed by various forms of resistance and innovation. As Lemos states, bicycles have transitioned from being a niche mode of transport in São Paulo to becoming an integral part of urban mobility (Lemos, 2021, p. 398), signaling a potential paradigm shift in how we conceive and organize urban spaces.

5.2.2 Cycling Infrastructure

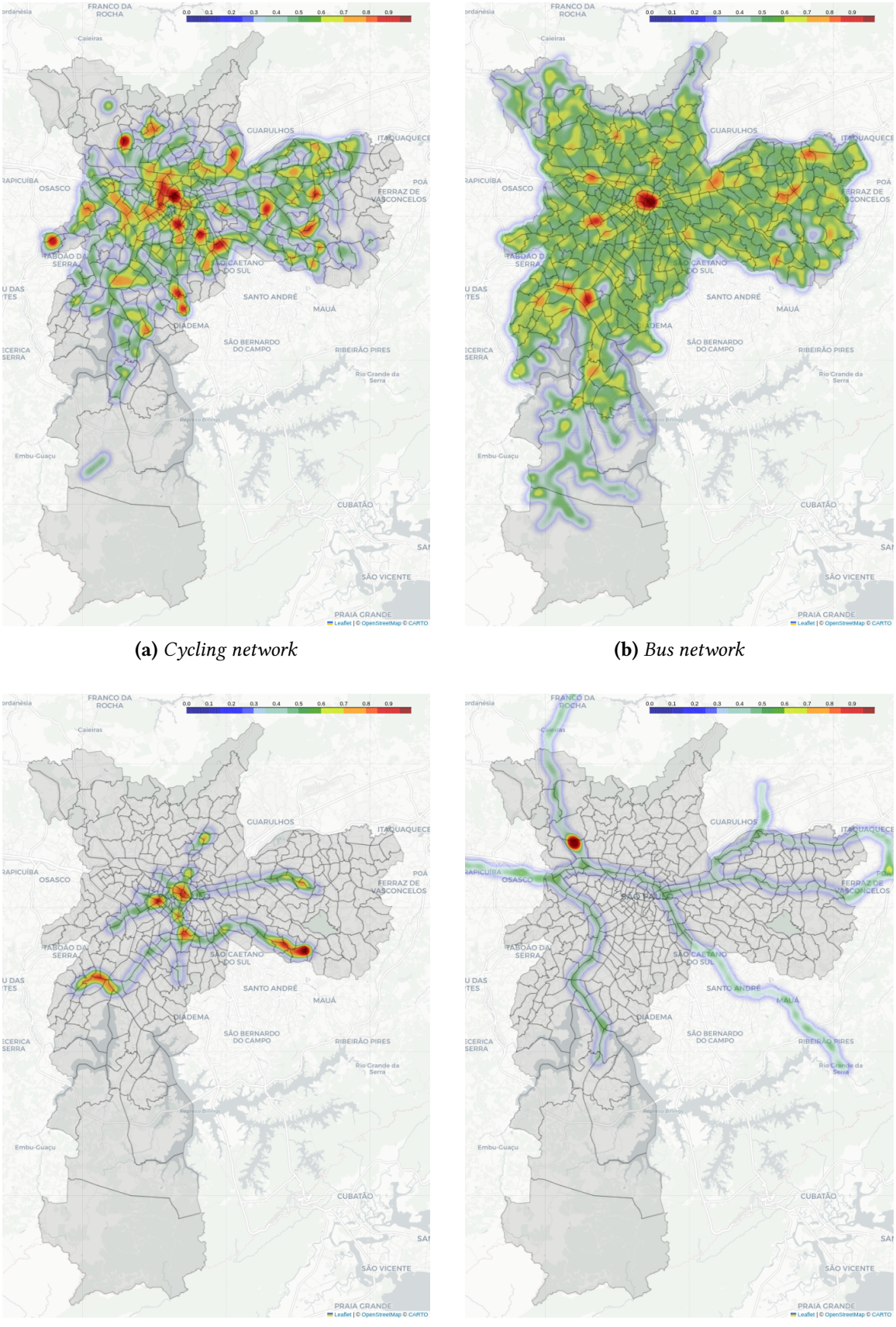
Cycle paths

In the past decade, São Paulo's City Hall has made substantial investments in the development of cycling infrastructure. Prior to 2007, the city had only 5.8 km of cycle paths. However, from 2008 to 2016, approximately 500 km of cycle paths were constructed (São Paulo's City Hall, 2020). Since 2016, more than 200 km have been added, and the City Hall aims to build another 300 km by 2025 (G1 SP, 2021). Despite these efforts, the slight increase in the cycling share from 2007 to 2017 indicates that infrastructure alone is insufficient to significantly increase the role of bicycles in the city, and that complementary strategies are required to encourage people to cycle.

The spatial distribution of the cycling network in the city is displayed in Figure 5.3a using a heatmap[15]. The map reveals that the city's cycling infrastructure is unevenly distributed, with a higher concentration in the central areas. The peripheral areas, in the north, south, and east, lack cycling infrastructure altogether. Moreover, the cycle paths are poorly connected, especially outside of the expanded center.

The cycling network can also be contrasted with the public transportation modes

[15] Heatmaps are graphical representations that visually display data by assigning different colors to represent ranges of values. In a heatmap, a higher intensity of a value is usually represented by a darker or "warmer" color (Optimizely, n.d.).



(a) *Cycling network*

(b) *Bus network*

(c) *Subway network*

(d) *Train network*

Figure 5.3: *Heatmaps showing the distribution of the mobility infrastructure across the city. The map of São Paulo is into the OD zones. Own work. The data sources were as follows: CET (n.d.[a]) provided the data for cycling, CEM (2017) for bus, and CET (n.d.[b]) for subway and train.*

available in the city. As shown in Figure 5.3b, the bus lines cover a large portion of São Paulo. However, some peripheral areas, especially in the south, have a scarcity of bus lines. On the other hand, the subway lines, as shown in Figure 5.3c, are mostly limited to the center of the city, while the train network (Figure 5.3d) extends further to some regions in the east and to the surrounding areas outside the city, but it still leaves many areas of the city unconnected.

The comparison between the spatial distribution of cycling infrastructure and public transportation suggests that many people who do not own cars rely on buses to move around the city, and that the combination of trains or subways with buses is likely to be a common strategy to achieve faster and longer trips. In this context, cycling could be a viable alternative to replace a part of the trip, especially the one covered by buses. However, this requires an improvement in the connectivity and accessibility of cycling infrastructure in the city, especially in the peripheral areas.

This unequal spatial distribution of mobility in the city is not simply a geographical phenomenon, but also a social issue. This is evidenced by Figure 5.4, which displays the total percentage of upper classes (A, B1, and B2)[16] in the trips for each OD zone.

The map was generated using the OD 2017 database, which was used to estimate the share of each social class in the trips for each zone, considering all modes of transportation. The trip expansion factor described in 5.1.1 was applied to the trips to obtain representative values. The sum of the percentages of classes A, B1, and B2 for each zone was then computed and plotted on the map.

Trips that had either their origin or destination in a particular zone were regarded as belonging to that zone. To avoid double counting trips that had different origins and destinations, trips that started and ended in the same zone were also duplicated, so that all trips had equal weight. Furthermore, six OD zones were excluded from the analysis, as they had less than five trips and thus were not reliable sources of information. These zones are marked in gray on the map. The number of trips in the remaining zones ranges from 38 to 2494 trips, with a mean of 631.8 trips.

The map reveals a notable disparity in trip patterns between central and peripheral regions. The central areas have a high density of trips made by upper classes, and as we move to peripheral areas, the percentage of lower classes increases. The magnitude of this variation is very large, going from 10.3% to 89.7%. This pattern, when compared with the availability of public transportation and cycling infrastructure, indicates a concerning scenario: individuals from lower classes, who typically rely more on public transportation or more affordable modes of transportation like cycling, are disproportionately disadvantaged in the allocation of infrastructure investments.

Parking

In 2018, the municipal government of São Paulo approved a legislative measure that requires the establishment of secure parking facilities for bicycles at all train and subway

[16] This class hierarchy follows the “Critério Brasil". More details about this classification can be found in Section 5.2.3.

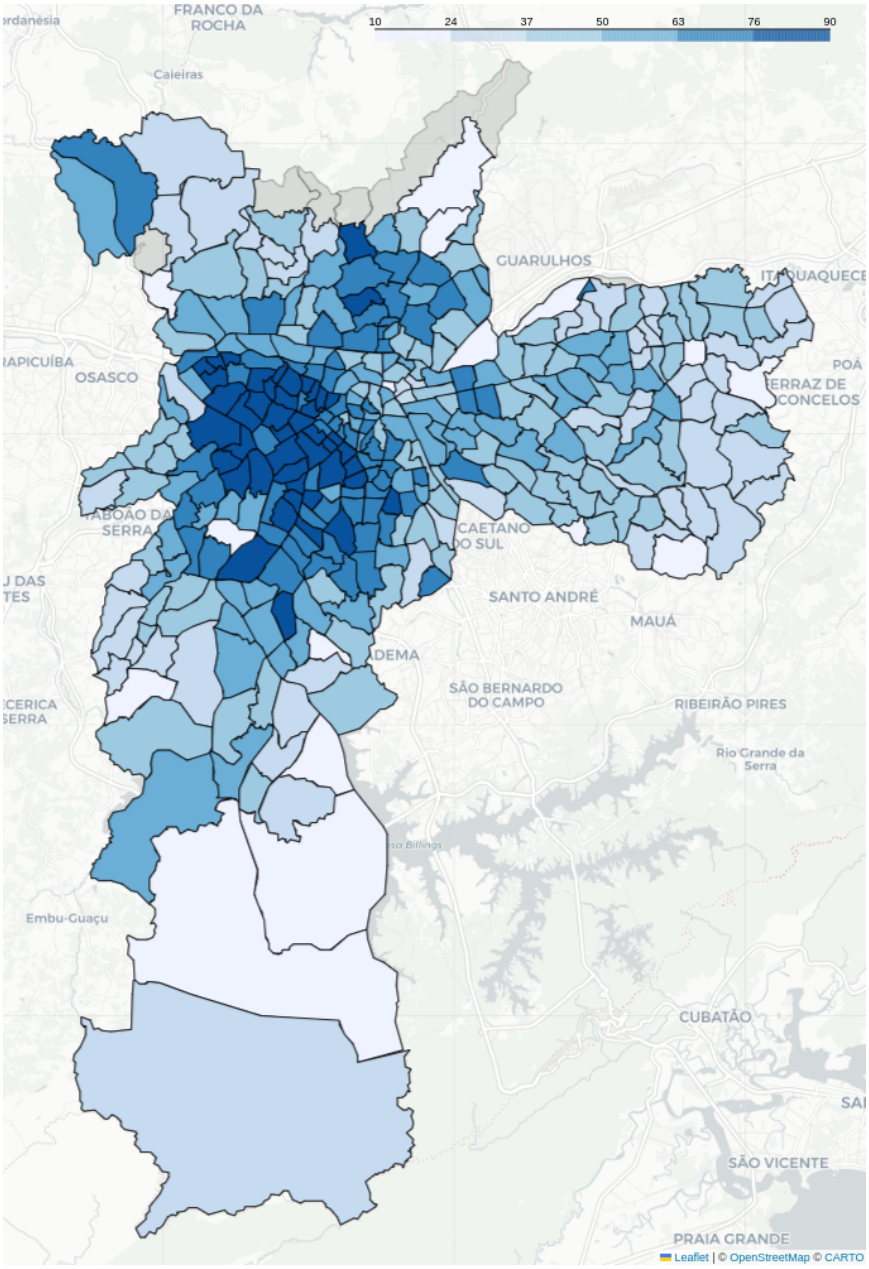


Figure 5.4: *Proportion of classes A, B1, and B2 in the trips originating or ending in each zone. Own work based on the OD 2017 database.*

stations, as well as bus terminals (Municipal legislation, 2018). Then, in 2021, the SMT, in collaboration with Ciclocidade[17], formulated a public bid for the bus stations, outlining specific requirements for the parking facilities of new or renovated stations. These requirements include a minimum of 50 spaces, appropriate lighting, ventilation, comfort, accessibility, surveillance, and security. Additionally, the bid mandates that these facilities must be implemented within a timeframe of 180 days following the approval of the project by the relevant public authority. Also, it recommends the installation of

[17] Ciclocidade is a São Paulo non-profit organization aimed at encouraging cycling as a mode of transportation in the city (Ciclocidade, 2023).

changing rooms in close proximity to the parking facilities (São Paulo's City Hall, 2021, pp. 36–37). This bid is a long-term measure that affects only new or renovated stations, but it represents a significant advancement for the bicycle parking infrastructure of São Paulo.

5.2.3 Cyclists Profile

There is an interesting pattern in the demographic profile of cyclists across diferent countries: in bike-friendly places, cycling is a widespread activity among all demographic groups, including a large number of women, children, and seniors. In contrast, in car-oriented cities with low levels of cycling, most cyclists are young to middle-aged men. These demographic differences are especially noticeable in utilitarian cycling, compared to trips made for recreational purposes (Pucher and Buehler, 2012, p. 211).

This section examines the profile of cyclists in São Paulo. As we will see, cycling in São Paulo is not an inclusive and population-wide activity, but rather concentrated in specific characteristics, especially regarding gender and age.

Gender

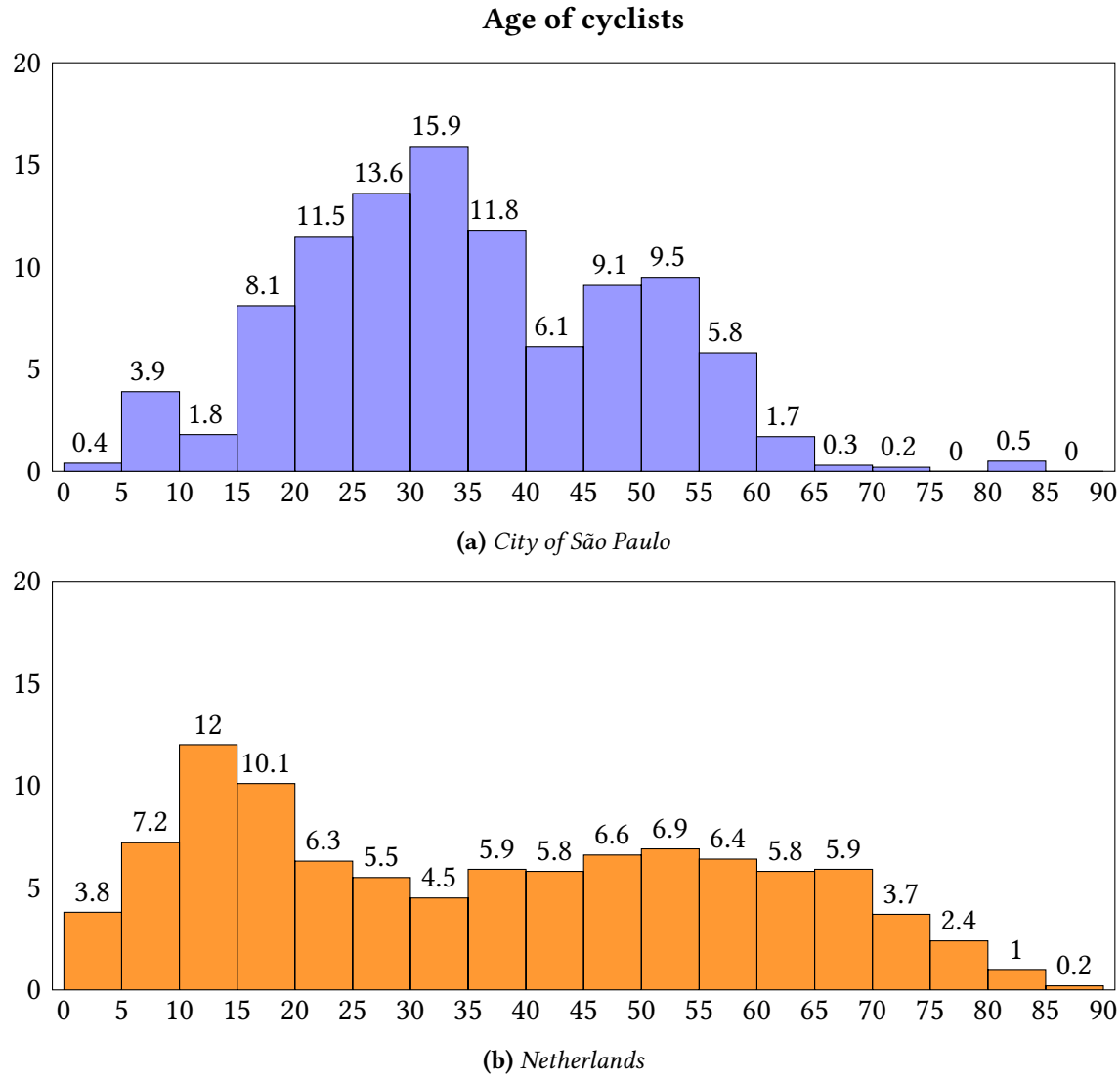
Despite women representing around 51.2% of the total trips of the city of São Paulo, they just account for 9.8% of all bike trips, according to OD 2017. Several theories were proposed to explain this gender gap, such as activity preference or a greater concern for personal safety. However, these factors may not fully explain the disparity between bike usage by men and women, as we do not observe this striking difference in cities with a more bicycle-friendly environment (Pucher and Buehler, 2012, pp. 212–229). In fact, some have argued that gender equity in cycling can be a good indicator of the cyclability of a certain region (Baker, 2009). In the Netherlands, for example, women accounted for 52% of the cyclists in 2017, according to OViN 2017.

A study conducted by Ciclocidade (Ciclocidade, 2016) revealed that this gender gap varies significantly across different regions of the city. Their study involved interviewing people who cycled in the city, and had 1804 respondents. The interviewers were instructed to prioritize approaching women, in order to obtain a representative profile of bicycle use in São Paulo. Nevertheless, women comprised only 14% of the responses. In central areas, which correspond to affluent neighborhoods and where cycling infrastructure tends to be better, women represented 23% of all bike trips. In contrast, in peripheral areas, this number decreased to 9%. It should be noted that this study adopted a purposive sampling strategy to obtain a larger proportion of female respondents, thus the mode share results are not representative of the general population and deviate from the percentages reported by the OD 2017 survey. Nevertheless, the observed disparities between central and peripheral areas underscore the importance of improving the conditions for cycling in order to enhance gender equality among cyclists.

Age

In a similar way to what happens with gender, bike-friendly environments tend to have a more balanced distribution of cyclists among all ages, with a higher number of

children and seniors cycling (Pucher and Buehler, 2012, p. 211). The age distribution of cyclists in São Paulo and in the Netherlands, shown in Figures 5.5a and 5.5b respectively, illustrates this contrast.



(a) *City of São Paulo*

(b) *Netherlands*

Figure 5.5: *Histograms depict the distribution of age groups (in intervals of 5 years) among bicycle users in the city of São Paulo and in the Netherlands in 2017. Own work based on the OD 2017 database for São Paulo and in the OViN 2017 for the Netherlands.*

The majority of cyclists in São Paulo (52.8%) belong to the 20-40 age group, while the cyclists in the Netherlands are more evenly distributed across all age groups, with only 22.3% in the same category. Moreover, the Netherlands has a higher proportion of cyclists in the younger (less than 15 years) and older (more than 60 years) age groups, which account for 23% and 19% of all cyclists, respectively. In contrast, São Paulo has only 6.1% of cyclists under 15 years old and 2.7% over 60 years old. These findings suggest that the age distribution of cyclists in São Paulo is not determined by physical limitations, but rather by cultural and safety factors that discourage cycling among certain age groups.

Social class

The OD survey also includes the socio-economic classification of the respondents. This variable is derived from the "Critério Brasil"[18], a scoring system that assigns households to different socio-economic strata based on the possession of certain consumer goods and the educational level of the household head. The scoring system classifies the households into five socio-economic strata, ranging from A (the highest class) to E (the lowest class). Figure 5.6 shows the proportion of each socio-economic stratum in the trips within the city of São Paulo.

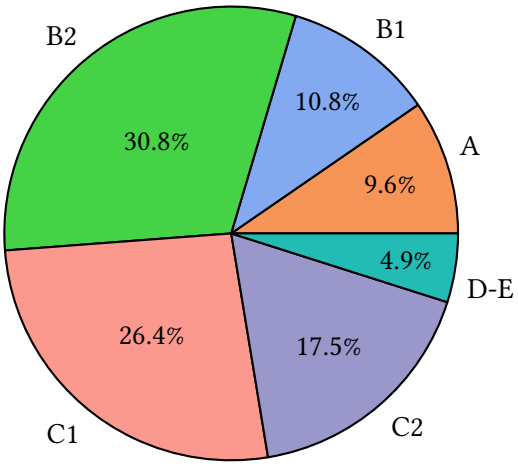


Figure 5.6: *Distribution of social classes among the intra-city travellers in São Paulo in 2017. Own work based on the OD 2017 database.*

Figure 5.7 depicts the mode share for each socio-economic class. The chart indicates that the mode share distribution varies significantly by social class. Individual motorized vehicles represent more than half of the trips made by class A, and this mode share diminishes for the subsequent classes. In contrast, walking and public transportation modes are more prevalent among the lower classes. For the most disadvantaged class (D-E), these two modes represent 87.8% of all trips.

Bicycle trips constitute the lowest share of trips in all classes, but they exhibit a peculiar pattern across the income classes, with the largest percentages observed in the lowest (1.8%) and in the highest class (1.2%). This figure may reflect different factors influencing the choice of cycling for each class. For the upper classes, the availability of better cycling infrastructure in the central (and wealthier) areas may encourage them to use bikes as a mode of transportation. Moreover, the upper classes tend to travel shorter distances to their work or school destinations, which makes bike trips more convenient. On the other hand, lower classes may opt for cycling due to the low cost associated with this mode of transportation.

[18] https://www.abep.org/criterio-brasil

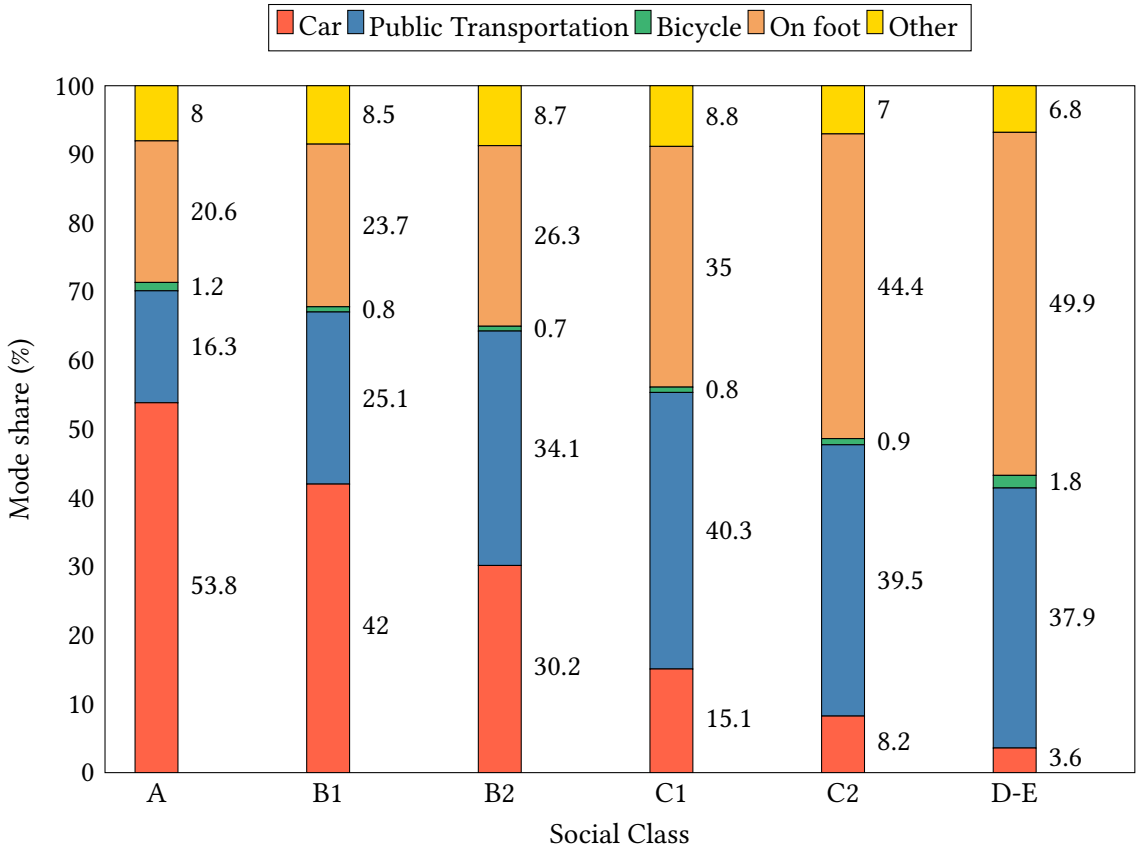


Figure 5.7: *Mode share separated by social class in the city of São Paulo in 2017. Own work based on the OD 2017 database.*

5.2.4 Bike ownership

The city of São Paulo has a large number of bicycles that are not used for daily transportation. Despite having a large bicycle fleet of approximately 1.6 million units, estimated by the Multiplicidade mobility research institute[19] (G1 SP, 2021), São Paulo exhibits a low cycling mode share of only 0.9%, equivalent to about 200,000 daily trips, as indicated in Figure 5.2. This suggests that there is a significant opportunity to promote bicycle usage in everyday travel. Furthermore, an analysis of the OD 2017 Survey, which also examined bicycle ownership among households, reveals that an estimated 33.4% of the households in the city have access to at least one bicycle.

5.2.5 Multimodality

This section presents an analysis of multimodal cycling trips in São Paulo, which are trips that combine cycling with other modes of transport. The analysis is based on the OD 2017 survey, which has a small sample size of 29 multimodal cycling trips, limiting the statistical significance and the external validity of the findings. Therefore, the results should be interpreted with caution and not be generalized to the cycling population in the city. Instead, these results should be regarded as indicative of certain patterns and

[19] Instituto de Pesquisa Multiplicidade Mobilidade Urbana (IPMMU), in its original name in Portuguese

preferences among multimodal cyclists.

The findings indicate that the majority of the multimodal trips (24 out of 29) involved cycling and one other mode of transport, while the remaining five trips involved cycling and two other modes of transport. As illustrated in Figure 5.8, the subway was the most common mode to complement cycling, followed by the bus and the train. This implies that public transport can be an important facilitator for cycling trips. However, the proportion of multimodal cycling trips in the city is very low, representing only 3.5% of the total cycling trips in the OD 2017 survey. This suggests that there are several barriers and challenges that discourage cyclists from integrating their bikes with public transport, such as the lack of bike parking facilities and the security issues within stations and terminals.

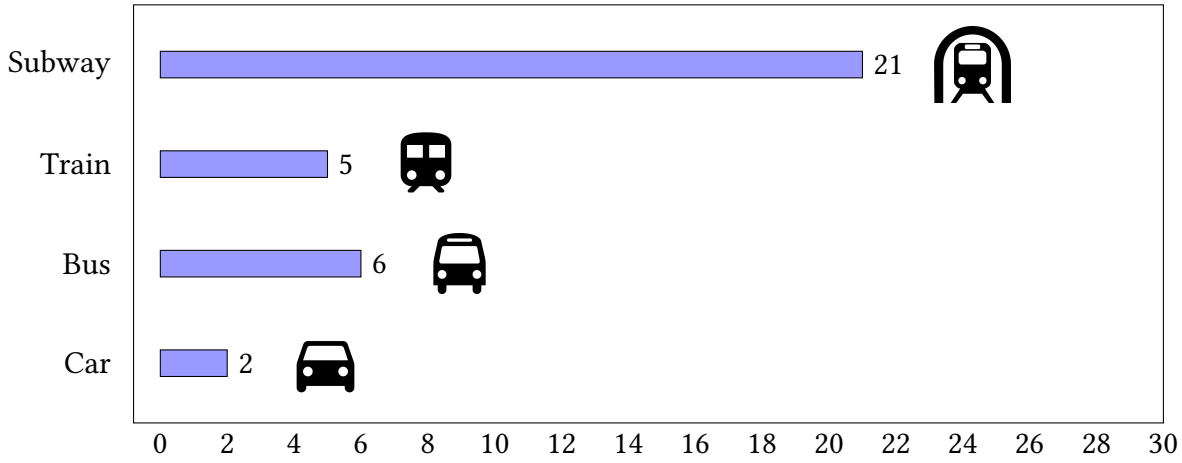


Figure 5.8: *Modes of transportation combined with cycling trips in São Paulo, according to the OD 2017 survey. The chart shows the frequency of each mode of transportation used along with cycling in the same trip. Trips that combined more than one mode with cycling were counted for each mode (multiple counting). Own work.*

5.3 Conclusions of the analysis and implications for the pilot design

In this section, we summarize the main findings of our analysis of cycling in São Paulo and discuss how they inform the design of the pilot project of Bike SP.

Gender: Our analysis revealed that women are significantly less likely to cycle than men in São Paulo, which suggests a need to stimulate women's participation in the pilot project. However, this also raises the question of why women are not cycling in the city and what barriers and challenges they face. Therefore, the pilot project should include a gender-sensitive approach to ensure that both genders are represented in the sample. Moreover, it would be beneficial for the pilot project to collect qualitative data to understand gender differences in preferences and difficulties regarding cycling.

Age: Our analysis revealed that there is a significant gap in the cycling participation of younger age groups in São Paulo, compared to bike-friendly places. Since the pilot project,

due to legal and practical constraints, will be limited to people who are 18 years or older, this factor will not be fully addressed. However, a possible strategy to attract younger age groups is to include students (especially from university, given the age restriction) in the selection, in addition to commuters who travel to work.

Social class and spatial distribution: Our analysis indicated that lower social classes tend to travel longer distances and live in areas with less access to cycling infrastructure and public transportation, especially subways. These factors may discourage or prevent them from cycling in the city. Therefore, the pilot project should be careful not to bias its choice of participants to higher classes, as they may already have more favorable conditions and incentives to cycle. Instead, the pilot project should aim for a representative spatial distribution across the city, since there is a relationship between the location of trips (central or peripheral) and the socio-economic status of the travelers.

Bike ownership: Our analysis revealed a low utilization rate of the existing bicycle fleet in São Paulo. This suggests that it would be reasonable for the pilot project to target people who already have cycling skills and access to a bicycle, either owned or shared. Specific programs for providing bikes to the participants could be recommendations for future implementations of the policy, especially considering the spatial distribution of social classes and cycling infrastructure in the city.

Having established the context of cycling in São Paulo, we can now formulate the Bike SP pilot project in accordance with the city's specific needs.

Chapter 6

Pilot project design

The previous chapters have discussed the analytical and theoretical foundations that guided the development of a pilot project design for the Bike SP program. This chapter elaborates on this design in detail.

The pilot project was conceived as a three-phase process: dissemination and enrollment, selection of participants, and travel recording. The subsequent sections explain the procedures and criteria devised for each phase. Moreover, we clarify how this design will be used to address the implementation questions formulated in Section 2.1. After these three phases of the pilot project are completed, an analysis of the results will be performed, and based on the findings, a public policy proposal will be developed. A timeline of these phases can be seen in Figure 6.1.

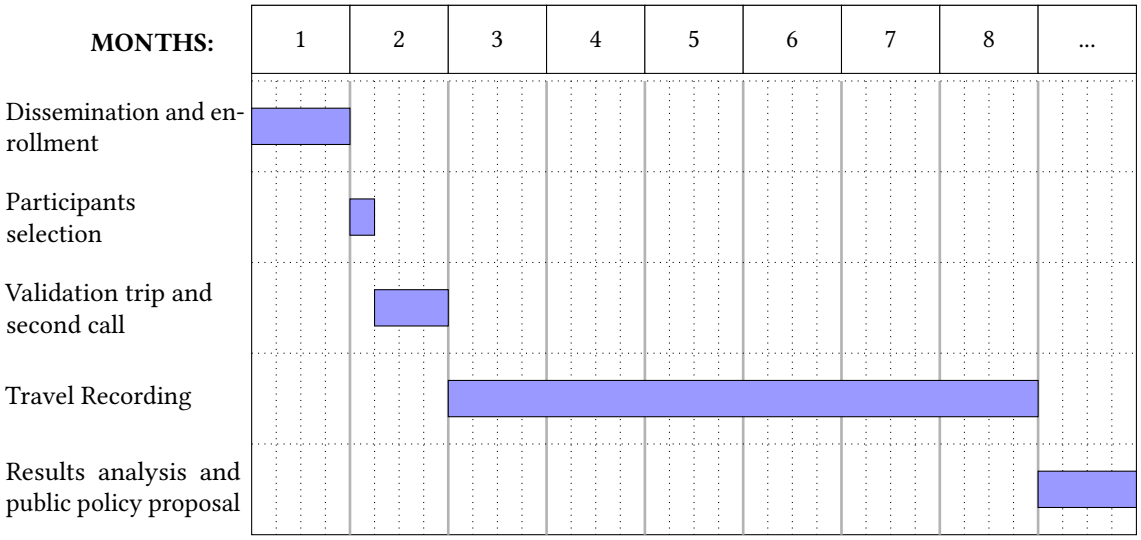


Figure 6.1: *Timeline with the duration of each stage of the pilot project. The duration of the results analysis has not been determined yet.*

6.1 Dissemination and enrollment

The pilot project will be officially announced by the city hall through various media outlets and platforms. The main goal is to reach a diverse and representative sample of people who are interested in participating in the research, in order to address IQ2 and follow principles of social justice. The Municipal Secretariat of Mobility and Transit (SMT) will lead the dissemination campaign, with the support of InterSCity and groups of cyclists and cycle activists.

The media release that we prepared and that will be used to advertise the pilot project is available in Appendix A[1].The media release contains the essential information about the pilot project, such as its objectives, features, and eligibility criteria. The media release also provides the necessary instructions and guidance for those who want to apply to participate in the program.

To be eligible for the pilot project, the interested people will have to meet the following criteria: be adults, residents of the city of São Paulo, have active cards from the Bilhete Único system in their name, have a smartphone with access to internet, and intend to make utilitarian trips by bicycle within the territory of the municipality during the duration of the research.

The registration period for the pilot project will last for one month, starting from the date of the official announcement by the city hall. During this period, the interested people will have to fill out an online questionnaire that will ask about their socioeconomic and demographic profile and their current travel patterns.

This online registration form is a key instrument for collecting data from the interested people and selecting the participants for the pilot project. We formulated the sections and questions of the questionnaire in a way to allow for the selection of the participants, which will be detailed in Section 6.2, and to use it as an input for the analysis of the pilot project in different profiles of the population. The registration form has the following sections:

Socioeconomic and demographic profile: This section collects data such as age, gender, income, education, and occupation. This information will allow us to understand the characteristics and diversity of the potential participants, and to balance the selection criteria across various social groups.

Current travel patterns: This section inquires about the transport modes that the interested people typically use for their utilitarian trips. The responses provide insight into their current travel behavior and preferences, and help estimate the potential for a modal shift to bicycle usage.

Origins and destinations for utilitarian trips by bicycle: This section requires individuals to pre-register the locations of their residence, workplace, educational institution, and other frequent destinations for which they intend to make utilitarian trips by bicycle during the pilot project. They are also asked to indicate, if possible, the approximate

[1] All the documents in the appendices of this capstone project are in Portuguese, since they were prepared for the São Paulo context.

proportion of cycle paths along their routes. This data will allow mapping the spatial distribution and demand of potential participants, as well as prioritizing those whose routes are safer and more feasible for cycling.

Informed Consent Form: This section presents the Informed Consent Form (TCLE[2]), explaining the pilot project's objectives, procedures, risks, benefits, rights, and responsibilities. The interested people must read and agree to the TCLE before submitting the questionnaire. The TCLE also informs them that their bicycle trips will be recorded and analyzed for research purposes only, and that their personal data will be protected and anonymized. The TCLE is a mandatory document required by the Ethics Committee for conducting a research experiment involving human subjects. The submission of this pilot project to the Ethics Committee and its approval will be discussed in Section 8.1.

The comprehensive set of registration questions is presented in Appendix B, and the TCLE is in Appendix C. The online version of the questionnaire, which will be used by participants, is available at http://bit.ly/bikesp-cadastro. The questionnaire was structured and made accessible online using the LimeSurvey tool[3].

6.2 Participants selection

After receiving the registrations from the interested people, a selection process will be carried out to choose approximately 800 participants for the pilot project. This number was chosen based on the budget and on the calculation of the sample size required to achieve statistical significance in the analysis of the pilot project. This calculation and the budget for the pilot project will be detailed in Sections 6.4 and 6.5, respectively.

The selection for the pilot will be based on the following factors (the data for all these criteria is obtained from the registration questionnaire):

Gender: Women represent only 10% of cyclists in São Paulo, according to the analysis presented in Section 5.2.3. To ensure a more representative sample, they will be prioritized during the selection process. This approach will facilitate an investigation of the gender differences in the factors influencing the choice and utilization of bicycles.

Social Class: The social class of the participants will be diversified to some degree to enable the examination of behavioral variation across different classes. However, lower classes will be given priority, as they are more likely to benefit from the financial incentives. This criteria has the purpose of increasing the impact of Bike SP on the equity of mobility, and it was based on the analysis of the travel pattern differences between social classes in São Paulo provided in Section 5.2.3.

Mode of Transport: Another element to take into account will be the mode of transportation the participants are currently using to travel the intended routes. The goal is to include participants who are not current cyclists but who are interested in cycling because of the program. We will try to balance participants who will switch from different modes of transport, such as cars, public transport, walking, etc. This will enable

[2] Termo de Consentimento Livre e Esclarecido (TCLE), in Portuguese.

[3] https://www.limesurvey.org/

the comparison of the effects of financial incentives on the travel behavior of users coming from different modes.

Residence Location: In order to ensure a balanced distribution of the pilot program across the city, the residences of participants and the destinations of their daily commutes will be considered. This decision is influenced by IQ2, which questions whether future policy implementation should target a specific city region to optimize results. This criterion allows for an exploration of how bicycle usage and mobility perceptions differ between residents of the city's peripheral and central areas. The spatial analysis of trips in São Paulo, which informed this decision, is detailed in Section 5.2.2.

Occupation: The occupation of the participants will also be considered to ensure a diverse sample of the pilot program. The participants will be selected from both students and workers, who have different schedules and mobility needs.

Route Characteristics: Finally, priority will be given to people whose estimated routes between their origins and destinations contain cycling infrastructure (bike paths or bike lanes) or less intense traffic roads, such as collector or local roads. These criteria are intended to minimize the risk of accidents and increase the safety of the participants.

The selection process will take place over a duration of one week. Subsequently, the selected people will be notified by email and asked to download and install a mobile application developed by InterSCity on their smartphones. The app will be used to record and upload the bicycle trips made by the participants during the pilot project. Information about how we coordinated the development of this mobile application is presented in Section 8.2.

To confirm their participation, the selected people will have to register on the app and make a validation trip using it, within two weeks after receiving the notification. The validation trip will confirm their interest in the pilot and test the app's functionality on their devices. It can be made using any mode and between any valid origin and destination[4]. Those who do not make the validation trip within the deadline will be excluded from the pilot project, and their spots will be transferred to other people on a waiting list. The waiting list will be composed of those who meet the eligibility criteria but are not initially selected due to quota limitations. Once they complete the validation trip, the participants will secure their place in the pilot project until its end, regardless of how many trips they register afterwards.

The participants will also have access to a free online course called "Pedal Safely"[5], taught by the Traffic Training and Education Center (CETET) of the Traffic Engineering Company (CET). The course will provide tips and guidance on how to ride a bicycle safely in urban environments. The participants will receive a credit bonus for completing the course. The purpose of both prioritizing people whose registered routes are safer and encouraging participation in the course is to minimize the possibility of accidents among participants in the pilot project.

[4] Only the locations that are specified in the registration forms will be considered as valid origins and destinations in the pilot. See Section 6.3.2 for further details.

[5] http://www.cetsp.com.br/consultas/educacao/cursos/condutores/pedalar-com-seguranca.aspx, last accessed on 03/12/2023.

6.3 Travel Recording

6.3.1 Overview

The pilot project aims to simulate the implementation of Bike SP in a controlled experiment. During the period that we call “Travel Recording", participants will use our mobile app to register their daily trips by bicycle and receive public transportation credits for them. The data collected from the app will be used for further analysis of the impacts and outcomes of the policy. Figure 6.2 shows an operational diagram of this phase. The bonus will be granted per kilometer traveled in the form of credits inserted directly into the Bilhete Único cards of the participants.

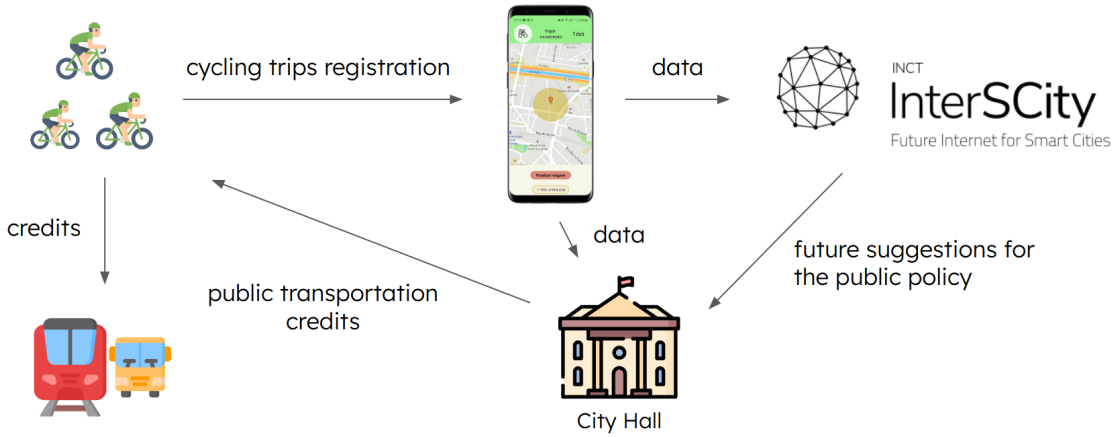


Figure 6.2: *Schematic representation of the pilot project’s implementation procedure. The mobile image contains a real screenshot of the application developed by our research group for the pilot. Own work.*

The first implementation question (IQ1) requires understanding the price elasticity of the program. In other words, the experiment seeks to determine the optimal amount of bonus per kilometer cycled that would balance the benefits for the recipients (increasing bicycle use) and the costs for the public authority (minimizing overpayment). To answer this question, the experiment addresses the following sub-questions:

- Sub-question 1 (SQ1): How does the number of trips vary between the groups of people who receive different levels of financial incentives and those who receive none, within the same time period?
- Sub-question 2 (SQ2): How does the number of trips change for the same individual when the level of financial incentive varies throughout the program?

To answer SQ1, the experiment requires a control group that does not receive any financial incentive for cycling, and at least two experimental groups that receive different amounts of mobility credits for each kilometer cycled, both greater than zero. This design allows comparing the effects of different incentive levels on the cycling behavior of the participants.

To answer SQ2, the experiment requires that the level of mobility credits per kilometer changes for the same individual at different stages of the program. This design allows

observing the behavioral responses of the participants to the changes in the incentive level.

By answering these sub-questions, the experiment will be able to address IQ1, which will allow for the evaluation of the impact of the cyclist bonus on modal shift and provide a basis for the optimal remuneration value for subsequent phases of implementing the Bike SP program.

We will employ a research design inspired in a randomized controlled trial (RCT) for the pilot project. An RCT is an experimental design that randomly assigns participants to either a treatment group (which receives the intervention) or a control group (which does not receive the intervention). This design is typically used in scenarios where researchers aim to determine the effectiveness of a new treatment or intervention by comparing it with a control group or existing standard treatments (Bhide *et al.*, 2018). By comparing the outcomes of the two groups, we can estimate the causal effect of the intervention on the outcome of interest.

To implement this design, a “scheduling system" will be used in the pilot project. The experiment will be divided into three periods of 2 months each, totaling 6 months. In the first period, the participants will be randomly assigned to one of three groups: (1) control group, which receives no financial incentive for cycling, (2) low incentive group, which will receive R$ 0.275 (equivalent to $\frac{1}{16}$ of a public transportation ticket) for each kilometer traveled by bicycle; and (3) high incentive group, which will be granted a higher amount of mobility credits for each kilometer (R$ 0.55, or $\frac{1}{8}$ of a public transportation ticket). The amounts that each group receives will change at the beginning of every two-month period. The change in remuneration will be mentioned in the registration form and will also be notified to the participant at the time of the change during the execution of the program.

In our analysis, we operate under the assumption that the actions of individuals in one time frame have a direct impact on their actions in subsequent time frames. This implies that the second period cannot be examined in isolation, but rather must be viewed in conjunction with the first period. That is, we have to compare the pairs [Remuneration at the first period, Remuneration at the second period]. Similarly, the conclusions from the third period must look at the sequence of remunerations in all the three periods. Furthermore, the seasonal variation of each period may affect the travel behavior of the participants. For instance, a month with higher precipitation levels may have fewer trips. To control for this confounding factor, we will only compare the participants who belong to the same period.

Table 6.1 illustrates the different remunerations per group and period. The following subsections will detail the comparisons and answers we want to take from the groups in each period.

First period

From the first period, we will do a comparative analysis between the groups to derive insights relevant to SQ1. The comparisons are structured as follows:

C1. **Baseline (Nothing) vs. Low Value ($):** This comparison seeks to comprehend

Group	1st period	2nd period	3th period
Control	Nothing	$	Nothing
Experimental 1	$	Nothing	$
		$	$
		$$	Nothing
Experimental 2	$$	Nothing	$
		$	Nothing
		$$	$$

Table 6.1: *Remuneration distribution during the three periods of the pilot project.*

the elasticity and the difference between a state of receiving no value and a state of receiving a low value.

C2. **Baseline vs. High Value ($$):** Similar to the first comparison, this analysis aims to understand the elasticity and the difference between a state of receiving no value and a state of receiving a high value.

C3. **Low Value vs. High Value:** This comparison is designed to calculate the average elasticity, which is defined as the variation in the number of trips in response to price variation. This analysis will provide a quantitative measure of how sensitive the number of trips is to changes in value.

Through these comparisons, we aim to explore the extent to which remuneration can motivate individuals to overcome inertia and shift their transportation habits towards cycling. Also, we want to understand the role that different incentive levels play in promoting this modal shift.

Second period

Starting from the second period, we aim to address SQ2, while also furthering our understanding of SQ1. To achieve this, we will conduct the following comparative analyses:

C4. **Nothing-$ vs. $-$:** This comparison is related to SQ2 and aims to estimate the willingness of individuals to participate in the program after a waiting period. The outcomes will be compared with those of C1 to quantify the 'impatience' metric, which represents the likelihood of individuals opting to participate in the program and earn a small amount of money after waiting, rather than abandoning the program altogether.

C5. **$-$ vs. $$-$$:** This comparison, related to SQ1, will be used to calculate the average elasticity. The results will be compared with those of C3 to gain a more nuanced understanding of the elasticity.

C6. **$-$ vs. $-$$:** This comparison, related to SQ2, seeks to determine whether an increase in payment midway through the program will lead to an increase in cycling activity.

C7. **$$-$$ vs. $$-$:** This comparison, also related to SQ2, investigates whether a decrease in payment midway through the program will result in a decrease in cycling activity.

C8. **$-$ vs. $-Nothing:** This comparison is intended to show the impact of terminating the remuneration after a certain period. The goal is to determine whether individuals have adopted the habit of cycling and will persist even in the absence of remuneration. It is associated with SQ2.

C9. **$$-$$ vs. $$-Nothing:** Similarly to C9, this comparison explores the effects of ending pay after a set time, but with a higher initial value.

Through these comparisons, we aim to further our understanding of the behavioral patterns of individuals in response to various payment structures within the program. The results of C8 and C9 will be compared to see if the effect of stopping the payment varies according to whether the individuals used to receive a greater or lower remuneration value per km.

Third period

The primary analyses and comparisons are conducted in the first and second period. The third period has two main objectives: First, to retain the participants in the pilot, especially those who receive no remuneration in the second period. The anticipation of a third period is necessary to obtain better data in the second period. Second, the third period allows for potential adjustments in the remuneration values and transitions, depending on the outcomes of the first two periods and the necessity of additional analyses.

Furthermore, the third period provides the following analysis:

C10. **$-$-$ vs. $$-$$-$$:** This comparison will be used to further calculate the average elasticity. The results will be compared with those of C3 and C5 to gain a deeper understanding of the elasticity.

6.3.2 Remuneration Constraints

In the context of the pilot project, remuneration will be provided to participants based on specific criteria related to their bicycle trips. These guidelines have been established to ensure a fair and equitable distribution of remuneration among the participants, while also encouraging consistent use of bicycles for transportation. The following conditions apply:

1. **Trip Validation:** Only bicycle trips that are made between pre-registered origins and destinations will be considered for remuneration. These trips must be recorded and validated by the Bike SP mobile app. This constraint is designed to encourage utilitarian trips and regular use of bicycles, and to simplify the analysis of the effect

of remuneration on the number of trips. Participants will be encouraged to register their usual places of study or work during the registration phase.

2. **Distance Calculation:** The remuneration calculation will take into account trips with a minimum distance of 1 km and a maximum distance of 8 km. Trips exceeding this distance will be considered as an 8 km trip for remuneration, while trips that do not meet the minimum distance requirement will not be eligible for remuneration. The distance used for these calculations and for determining the remuneration amount will not be the actual distance traveled by the participant, but rather a predetermined distance between the origin and destination points that the participant has registered. This approach simplifies the development of the mobile application and prevents participants from artificially inflating their remuneration by taking unnecessarily long routes. However, it should be noted that the actual routes taken by participants will be recorded and analyzed to base improvements for the subsequent phases of the policy.

3. **Trip Limit:** A maximum of two trips per day will be remunerated for each participant. In the event that a participant makes more than two trips in a day, only the first two trips will be considered for remuneration. This constraint helps to ensure that the pilot remains within budget while covering the majority of people who make one trip to go to and from their destination or an intermediate station.

Weekend trips will be treated the same as any other trip and are subject to the same distance and trip limit criteria, allowing for the inclusion of weekend workers or students.

6.3.3 Qualitative Data Collection

The main source of quantitative data for this study is the number of trips registered by the participants in the app. This data allows us to measure the frequency and distance of cycling trips, as well as the remuneration received by each participant. However, this data source is subject to some limitations, such as:

- **Unregistered Trips**: Participants may not register all their trips in the app. This is especially likely among those who do not receive remuneration and, therefore, have no direct incentive to log their journeys.
- **External Factors**: Participants may stop cycling due to reasons unrelated to the program.

To address these limitations, we will supplement the quantitative data with qualitative data obtained from questionnaires that will be administered to the participants at the end of each 2-month period.

Moreover, this approach will enable the collection of data about the experiences of cyclists in São Paulo. Since the main target of the pilot project are new users of bikes as their mode of transportation, their input could be instrumental in guiding policy makers in making cycling more attractive in São Paulo. This strategy aligns with the epistemic dimension of the mobility data justice framework discussed in Section 4.3, which supports

the inclusion of qualitative data as a form of knowledge, in addition to quantitative data. Therefore, the following additional topics will be examined in these surveys:

- **Cycling Experience**: The motivations, the type of bike used (whether owned, shared, or borrowed), and any problems encountered during cycling.
- **Route Selection**: The factors that participants consider most important when choosing their route.
- **Cycling Infrastructure**: The feedback on the cycling infrastructure encountered during their journeys.

Appendix D contains the complete list of questions that we formulated for the questionnaire. To encourage participants to respond, we will offer an additional bonus equivalent to the value of five public transport tickets for each completed questionnaire. This bonus will be independent of the remuneration received for the cycling trips, and will be available for all participants, regardless of whether they registered any trips or not. This way, we aim to avoid any interference of this bonus with the participants' travel decisions, which should ideally only be influenced by the remuneration value per km of each period.

This strategy also serves to motivate individuals to persist in the experiment, especially those who are allocated to the control group and do not receive any compensation at the beginning.

The pilot program will conclude with the completion of the last questionnaire, which will be administered after the final 2-month period.

6.3.4 Monitoring and Adapting the Incentive Scheme

The project design allows for flexibility in the allocation of groups and incentives in case of unforeseen deviations from the expected outcomes in the first or second phase. This is to ensure the feasibility of the project within the budget constraints and the validity of the statistical analysis. The deviations will be detected by a weekly monitoring of the actual values versus the expected values.

The main corrective measure will be to modify the incentive scheme for the third phase, since the more important analyses and conclusions are concentrated in the first two phases. Therefore, if the number of trips exceeds our budgetary expectations, we can reduce the remuneration value in the final phase. Conversely, if the number of trips falls short of our estimates, we can increase the per kilometer remuneration value in the third phase. This will also serve as a basis for the incentive value for the policy implementation.

6.4 Statistical power analysis

One of the main objectives of the pilot project is to examine the behavioral effects of financial incentives on the number of trips registered in the app by the participants (IQ2). We hypothesize that the participants who receive higher remuneration will make more trips using the app than those who receive lower or no remuneration. To test this hypothesis, we need to ensure that the sample size of the pilot project is large enough

to detect a statistically significant difference between the treatment groups, if such a difference exists.

As mentioned in Section 6.2, the sample size of 800 participants was initially determined by considering the budgetary and logistical constraints of the study. To assess the adequacy of this sample size for addressing IQ2, a post-hoc power analysis was conducted. A power analysis is a statistical method that allows researchers to estimate the minimum sample size needed for a study. A post-hoc power analysis involves calculating the power based on the sample size and other parameters of the study, rather than specifying the desired power and deriving the required sample size (Lenth, 2007). This approach is suitable when the sample size is already fixed by practical factors, as in our case.

Therefore, the aim of the power analysis was to determine the adequacy of the sample size (approximately 800 participants) for detecting the effect of the remuneration with a high statistical power (commonly 0.8 or higher). A high power implies a high probability of finding a significant difference between the groups, given that one exists, and a low probability of committing a type II error, which is failing to reject the null hypothesis of no difference between the groups when it is false.

The power analysis for this study was performed using Python, and the code is available at the link https://github.com/anayflima/bikesp-analysis/tree/main/power_analysis. A power analysis consists of four main elements (Brownlee, 2018):

1. Statistical power: The likelihood of detecting a specific effect in the population, if it exists.
2. Sample size: The minimum number of observations required to detect an effect of a certain size with a desired level of statistical power.
3. Significance level (alpha): The maximum probability of falsely rejecting a true null hypothesis that is acceptable for the study.
4. Expected effect size: A measure of the expected difference between the distributions of the populations under the null and alternative hypotheses, indicating the impact of the intervention.

Given three of these elements, a power analysis can estimate the fourth one. For our purpose, we will estimate the statistical power based on the sample size, the significance level, and the expected effect size. The following three sections describe how we obtained each of these elements, and then Section 6.4.4 shows how we conducted the power analysis.

6.4.1 Sample size

The first parameter we have to define is what is the sample size of each group that we will consider in the power analysis.

The experimental design of the pilot project that will determine our sample size is already described in Section 6.3 and summarized in Table 6.1. As shown, the participants will be initially divided into three groups: Control, Experimental 1, and Experimental 2. In the second period, each experimental group will be further split into three subgroups.

The control group will not be divided throughout the experiment. This way, we have seven different groups at the end of the pilot. Each group will consist of 115 participants, resulting in a total sample of 805.

Thus, we conducted a test on a sample size of 115 individuals in each group. It should be noted that this represents the number of participants in each group during the second and third periods. Given that the first period has a larger sample size per experimental group compared to the subsequent periods, if we can achieve a high level of statistical confidence in the later periods, the comparison between groups in the first period would have an even greater level of statistical confidence.

The power analysis was based on three groups: a control group (T1), which received no remuneration; a low remuneration group (T2), which received a small amount of money; and a high remuneration group (T3), which received a larger amount of money. These groups encompass all the possible scenarios of the experiment, in each period. The low-remuneration group (T2) was chosen as the reference group. This way, we will test for statistical significance in two comparisons: (1) between the distribution of outcomes of T2 and T1, and (2) between the distribution of outcomes of T2 and T3. This approach is justified by the assumption that T2 would have an intermediate position in the distribution of results. If differences between T2 and the other groups can be detected with statistical significance, then the other pairwise comparisons will also be feasible.

Having established the sample size and the groups for our power analysis, we will now present the rationale for choosing the significance level parameter.

6.4.2 Significance level

The second parameter that needs to be specified for the power analysis is the significance level (α) that will be used for the hypothesis testing, and which defines the probability of a Type I error. A conventional value for α in applied research is 0.05 (Brownlee, 2018). This implies that the null hypothesis will be rejected 5% of the time when it is actually true.

However, when multiple hypotheses are tested, the likelihood of committing a Type I error increases. To address the issue of multiple comparisons, the Bonferroni correction is a statistical adjustment that tests each individual hypothesis at a significance level of $\frac{\alpha}{m}$, where α is the desired overall alpha level and m is the number of comparisons (Armstrong, 2014). This correction ensures that the probability of making at least one Type I error in a family of hypotheses is controlled at the level of α.

Since we are doing two comparisons (T1 vs. T2 and T3 vs. T2), we are going to use the Bonferroni correction to define our alpha. We will consider the overall desired alpha level as being the standard value of 0.05. Applying the Bonferroni correction, we have our resulted alpha as $\frac{0.05}{2} = 0.025$.

6.4.3 Expected effect size

The third and final parameter that we need to specify for the power analysis is the expected effect size, which indicates the magnitude of the difference between the distribu-

tions of a pair of groups that we want to compare. In our case, the effect size is a measure that combines the mean and standard deviation of the number of trips of these two groups. It can be computed as the ratio of the difference between the group means and the pooled standard deviation. The pooled standard deviation is the square root of the average of the two groups' squared standard deviations. The formula for the effect size between two groups is given in Equation (6.1).

$$\text{Effect Size} = \frac{\mu_1 - \mu_2}{\sqrt{\frac{std_1^2 + std_2^2}{2}}} \tag{6.1}$$

where:

- μ_1 and std_1 are, respectively, the mean and standard deviation of group 1,
- μ_2 and std_2 are, respectively, the mean and standard deviation of group 2.

Therefore, to estimate the expected effect size, we have to calculate the means and standard deviations of the groups T1, T2, and T3. Since we do not have the actual data on the number of trips, we will assume some hypothetical distributions for this variable. We will now explain the assumptions and the methods for generating the distributions.

For the power analysis, we assumed that the number of trips follows a zero-inflated negative binomial distribution, which combines a point mass at zero with a negative binomial distribution (RDRR.IO, n.d.). This implies that we are assuming that a relatively large proportion of people will make no trips, without registering anything in the app, and the number of trips for the rest of the people will likely follow a negative binomial distribution, with some dispersion around a mean.

To generate this zero-inflated distribution, we followed two steps:

First, we generated a binomial distribution with probability p_{zero} and $n = 1$. This results in a combination of values of 0 and 1, and the percentage of ones in the sample is approximately p_{zero}%. The formula for the probability mass function of a binomial distribution is shown in Equation (6.2):

$$P(X = k) = \binom{n}{k} \cdot p_{zero}^k \cdot (1 - p_{zero})^{n-k} \tag{6.2}$$

where:

- $P(X = k)$ is the probability of k successes,
- p_{zero} is the probability of success in a single trial,
- n is the number of trials (1 in our case),
- k is the number of successes.

We used the function `np.random.binomial`[6] of Python, which takes as parameters

[6] https://numpy.org/doc/stable/reference/random/generated/numpy.random.binomial.html

the n, the p_{zero}, and the sample size (115 in our case). The output is an array of values of 0s and 1s and the percentage of 1s is approximately p_{zero}. We will call this array *is_zero*.

Second, we generated another distribution based on the array obtained from the previous step: we assigned zero values to the elements that corresponded to one in the *is_zero* array, and the remaining elements followed a negative binomial distribution. The probability mass function of a negative binomial distribution is given by Equation (6.3).

$$P(X = k) = \binom{k + n - 1}{k} \cdot p^k \cdot (1 - p)^n \tag{6.3}$$

where:

- $P(X = k)$ is the probability of k successes,
- n is the number of failures until the experiment is stopped,
- p is the probability of success in a single trial,
- k is the number of successes.

To generate a negative binomial distribution in Python, we used the function `np.random.negative_binomial`[7]. This function takes three parameters: n and p, that come from the formula in Equation (6.3), and *size*, that represents our sample size (115).

We can estimate p by using n and the mean of the distribution, as shown in Equation (6.4).

$$p = \frac{n}{n + mean} \tag{6.4}$$

Therefore, to generate the distributions of number of trips, assuming that they will follow a zero-inflated negative binomial distribution, we need to define three parameters, for each group: (1) p_{zero}; (2) *mean*, and (3) n. We performed the power analysis by considering different combinations of these parameters to generate the corresponding distributions, and using them as input for calculating the expected effect size. We used the following assumptions to define the parameters:

1. p_{zero}: The additional probability of observing zero trips, besides the values in the normal negative binomial distribution. We assumed different values of p_{zero} for each group, reflecting the expected effect of the treatment. We hypothesized that the control group (T1) will have the highest probability of making zero trips, and the experimental group with the highest reward (T3) will have the lowest probability of making zero trips. We decided to set the values of p_{zero} to 30% for T1, 20% for T2, and 15% for T3.

2. *mean*: The mean number of trips per month for each group. This parameter depends on the treatment group. For our assumptions in the power analysis, we will assume

[7] https://numpy.org/doc/stable/reference/random/generated/numpy.random.negative_binomial.html

a mean of the base group (T2) and derive the mean of the other groups from this base mean. We supposed that T1 will make fewer trips than T2 (we fixed the ratio at 0.5) and that T3 will make more trips than T2 (we fixed the ratio at 1.5). Thus, the mean number of trips for T1 and T3 can be derived from the mean number of trips for T2 by multiplying by the corresponding ratio.

3. *n* for the negative binomial distribution: The number of failures until the experiment is stopped. We assumed the same value of n for all groups, equal to the mean number of trips for T2.

As we only had assumptions about the number of trips people will make during the pilot project, we tested different scenarios with different values of the mean number of trips for T2. We iterated through the following values: 6, 12, 18, 24, 30.

Figure 6.3 shows an example of the distributions that we generated for each of the three treatment groups, given a certain mean value for the number of trips in T2.

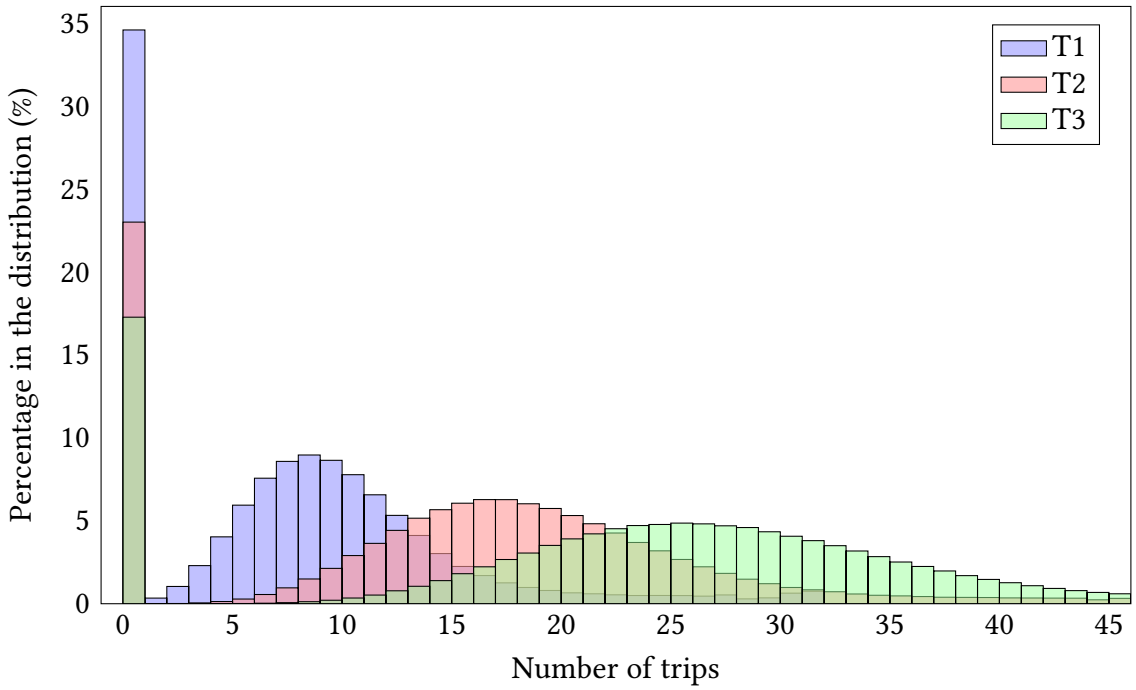


Figure 6.3: *Random zero-inflated negative binomial distributions of the number of trips for the three groups. The distributions were simulated using the following means for each group: 9 trips for T1, 18 trips for T2, and 27 trips for T3. The results were obtained by averaging 10,000 iterations. Own work.*

We performed a power analysis for each value of mean(T2) using the following method: For each value of mean(T2), we generated the distributions of the number of trips for the three groups, based on the specified parameters. Then, we calculated the effect size using the distributions and performed the power analysis. We repeated this process 10,000 times for each value of mean(T2) to account for the randomness in the distribution generation. The final power for each value of mean(T2) was the mean of the power results across the 10,000 iterations. Algorithm 1 shows the pseudocode of this method.

Having demonstrated the derivation of the three parameters required for the power

Algorithm 1 Power analysis method

```
for each value of mean(T2) do
    for i = 1 to 10000 do
        for each group do
            Generate distribution of number of trips
        end for
        Calculate the effect size
        Perform power analysis
    end for
    Calculate mean of stored power results
end for
```

analysis, we will now present the implementation of the power analysis in Python.

6.4.4 Power analysis performance

As indicated in Section 6.4.1, we want to test for statistical significance in two comparisons: (1) T1 vs. T2, and (2) T3 vs. T2. Accordingly, we conducted two power analyses based on the distributions of the groups: one for T1 and T2, and another for T2 and T3. We selected a one-sided test, since we are only concerned with testing the following hypotheses: number of trips(T1) < number of trips(T2) and number of trips(T2) < number of trips(T3). Consequently:

- For T1 vs. T2, we employed a left-tailed test, to test if T1 has a lower mean than T2.
- For T3 vs. T2, we employed a right-tailed test, to test if T3 has a higher mean than T2.

To perform the power analysis in Python, we used the `TTestIndPower.solve_power`[8] function from the `statsmodels`[9] library. This function enables us to estimate one of the four parameters of the power analysis (effect size, sample size, significance level, or power) given the other three as inputs. In our case, we specified the sample size, the significance level, and the expected effect size as inputs, and the function returned the corresponding power value for that scenario. As we mentioned in Section 6.4.3, we ran 10,000 iterations of powers, to account for the randomness of the effect size parameter, and used the mean of power of all the iterations.

Figure 6.4 summarizes the results of the power analysis for the comparisons of T1 and T3, with varying degrees of deviation from the base group (T2). A full version of the results, including the mean and standard deviation of each set of parameters, is available in a CSV file in the repository referenced.

The results indicate that, with a variation between 25% and 30% in the number of trips, the power is above 80%. With variations above 30%, the power usually exceeds 90%. Since we expect that the remuneration should have an impact greater than 30% on the number

[8] https://www.statsmodels.org/dev/generated/statsmodels.stats.power.TTestIndPower.solve_power.html

[9] https://www.statsmodels.org/

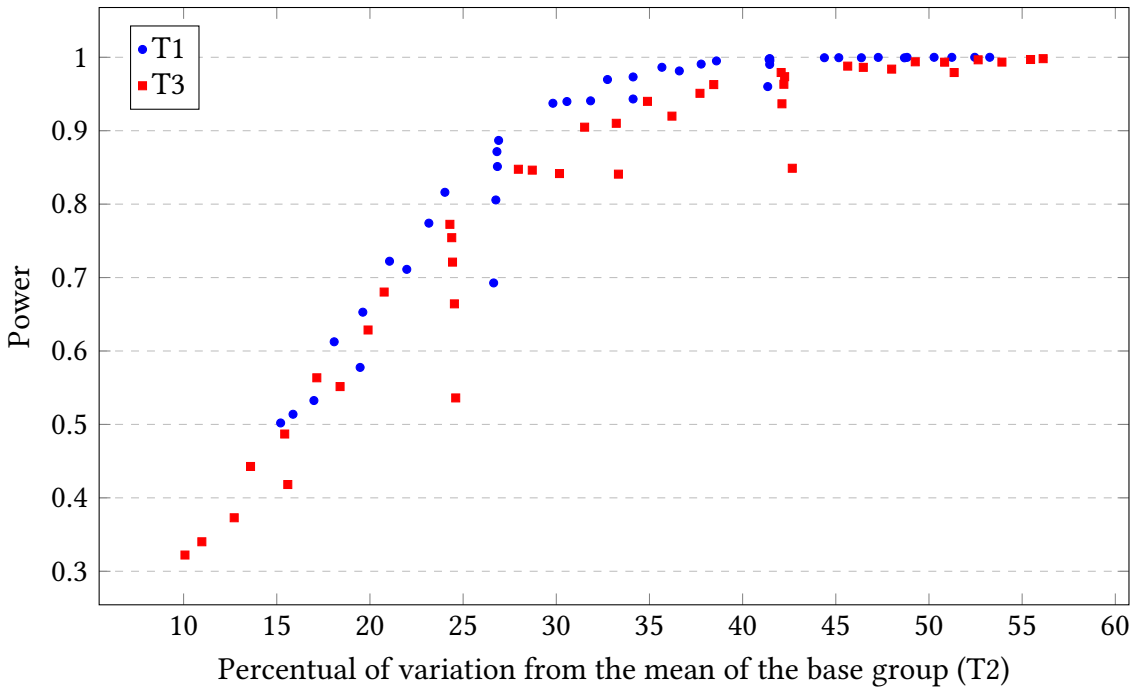


Figure 6.4: *Power analysis curve. The figure shows the level of statistical power obtained in detecting different percentual differences in the mean values of the groups T1 and T3 compared to the reference group T2. Own work.*

of trips to justify the policy implementation, these power levels are acceptable for our case. Therefore, the power analysis confirmed that the sample size of 800 is reasonable, based on the assumptions made in this study.

6.5 Budget estimation

To secure the approval of the city hall for the funding of the pilot project, we conducted a budget estimation for the project. We emphasize that this is only a rough approximation. As mentioned in Section 6.3.4, the remuneration in the third period of the pilot can be adjusted depending on the actual number of trips made by the participants, to keep the pilot within the allocated budget.

The budget consists of two components: the payment per kilometer cycled and the bonus reward for completing the online safety course (see Section 6.2) and the qualitative data questionnaires (see Section 6.3.3). We will estimate each of these components separately.

Regarding the payment per kilometer, we initially calculated the cost by considering the following assumptions:

- Average number of trips per person per month: 42 (2 per day for 21 working days);
- Average distance per trip: 3.5 km.

Next, we calculated the incentive for each group in each period of the pilot project, by

multiplying the total distance traveled by each person by the payment rate per kilometer for that group in that period. The formula for the calculation is shown in Equation (6.5). Table 6.2 shows the values computed for each group using this formula.

$$Payment_{period} = Size_{group} \times N_{trips} \times D_{per\_trip} \times Rate_{per\_km} \times N_{months} \tag{6.5}$$

where:

- $Payment_{period}$ is the total expenditure on bicycle trips for a specific group during a given period of the pilot project,
- $Size_{group}$ is the number of participants in the group,
- N_{trips} is the fixed monthly frequency of bicycle trips for each individual (assumed to be 42 trips),
- D_{per_trip} is the fixed distance covered in each trip (assumed to be 3.5km),
- $Rate_{per\_km}$ is the payment rate per kilometer for the group in a given period,
- N_{months} is the duration of a period in months (in our case, each period consists of 2 months).

Group	$Size_{group}$	1st period	2nd period	3th period	Total
Control	115	R$0	R$9,298	R$0	R$9,298
Exp. 1	115	R$9,298	R$0	R$9,298	R$18,596
	115	R$9,298	R$9,298	R$9,298	R$27,893
	115	R$9,298	R$18,596	R$0	R$27,893
Exp. 2	115	R$18,596	R$0	R$9,298	R$27,893
	115	R$18,596	R$9,298	R$0	R$27,893
	115	R$18,596	R$18,596	R$18,596	R$55,787
Total	805	R$83,680	R$65,084	R$46,489	R$195,253

Table 6.2: *Initial budget estimation for each group during the three periods of the pilot project.*

This way, the total payment for all groups and periods is R$ 195,253. However, this value was derived assuming that everyone will make 42 trips per month of 3.5 km each, which is unlikely. As we indicated in our power analysis, we anticipate some people to not make any trips, and even for those who do, we expect the monthly mean to be lower than 42 trips. For this reason, we will use an estimate of 60% of the total incentive initially calculated, to account for the variability in the number of trips. Thus, the payment component of the budget will be R$ 117,151.65.

Next, we will compute the budget's bonus component. There are four bonuses that will be available to all participants during the pilot: the "Pedal Safely" online course, and the three qualitative data questionnaires. The amount that will be paid for each of these rewards is shown in Table 6.3.

Bonus	Amount	Correspondence
Completion of the “Pedal Safely" online course	R$ 17.60	4 public transportation tickets
Completion of the intermediate questionnaire (between the 1st and 2nd periods)	R$ 13.20	3 public transportation tickets
Completion of the intermediate questionnaire (between the 2nd and 3rd periods)	R$ 13.20	3 public transportation tickets
Completion of the final questionnaire (after the 3rd period)	R$ 17.60	4 public transportation tickets
Total per person	R$ 61.60	14 public transportation tickets

Table 6.3: *Bonus amounts that will be available for the pilot project participants.*

The total bonus amount available per person is R$ 61.60. With 805 participants, the total bonus amount for all participants is R$ 49,588. However, again, it is improbable that every participant in the pilot project will complete all the requirements to receive all the bonuses. To estimate the budget, we will use a conservative value of 70% of the total bonus amount to account for the completion rate. Therefore, the bonus component of the budget will be R$ 34,711.6.

The budget estimation is summarized in Equation (6.6).

$$\begin{aligned} Budget &= \sum(Payment_{per\_km}) + \sum(Bonus) \\ &= 117,151.65 + 34,711.6 \\ &= 151,863.25 \end{aligned} \tag{6.6}$$

Therefore, we estimated the budget for the pilot project to be R$151,863.25. This amount was presented to the City Hall and approved. A more detailed account of this interaction with the municipal administration is provided in Section 8.3.

Chapter 7

Recommendations for the results analysis

The data generated from the implementation of the pilot project will be subjected to analysis, and the findings will inform the formulation of the Bike SP program as a public policy. To facilitate the transition from the pilot project to a viable policy intervention and to prevent the reproduction of injustices, this chapter draws on the social justice literature to propose some recommendations for the future implementation and evaluation of the pilot. These suggestions are grounded on the three dimensions of the Mobility Data Justice framework (Behrendt and Sheller, 2023) that were discussed in Section 4.3: distributive, procedural, and epistemic. The following sections elaborate on the recommendations for each of these dimensions.

7.1 Distributive

The analysis of the pilot project should take into account the disparities in mobility and data in São Paulo across different segments of the population and different areas of the city. These variations have implications for the evaluation of the pilot project and the expansion of its findings. In our analysis in Chapter 5, we identified two main dimensions of this unequal distribution: group-based and spatial-based.

The first dimension is the distribution of mobility among different segments of the population, which is influenced by factors such as gender, age, and socio-economic status. As explained in Section 6.2, we have used some socio-economic and demographic criteria to select participants for the pilot. Therefore, we have the information we need for the analysis of the pilot project to adopt a group perspective.

The second dimension is the spatial-based distribution of mobility and data in São Paulo. The spatial analysis in Section 5.2.3 has shown that the public transportation and cycling infrastructures are unevenly distributed in São Paulo, with a higher concentration in the central (and wealthier) areas. This distribution affects the accessibility and attractiveness of different modes of transportation for distinct areas of the city. Therefore, the analysis of the pilot project should take into account the spatial context of the participants and

their trips. For example, it is not sufficient to analyze quantitative indicators that may indicate that people traveling in central areas are more likely to adopt the policy and thus conclude that future implementations of the policy should focus only on the central areas. It is necessary to understand why the central areas are more favorable for the policy and how to address the barriers and challenges in other areas.

Moreover, we have to consider the intersectionality of these two dimensions. As demonstrated in Chapter 5, there is a correlation between the areas privileged by the mobility network and the areas with the higher classes. Also, there is a possibility of intersection within groups in the first dimension. This way, a young woman from a lower class, for example, living in the peripheral areas of São Paulo, is much more susceptible to facing unfairness in the distribution of mobility and data than someone who has only one of these characteristics. Thus, she may also benefit more from the implementation of the policy. The analysis of the pilot project should consider how this interplay affects the evaluation of the policy.

Therefore, when answering IQ1, which asks how the number of trips varies with different remuneration values, the analysis should also segment this question for each group and each area, and consider how the unequal distribution of mobility and data in São Paulo influences the outcomes.

Additionally, we have to consider the exclusions arising from the data collection process in the pilot. One of the possible sources of exclusion is the requirement to use a mobile application to participate in the pilot project. This may create barriers for people who lack access to smartphones or internet connection, or who are not familiar with the technology. Also, the pilot project only targets those who either possess a bike or can have access to one through a loan or sharing systems. Another factor is the safety perception of cycling, which might deter some people from joining the program. Finally, since the distribution of cycling infrastructure in São Paulo favors the wealthier neighborhoods, effort must be taken to ensure that the middle and upper classes are not unfairly and unintentionally privileged, since the lower classes are the ones who can benefit the most from the financial incentives.

Consequently, the expansion of findings should account for the potential exclusion of certain groups of people from the pilot project, either by the design itself or by the eligibility criteria. A critical question is who is actually included in the data collection process and who is left out.

7.2 Procedural

As discussed in Section 4.1.1, the state still has a dominant role in transportation planning. In contrast, the Bike SP program, through this research, is already involving academic institutions, the government, and cycloactivists to base the implementation of the policy. This collaboration contributes to the procedural dimension of mobility data justice, as it allows for different perspectives and interests to be considered.

Nevertheless, the program still needs to explore ways of engaging the community in decision-making and in the provision of feedback for the policy (see Chapter 7 for

recommendations on this matter). Otherwise, there is a risk of perpetuating historical injustices. Moreover, it is essential to make periodic adjustments to the policy parameters (e.g., the eligibility criteria, the benefit amount for each group, etc.), in order to ensure that the program is responsive and adaptive to the changing needs and preferences of the people. In this regard, it is important to reflect on who will be involved in these adjustments, what criteria will guide these decisions, and, more broadly, who will have a say in future designs of the policy.

7.3 Epistemic

The epistemic dimension of data justice requires us to critically examine what constitutes data in the analysis of the pilot project. The Bike SP program will not only generate data on the impact of financial incentives on cycling behavior, but also provide valuable insights on the cycle routes, and the diverse preferences and motivations of different segments of the population. Besides the number of trips and the remuneration values, we also regard as data all the socioeconomic and demographic aspects presented in Section 6.2.

In this context, the privacy issue has to be addressed. As mentioned in Section 6.3.3, the data collected from the pilot project will serve not only to inform the Bike SP policy, but also to support other initiatives regarding cycling policies in São Paulo. The participants of the experiment will sign an agreement to share their data, which will be analyzed only in an aggregated and anonymized way. However, if the policy is scaled up in the future, the type and amount of data that is necessary should be reconsidered. It is important to determine what should be collected as data in the first place, and how to balance the individual right to privacy with the collective benefits of data sharing. This should be done with transparency and consent from the participants, who should be aware of what they are sharing in exchange for the financial benefits.

Chapter 8

Preparation for the pilot implementation

The implementation of the pilot project requires several preparatory steps. In this research, our objective included both delineating the design of the pilot project and ensuring its readiness for future implementation. To accomplish the latter, we focused on three key aspects: (1) Ethical approval, (2) Mobile application development, and (3) Coordination with the City Hall. This chapter describes the activities undertaken in each of these aspects.

8.1 Ethical Approval

The Research Ethics Committee (CEP)[1] approval is a prerequisite for conducting research involving human subjects. The CEP is in charge of ensuring that the research project complies with ethical principles and guidelines, as well as assessing its suitability, safety, and respect for human dignity (Defesa, 2023). Therefore, to implement the pilot project of Bike SP with citizens in São Paulo, we obtained the CEP's approval. For this purpose, we compiled and submitted all the necessary documents. The project was submitted to CEP through the "Plataforma Brasil" website[2] on June 13th and approved on July 10th. Thus, we can proceed with our pilot project from an ethical standpoint.

The following documents were submitted to the Ethics Committee in this process:

1. **Detailed project description:** A document of 10 pages with a general description of the program. It included the context of the experiment, its significance as a research project, and the actors involved in the research. Moreover, this document contained the objectives, methodology, and experiment design, in a concise version of what we presented in Chapter 6. This document is included in Appendix E.
2. **Free and Informed Consent Form (TCLE)**: A document of 4 pages that all participants in the pilot project will sign. By signing this document, the participants

[1] Comitê de Ética em Pesquisa (CEP/HFA), in Portuguese.

[2] https://plataformabrasil.saude.gov.br/login.jsf

consent to share their bicycle travel data during the pilot and assume responsibility for any potential material, moral, or aesthetic damage incurred during trips related to the project. This form also contains instructions for the participants on the remuneration policy and constraints during the pilot, as described in Section 6.3. The TCLE submitted for approval is attached in Appendix C.

3. **Forms:** The online registration form, described in Section 6.1, and the surveys for qualitative data collection, detailed in Section 6.3.3. The questions that constitute each of these forms can be found in Appendices B and D, respectively.

8.2 Mobile Application development

As outlined in Chapter 6, the execution of the pilot project demands a mobile application to register and validate the bicycle trips of the participants, so that we can reward them and collect the data for the pilot's evaluation. Thus, in preparation for the pilot's implementation, we coordinated the development of this mobile application, by preparing its requirements, hiring developers, and supervising the development process.

In this aspect, the first step consisted of specifying and prioritizing the functionalities of the application, based on their relevance and feasibility. Table 8.1 presents the main functionalities identified in this phase, along with their assigned priorities. Furthermore, in order to facilitate the development process, a prototype was designed to illustrate the sequence and layout of the application screens. The prototype served as a visual guide for the developers to follow and implement the desired features.

Next, we opened a call for internships for the students of the Institute of Mathematics and Statistics of the University of São Paulo (IME-USP) and selected three undergraduate students from the Computer Science department. Later, we hired two more developers to join the team and increase the development capacity.

During the application development, we adopted the agile software development methodology, which consists of iterative and incremental cycles of software delivery (Abrahamsson *et al.*, 2017). The development was divided into two-week sprints, and our main role during the development was to act as the product owner of the application, which entailed defining the tasks for each cycle, providing feedback to the developers, and ensuring that the development met our expectations.

The development of the application began in late May 2023, and an initial usable version was ready in mid-September, only compatible with Android-based operating systems. The development is still ongoing, focusing on the detection and correction of bugs and the addition of tests and minor functionalities. Figure 8.1 displays the user interface of the mobile application developed.

In November, we conducted a beta test of the mobile application in order to assess its performance with external users and to test our mechanism of rewarding and communicating with the participants. This test is detailed in the next subsection.

Figure 8.1: *Screenshots of the user interface of the mobile application for the Bike SP pilot project, taken on November 22nd. The arrows indicate some of the possible navigation paths within the application, but they are not exhaustive.*

Functionality	Description	Priority
Registration and login control	The app restricts access to users who have completed the registration process and were selected.	Critical
Storage of routes	The app stores the sequence of geographic coordinates that correspond to the user's trajectory and the timestamp associated with each coordinate.	Critical
Validation of bike trips	The app verifies whether a trip recorded by a user was actually performed using a bicycle as the mode of transportation.	High
Validation of origin and destination	The app checks whether the user's trip started and ended at the locations of origin and destination predefined by the user during the registration process.	High
Record of the "Validation trip"	The app labels the first trip registered by the user as the "Validation trip" and accepts any mode of transportation for this trip.	Medium
Remuneration control	The app calculates and stores the amount of money earned by the user for a specific trip based on the experimental group he belongs to.	Medium
Contestation interface	The app provides an interface for users to contest rejected trips after the validation step. It should enable the developers to analyze the contestation afterwards and decide whether to approve the contested trips or not.	Medium
Travel history	The app displays the user's current balance and the log of all trips registered in the app.	Medium
Travel monitoring	The app shows the user the progress of their trips in the app.	Low
Qualitative surveys	The app displays the progress of the qualitative surveys completed by the user during the pilot.	Low

Table 8.1: *Main functionalities of the mobile application for the Bike SP's pilot project, together with their priorities*

8.2.1 Beta test

To evaluate the functionality and usability of the Bike SP mobile application, we conducted a beta test with 12 participants over a period of three weeks in November 2023. Beta testing is a stage of software development where the software is tested by external users before it is officially released to the public (ProductPlan, n.d.).

The specific objectives of the beta test were: (1) to identify and resolve any bugs and issues in the application before launching the pilot project; (2) to emulate the communication with participants and the internal organization of the research and development teams, in order to create a good testing environment for the pilot project.

The beta test followed a similar procedure to the one designed for the pilot project, with the participants using the mobile application to record their trips and earning public transportation credits for them. However, some modifications were made to accommodate the particular goals and limitations of the beta test. This section presents the operation and outcomes of the beta test. A timeline of the beta test activities is shown in Figure 8.2.

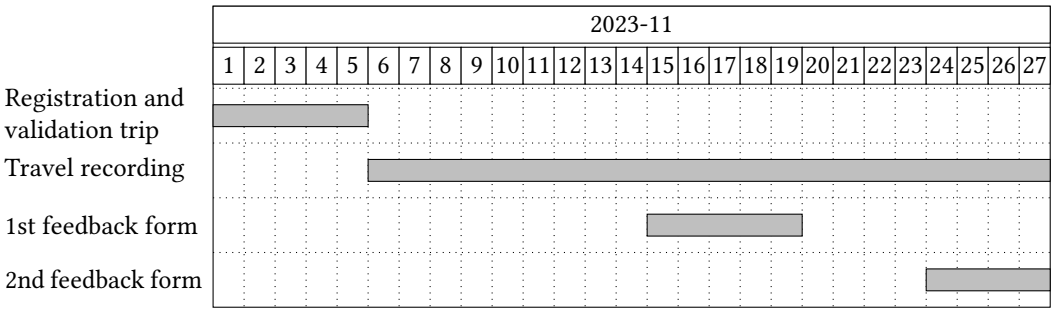


Figure 8.2: *Timeline of the beta test, from November 1st until November 27th.*

Selection of participants:

The participants were selected from our professional network, without an open call for registration as planned for the pilot project. We recruited individuals who were frequent cyclists and who consented to make and record a sufficient number of trips per week using the app, since our objective was to evaluate the functionality of our application, not the effect of the remuneration on their cycling behavior. Furthermore, we sought to achieve a diverse sample of participants in terms of gender, occupation, age, and region, as this would enable a more comprehensive assessment of the app.

The participants were required to complete the same online questionnaire form (described in Section 6.1) that will be used in the pilot project. However, unlike in the pilot, the form was not used as a selection criterion, but rather as a way to test our registration process and collect feedback on our form.

After the initial invitations to the participants, made personally by WhatsApp or phone, we used the same channels of communication that will be used in the pilot project. These channels included email, the Frequently Asked Questions (FAQ) page[3], the "contestation" screen within the Bike SP app, and the feedback questionnaires.

Travel recording:

The "Travel Recording" phase (see Section 6.3) of the beta test lasted for three weeks, during which the participants used the mobile application to record their bike trips and earn credits for them. The credits were based on the distance of the trips and the fixed rate of R$ 0.55 per km, which is the maximum value to be applied in the pilot project. Unlike the pilot project, which will use a "scheduling system" to adjust the credits according to the group and period of the trips, the beta test used a constant rate for all participants. The credits were transferred to the participants' public transport cards weekly, based

[3] The online page, in Portuguese, can be accessed at https://interscity.org/bikesp/piloto/perguntas-frequentes.

on the trips made from Monday to Sunday. The SP Trans platform imposes a minimum amount of R$ 10 for each transfer. Therefore, values below this threshold in one week were accumulated for the next week. The rewards were funded by the InterSCity research project.

Similarly to what will be done in the pilot project, the mobile application automatically verified the trips recorded by the participants and classified them as "approved" or "disapproved" according to whether they were made by bicycle or not, and whether they matched the pre-registered locations of the participants. The participants could contest the disapproved trips in the app, and the development team could review them and change their status. During the beta test, we approved all the contested trips, in order not to discourage the use of the application or penalize the participants for the errors of the algorithm.

During the travel recording period, the participants were asked to fill out a feedback form twice to assess the usability and functionality of the mobile application. To motivate participation, incentives were provided in the form of credits for the public transport card, totaling R$ 22.00 for each completed form[4]. This incentive scheme was similar to the one that will be used to gather the qualitative data in the pilot project (described in Section 6.3.3). However, the purposes and questions of the forms were different. The goal was to obtain feedback on the application, rather than explore the participants' cycling experiences and challenges or supplement the data on the impact of remuneration. Appendix F contains the questions that were asked to the participants.

Results:

The beta test involved 12 participants who completed the registration forms. During the travel recording phase, a total of 128 trips were recorded in the app, made by 10 out of the 12 participants. The remaining two participants did not use the app to record any trips. The number of trips per active participant varied from 2 to 28, with a mean of 6.7 trips per day for the whole sample.

Out of the 128 recorded trips, the app approved 98 while rejecting 30. The rejected trips were either not considered to be made by bike or not made between valid origins and destinations. The participants had the option to contest the app's evaluation, if they disagreed with the rejection of their trips. There were 18 contested trips throughout the testing period, which were reviewed manually and approved by the development team. At the end of the beta testing, there were 116 approved trips and 12 rejected.

Five participants answered the first questionnaire, and nine participants answered the second one. The total incentive paid for the trips was R$ 376.94, and the total bonus paid for the questionnaires was R$ 308. Thus, the total amount credited to the participants during the beta test was R$684.94.

The functionality of the application was one of the main aspects evaluated in the beta testing. The application was tested on a variety of cellphones with different versions of the operational system (Android). It was found that some functionalities were highly sensitive

[4] This amount is equivalent to five public transport tickets at the time of the beta test.

to the system version. The most significant issue encountered was the instability of the GPS recording, which resulted in some trips being disapproved due to the lack of GPS data. This issue was anticipated before the beta testing, as the battery optimization feature in the cellphone could interfere with the GPS data collection. However, the beta testing revealed that other factors, such as the concurrent use of the Bike SP app with other applications, could also affect the GPS recording.

The questionnaires also provided valuable feedback from the users about the app. The users reported a positive experience with the app, giving it a rating between 3 and 5 (average of 4.5). The users also suggested some new functionalities, such as:

1. Incorporate the option to pause the trips in the middle. According to the questionnaire, a significant number of the participants reported making stops along the way. This could be an interesting feature to consider in the pilot project, as it would allow the app to accommodate the users' preferences and needs regarding their travel interruptions or pauses;

2. Implement the option to set a reminder to start a trip in the app at a predetermined time. Alternatively, develop an automatic detection of whether the user is in a valid origin of a trip to remind him to start a trip in the app. This functionality received mixed opinions among the participants, which suggests that it should be optional.

The beta testing also served as a test for our communication with the participants, indicating that a dedicated small team will probably be necessary in the pilot to address the participants' queries. Moreover, it revealed that we should be prepared for the potential need of some participants to modify, during the travel recording phase of the pilot project, the number of their Bilhete Único cards or the addresses pre-registered as valid origins and destinations.

The beta test also served as a demonstration of the potential of Bike SP as a data source, as will be discussed in Section 9.1. Figure 8.3 illustrates the distribution of the routes of trips conducted during the beta test, along with the cycling infrastructure. The results were aggregated to protect the privacy of the participants. Even with a small sample and in a limited period of time, it is already evident that people tend to follow the cycling infrastructure, and it is possible to identify some gaps that could inform the construction of future cycle paths. This scaled up in the pilot and subsequently in the policy could effectively inform the cycling infrastructure investments in the city.

8.3 Coordination with the City Hall

This section reports on the collaboration established with the public authorities, namely the São Paulo Municipal Secretariat of Mobility and Transit (SMT), to design and implement the pilot project. The interaction with SMT involved several aspects, such as budget, legal procedures, remuneration of participants, and pilot dissemination, which are described below:

Budget: The budget proposal for the pilot project was discussed and agreed upon with SMT between March and May 2023. As presented in Section 6.5, the budget was based on the sample size required for a statistical analysis of the pilot outcomes, as well as the

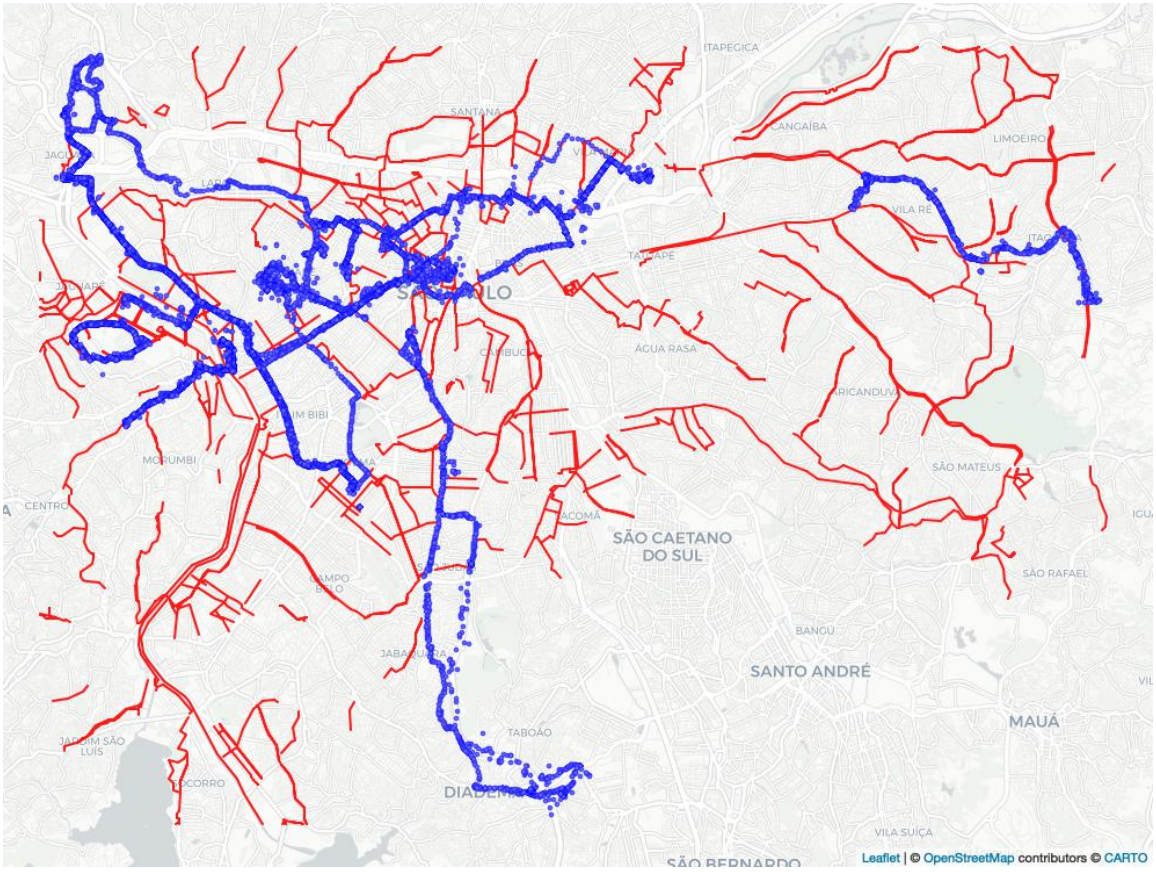


Figure 8.3: *Spatial distribution of trips during the beta test. Travel GPS points are shown in blue and cycle paths and cycle lanes in red. The image was generated using the map view function*[a] *in the R programming language*[b].

[a] https://cran.r-project.org/web/packages/mapview/index.html

[b] https://www.r-project.org/

estimation of the number of bicycle trips that each participant would make during the pilot period. SMT agreed to allocate the necessary resources for the implementation of the pilot project, while InterSCity would finance the development of the mobile application discussed in Section 8.2. In September 2023, the Bike SP program was incorporated into the law project that stipulates the annual budget law of the city[5] for the year 2024.

Legal Aspects: The legal procedures required to implement the pilot project were discussed with the SMT legal team in May 2023. One of the debates was whether the inclusion of an online course on road safety would provide more legal certainty for the pilot project. The SMT legal team also approved the documents submitted to the Ethics Comittee, detailed in Section 8.1.

Participant compensation: The remuneration mechanism for the participants will consist of credits on the Bilhete Único system, as mentioned in Chapter 6. In order to enable this mechanism, there were some meetings with the São Paulo public transportation

[5] Lei Orçamentária Anual (LOA), in its original name in Portuguese. The LOA 2024, which includes Bike SP, is available at this link.

agency (SP Trans[6]) between July and August 2023, to discuss the technical aspects of how the payment system would work and the requirements and specifications for the platform and the mobile application.

Pilot dissemination: The future dissemination of the pilot project was aligned with the communication team of SMT. As explained in Section 6.1, the City Hall will make an official announcement to promote the program. For this end, we prepared a media release and compiled a list of frequently asked questions to be published on a webpage for participants. These documents can be found in Appendices A and G, respectively.

The project design was also presented in July to the Secretary of Mobility and Transit, who granted his approval to the implementation and funding of the pilot project.

[6] https://www.sptrans.com.br/

Chapter 9

Potential of Bike SP beyond financial incentives

Based on the background information on financial incentives for cycling, mobility data justice, and the cycling context of São Paulo, and on applying this knowledge to the design of the pilot project, we can argue that the Bike SP program is not merely a remuneration policy. Rather, Bike SP can also offer potential features that can enhance the effectiveness and fairness of other cycling initiatives and of mobility in general. This chapter will explore some of these benefits, and provide some examples and recommendations for future implementations of the policy, in three main directions: potential of the program in generating cycling data, potential to enhance the equity of mobility, and other strategies that can foster synergies between cycling initiatives.

9.1 Bike SP as a data source

As discussed in Section 4.2, cycling remains a largely unobserved mode of transportation, and there is a lack of comprehensive data on cycling patterns in São Paulo. In this context, the Bike SP program not only positions itself as a way to promote cycling as a mode of transportation by offering financial incentives, but also as a source of rich data that can support and improve other cycling initiatives in São Paulo. The pilot project design in this research will already offer part of this data, in a small scale, but there are several other possibilities if the policy is scaled up. The data that can be collected through the Bike SP program include:

Cycle routes: The mobile application that the participants will use to register their trips records the routes that they take from their origins to their destinations. This can reveal the actual preferences and behaviors of the cyclists. It can also indicate the factors that influence their route choices, such as the availability and quality of cycling infrastructure, the safety and security conditions, and the topography and distance of the areas. This data can help the public authorities to identify the gaps and needs in the existing cycling network, and to prioritize the investments in cycling infrastructure in areas with high potential demand.

Bike parking: In the registration phase, as explained in Section 6.1, the candidates will indicate their origins and destinations, and there will be a specific question to indicate possible public transportation stations that they will travel to during the pilot. This will enable the public authorities to use this data to easily identify the stations that have the highest potential for multimodal integration, and that can benefit from the provision of bike parking facilities. This data can also be used to evaluate the impact of bike parking on the travel behavior of the participants. For example, the public authorities can compare the rates of multimodal trips between the stations that already have bike parking and those that do not.

Cycling barriers and attitudes: The qualitative data that will be gathered during the pilot, presented in Section 6.3.3, can provide insights into the perceptions and attitudes of the participants towards cycling. This can include the reasons that motivate or discourage them from cycling, the criteria that they use to select their routes, and the challenges and benefits that they experience from cycling. This mechanism of qualitative data collection can continue even after the pilot. This data can help the public authorities to understand the needs and preferences of the cyclists, and to design policies and programs that can address them.

Cycling community: The Bike SP program can also create an opportunity to engage and empower the cycling community in São Paulo. The public authorities can use the data to communicate and collaborate with the cyclists, and to involve them in the decision-making process. For instance, the mobile application can incorporate elements of crowdsourcing, and allow the cyclists to provide feedback and suggestions on cycling initiatives. This can enhance the effectiveness and acceptability of cycling policies, and foster a society-centric approach to transportation planning in São Paulo. Moreover, Bike SP can also facilitate interaction within the cycling community, enabling, for example, the coordination of group cycling trips for safety in numbers.

The public authorities can use this data from the Bike SP program to inform their decisions and actions, and to design and implement cycling programs that are more effective and responsive to the needs of the cycling community. The data can also help the public authorities to evaluate the impact of the cycling initiatives, and to identify the areas that need further improvement.

9.2 Potential to enhance the equity of mobility

As discussed in Section 4.1, mobility justice is not only about distributing mobility resources equitably among the population, but also about making mobility accessible and inclusive for everyone. The Bike SP program can contribute to enhancing the fairness of mobility in São Paulo, by offering people the opportunity to access the mobility network of São Paulo by cycling and subsidizing their subsequent trips with public transportation credits. For instance, with the highest value adopted by the pilot project (R$0.55 per km), people can pay for one public transportation ticket by cycling for 8km (which takes around 20-40 minutes at an average speed of 12km/h – 24km/h).

Moreover, the remuneration policy in Bike SP can be complemented by other initiatives to encourage and enable people to cycle. In the future, the policy can also target those who

do not own a bike. One possible initiative is an earn-a-bike program, where the government lends a bike to someone for their trips, and after a certain number of trips registered in the app, the person can keep the bike and start to earn for their trips as well. Another possible initiative is a bike recycling program, where the government collects unused bikes from people in exchange for public transportation credits, and then distributes them to those who need a bike and want to participate in the Bike SP program. As shown in Section 5.2.4, there are a lot of unused bikes in São Paulo that can be repurposed for this initiative.

Additionally, the participant selection process enables the government to prioritize some marginalized groups of the population, and reduce the effects of the unequal distribution of current cycling investments. This is not a substitute for the development of cycling infrastructure, but rather a supplementary measure to redress past inequalities and to broaden the scope of cycling benefits.

9.3 Additional strategies to increase the potential of Bike SP

Besides the remuneration policy, there are other methods that can increase the potential of the Bike SP program to promote cycling in São Paulo. This section will explore some of these strategies.

Gamification: The Bike SP program can also introduce gamification elements to motivate and reward the participants. For example, the program can set performance indicators, put parameters of performance, monitor health parameters, track distance cycled, estimate carbon credits, and offer prizes to active members of the community. The program can also allow the participants to donate their credits earned by cycling to a good cause.

Partnerships with companies: Partnerships with companies can be a way of funding the program, and providing the employers with an overview of the number of kilometers cycled by their employees. This way, the companies can also pursue their sustainability objectives, such as reducing their carbon footprint, improving their corporate social responsibility, and enhancing their brand image. The Bike SP program can be part of the package of benefits offered by the companies to their employees who cycle, since many companies already have a budget dedicated to commuter benefits and transit passes. The policy can be a way to extend these benefits to employees who cycle to work, and to encourage more employees to adopt cycling as a mode of transportation. This public-private partnership is consistent with the adoption of similar policies in other countries, as reviewed in Section 3.1.

Carbon credits conversion: A system that converts bicycle use via the app into carbon credits is a potential feature for the future development of the Bike SP program, which could follow the example of Tembici, a bike-sharing company that has implemented a similar initiative. To explore this possibility, we conducted an interview with the Tembici representatives who are responsible for this carbon credit initiative. They explained that

they use a UN-approved methodology[1]to quantify the CO2 emissions avoided by their bike system and then sell the credits in the carbon market. However, they also noted that the credits generated by an individual user are not very significant and that it would be more appealing to aggregate the credits at the community level. For instance, the Bike SP app could accumulate the carbon credits from its users and offer prizes to the most active participants or conduct a lottery among the community. To integrate this feature into Bike SP in the future, a more detailed study is required. Some of the key aspects to consider are:

1. The ownership of the credits, which requires proving that the bicycle use is attributable to the program. This is relatively easy for Tembici, since they own the bicycles on their sharing system and can assume that the users are riding them because of their service. However, this is more complex for Bike SP, since the users may own their bicycles and cycle independently of the program. Therefore, the data from the modal shift section of the online registration surveys described in Section 6.1 would be necessary to establish the causal link between the program and bicycle use.
2. The prevention of double counting, which could occur if both Bike SP and Tembici claimed credits for the same bicycle trip, for example.

However, regardless of actually using the carbon credits for monetary conversion, a useful feature for the app would be to estimate the carbon credits saved from a certain trip and display them to the user as an additional motivation for them to cycle and as a conscientization measure. A similar feature is already present in the Tembici mobile application.

[1] CDM-UNFCCC AMS-III.BM: Lightweight two and three wheeled personal transportation.

Chapter 10

Conclusion

This capstone project proposes a systematic methodology that enables the future implementation and assessment of the Bike SP Program based on empirical evidence. To achieve this, we designed and prepared the execution of a pilot project for the policy. This final chapter summarizes the key findings of this work, the contributions, limitations, and directions for future research.

10.1 Key findings

In this section, we present the main findings of our research on the public policy of financial incentives for cycling in the city of São Paulo, Brazil. We highlight the importance of an interdisciplinary perspective, the challenge of ensuring data representativeness, and the potential of the policy.

Importance of an interdisciplinary perspective: A public policy of financial incentives for cycling is a complex and multidimensional intervention that requires a comprehensive and interdisciplinary approach. The policy design, implementation, and evaluation should consider not only the economic and environmental aspects, but also the social and behavioral ones. To do so, the policy should draw on various fields of knowledge, such as statistics, computer science, economics, experimental modeling, and social science. The policy should also be sensitive to the contextual factors that may influence the policy outcomes. Each of these elements was essential for the design of the pilot project.

Challenge of ensuring data representativeness: The participant selection for the Bike SP public policy should account for the current scenario of an unequal distribution of cycling investments in the city. Therefore, the selection criteria should ensure a representative sample of the population as a whole, not only of the population that is more prone and convenient to adopt cycling. Both the implementation and the analysis of the pilot project should consider the fact that different groups of the population will have different responses and different degrees of benefit from the policy. The policy should also be used as a mechanism to prioritize people who are currently disadvantaged in terms of mobility and cycling investments.

Potential of the policy: A policy of financial incentives for cycling has multiple dimensions and implications beyond rewarding people and inducing them to cycle. There are many other potential benefits. For instance, such a policy can produce valuable cycling data and foster a cycling community, which can in turn inform and integrate other mobility policies in the city.

10.2 Contributions

This work contributes to the field of cycling mobility in four main ways.

First, it conducted a data analysis of cycling in São Paulo, informed by the mobility and data justice literature review, and revealed demographic and socio-economic inequalities in cycling within the city. This analysis serves as the basis for the pilot project of Bike SP in this work, and can also inform other cycling policies in São Paulo. Moreover, it reviewed existing implementations of financial incentives for cycling and discussed them, providing a useful reference for this type of policy.

Second, it designed a pilot project for Bike SP and prepared the main requirements for its implementation. It defined the objectives, recruitment plan, target population, sample size, treatment groups, intervention period, budget, and outcome variables of the pilot. It also obtained the approval of the Ethics Committee for the pilot, coordinated the development and testing of the mobile application that will record the cycling trips of the participants, and aligned all steps of the research with the City Hall of São Paulo. Thus, it ensured the readiness of the pilot for execution, pending the official approval of the annual budget.

Third, it formulated questions and recommendations for post-implementation analysis of the pilot, to scale it up into a public policy. It proposed a set of implementation questions to assess the impact of the policy in São Paulo, and suggested a mobility and data justice perspective for the analysis. Furthermore, it outlined the future potential of the policy and how to incorporate other strategies to maximize its benefits.

Finally, this work contributes to the field of transportation planning by illustrating how to design a feasible pilot project that can provide valuable insights and evidence for public policy decisions. This approach can be generalized and applied to other policy domains that require rigorous evaluation and experimentation.

10.3 Limitations and future work

This capstone project has some limitations that should be acknowledged and addressed in future research.

One limitation is related to the fairness of the pilot design. During the design process, we aimed to account for and address elements of social justice. Nevertheless, some potential beneficiaries of the policy may still be excluded from cycling due to safety reasons, for example, which disproportionately affect the most vulnerable segments of the population. Therefore, we argue that the Bike SP program should not be seen as a way to transfer

responsibility to the individual for their cycling choice, but rather as a component of a broader set of measures to enhance the safety and quality of cycling in the city, in order to achieve a truly fair cycling environment.

Another limitation is associated with the scope and duration of the pilot intervention, which will involve a small sample of the population and last for a few months. Thus, it will not be enough to capture the long-term and large-scale effects of the policy, such as improvements in health and well-being or reductions in greenhouse gas emissions. Therefore, the pilot intervention should be complemented by other methods and data sources to assess the impact of the policy in a more comprehensive and robust way. The pilot is the initial step to enable the policy's implementation and should be followed by progressively larger and longer implementations of the policy, which should also incorporate the strategies suggested in Section 9.3.

Finally, this research does not include the implementation and evaluation of the pilot project, which is left for future work.

Appendix A

Media release for Bike SP

Título: Projeto da Prefeitura dará créditos no Bilhete Único para quem usar bicicleta

Subtítulo: Inscrições para o projeto-piloto do Bike SP, programa que vai conceder créditos no Bilhete Único de quem optar por fazer seus deslocamentos de bicicleta, começam nesta sexta-feira, dia 15 de setembro

Conteúdo

A cidade de São Paulo vem ampliando sua malha cicloviária e já conta com a maior rede dedicada aos ciclistas do Brasil, com 722 km de extensão. Até o fim do ano que vem, 2024, o objetivo da Prefeitura, por meio da Secretaria de Mobilidade e Trânsito, é atingir os 1.000 km de vias com tratamento para quem pedala. Agora, um novo instrumento de mobilidade vai ajudar a fomentar o uso da bicicleta como meio de locomoção entre os paulistanos: o projeto-piloto do programa Bike SP. Trata-se de uma parceria com o Departamento de Ciência da Computação do Instituto de Matemática e Estatística da USP (IME-USP). A meta da Capital é quintuplicar o número de ciclistas nas ruas até 2030, conforme previsto no Plano de Ação Climática do Município de São Paulo 2020-2050.

As inscrições dos interessados em participar do projeto-piloto vão até 15 de outubro e podem ser feitas pelo formulário online no link bit.ly/bikesp-cadastro. A iniciativa concederá créditos no Bilhete Único para quem passar a usar a bicicleta em seus deslocamentos para o trabalho ou local de estudos. A lógica do programa é incentivar o uso da bicicleta aumentando o acesso de quem pedala ao transporte público.

O secretário de Mobilidade e Trânsito, Celso Gonçalves Barbosa, entende o Bike SP "como um importante passo da Prefeitura no sentido de ampliar a participação da mobilidade ativa dentre as viagens realizadas na cidade diariamente, enquanto estimula também a utilização do transporte público coletivo". Na visão dele "é o conjunto das ações da Gestão que vai garantir a concretização da 'Cultura da Bicicleta' na cidade, ou seja, a ampliação e a conservação da malha; e, agora, o estímulo ao uso do modal".

O programa Bike SP foi criado pela lei municipal 16.547/2016 com o objetivo de ajudar

a promover uma migração dos modos de transporte motorizados para a bicicleta. Entre 2021 e 2022, a SMT encomendou um estudo para o Banco Mundial que apontou que, a depender da remuneração percebida pelas pessoas, a iniciativa pode ser quase tão forte na decisão de escolher a bicicleta quanto a existência de infraestrutura cicloviária.

Mas ainda restam algumas dúvidas relacionadas à implementação, tais como qual valor deverá ser concedido por quilômetro rodado e quais públicos deverão ser priorizados quando o programa for efetivado. São essas questões que o projeto-piloto buscará responder na prática.

"A SMT nos procurou para aprimorar a pesquisa sobre o Bike SP. Nossa intenção ao transformá-lo em um projeto-piloto nas ruas foi a de utilizar o método científico para compreender como o programa funcionaria em um ambiente real. Iremos extrair as respostas necessárias a partir da análise do comportamento de novos ciclistas, que vejam na possibilidade de receber uma bonificação o impulso que faltava para adotarem a bicicleta", explica Fabio Kon, professor de Ciência da Computação do IME-USP e coordenador do INCT da Internet do Futuro para Cidades Inteligentes, que conduz a pesquisa e analisará seus resultados.

Como vai funcionar o projeto piloto?

As pessoas selecionadas usarão um aplicativo desenvolvido pelo IME-USP especialmente para o Bike SP (num primeiro momento, apenas para celulares Android). Elas registrarão seus deslocamentos de bicicleta para fins de estudo, trabalho ou residência entre destinos pré-cadastrados e receberão créditos no bilhete único equivalentes às distâncias percorridas. Poderão ser creditadas até duas viagens por dia.

A bonificação será repassada semanalmente para os cartões cadastrados, devendo ser validada nas máquinas de recarga de Bilhete Único existentes em terminais e estações de transporte público da cidade. Os créditos recebidos poderão ser utilizados normalmente nos ônibus municipais e metropolitanos, assim como no metrô e no trem.

Como vai funcionar o processo seletivo?

Qualquer pessoa maior de idade, residente na cidade de São Paulo que saiba pedalar, tenha acesso a uma bicicleta durante a duração do projeto e não tenha impedimentos de saúde pode se inscrever desde que tenha um Bilhete Único ativo. Quem se interessar por participar do projeto piloto deve manifestar sua intenção se inscrevendo no formulário online pelo link bit.ly/bikesp-cadastro até o dia 15 de outubro. O cadastro leva cerca de 20 minutos para ser preenchido. As regras detalhadas estão em https://interscity.org/bikesp/piloto/.

Serão selecionados cerca de 800 participantes. O resultado ficará disponível no site da SMT e do InterSCity a partir do dia 17 de outubro. Mas fique atento(a)! As pessoas selecionadas receberão um email de aviso e terão uma semana para confirmar a participação. Uma segunda chamada para vagas remanescentes será aberta no dia 25 de outubro. O projeto piloto começa de fato nas ruas no dia 1º de novembro e está previsto para durar 6 meses.

Appendix B

Registration forms

Título do documento: Questionário de cadastro para o Bike SP

B.1 Seção 1: Filtro da pesquisa

Você sabe andar de bicicleta? ( ) sim ( ) não

Você tem algum problema que te impeça de realizar exercícios físicos? ( ) sim ( ) não

Você tem uma bicicleta própria para usar para o projeto piloto? ( ) sim ( ) não

Se respondeu não ao item anterior, como você conseguirá acesso a uma bicicleta para utilizar durante o programa? ( ) comprarei ( ) pegarei emprestada ( ) usarei bicicletas compartilhadas (Bike Itaú, Bike Bradesco) ( ) outros _____

B.2 Seção 2: Termo de Consentimento Livre e Esclarecido (TCLE)

Esta seção trará o texto do TCLE na íntegra para leitura e checkboxes para validação de leitura e concordância sobre seu conteúdo. Também trará um link para que as pessoas possam baixar o PDF do TCLE.

[TEXTO DO TCLE] (Appendix C)

Tendo em vista os itens acima apresentados, eu, de forma livre e esclarecida, manifesto meu consentimento em participar da pesquisa. Declaro que autorizo a realização da pesquisa e a divulgação apenas dos resultados obtidos neste estudo. ( ) sim

Autorizo a coleta e a utilização computacional das informações das viagens que eu registrar no aplicativo do programa e das minhas respostas aos formulários e questionários apresentados. ( ) sim

O link para acessar o PDF do TCLE é este aqui: <link>. Por favor, pedimos que você baixe uma cópia deste documento. Pessoas selecionadas para a pesquisa também receberão uma

cópia dos termos junto com o email de confirmação de participação.

B.3 Seção 3: Informações pessoais

Nome completo: _____

Data de nascimento: _____

Sexo: ( ) Masculino ( ) Feminino

Raça: ( ) Branca ( ) Preta ( ) Parda ( ) Amarela ( ) Indígena ( ) Outros _____

RG: _____

CPF: _____

Você possui um Bilhete Único cadastrado no seu nome? (obrigatório para poder se inscrever) ( ) sim ( ) não

N° do Bilhete Único cadastrado no seu nome: _____

Email para contato: _____

Telefone celular (precisa ser o mesmo que será usado para o projeto piloto): _____

Sistema operacional do telefone: ( ) Android ( ) Apple ( ) Outros

Você tem o programa WhatsApp instalado no telefone? ( ) sim ( ) não

Se não tem, poderia instalar caso seja selecionado para o projeto piloto? ( ) sim ( ) não

Confirmo que poderei instalar o aplicativo do Bike SP para participar do projeto piloto: ( ) sim ( ) não

Endereço completo de residência:
Observação: Lembre-se que é preciso ser residente na cidade de São Paulo para participar da pesquisa

Rua: _____
Número: _____
Complemento:_____
Bairro: _____
CEP: _____
Cidade: _____
Estado: _____

Incluindo o(a) Sr(a), quantas pessoas moram na sua casa/apartamento, ou seja, quantas pessoas dormem e fazem suas refeições na maioria dos dias da semana lá? _____

Renda mensal estimada do seu domicílio, isto é, a soma da renda mensal de todas as pessoas que moram na sua casa/apartamento:

( ) R$ 0 a R$ 1.320
( ) R$ 1.321 a R$ 2.640
( ) R$ 2.641 a R$ 3.960
( ) R$ 3.961 a R$ 6.600
( ) R$ 6.601 a R$ 13.200
( ) R$ 13.201 a R$ 26.400
( ) R$ 26.401 a R$ 39.600
( ) Acima de R$ 39.600

Você estuda regularmente? ( ) Não ( ) 2° Grau / Médio ( ) Superior / Universitário ( ) Outros

Grau de Instrução: ( ) Não alfabetizado / Fundamental I incompleto ( ) Fundamental I completo / Fundamental II incompleto ( ) Fundamental II completo / Médio incompleto ( ) Médio completo / Superior incompleto ( ) Superior completo
Observação: O Ensino Fundamental I corresponde ao período da 1ª à 4ª série do 1º grau (antigo Ensino Primário); o Ensino Fundamental II corresponde ao período da 5ª à 8ª série do 1º grau (antigo Ginásio); o Ensino Médio corresponde ao período da 1ª à 3ª (ou 4ª) série do 2º grau (antigo Colegial); o Superior corresponde ao 3º grau ou nível Universitário.

Condição de Atividade: ( ) Tem trabalho regular (formal ou informal) ( ) Faz atividades esporádicas e ganhos são avulsos ( ) Em licença médica ( ) Aposentado / pensionista ( ) Sem trabalho / desempregado ( ) Dona de casa ( ) Estudante sem trabalho regular

Vínculo empregatício: ( ) Assalariado com carteira ( ) Assalariado sem carteira ( ) Autônomo ( ) Empregador / Dono de negócio familiar ( ) Nenhum

Renda mensal individual (considerar média dos últimos 3 meses): ( ) R$ 0 a R$ 1.320
( ) R$ 1.321 a R$ 2.640
( ) R$ 2.641 a R$ 3.960
( ) R$ 3.960 a R$ 5.280
( ) R$ 3.961 a R$ 6.600
( ) R$ 6.601 a R$ 7.920
( ) R$ 7.921 a R$ 9.240
( ) R$ 9.241 a R$ 10.560
( ) Acima de R$ 10.560

Na última semana, quantas viagens para o trabalho e para local de estudo você fez ao total? (ida e volta contam como duas viagens)
Inserir quantidade por modo de transporte. Não considerar viagens feitas com outras finalidades, como compras ou lazer.

_____ Inteiro a pé
_____ Combinação A pé + Transporte público
_____ Em bicicleta
_____ Em Combinação Bicicleta + Transporte público
_____ De ônibus
_____ De trem ou metrô
_____ Combinações entre diferentes transportes públicos (ex. Ônibus + Trem)
_____ De carro particular / aplicativo

_____ De moto
_____ Combinação Carro ou Moto + Transporte público
_____ Outros modos e combinações de transporte

B.4 Seção 4: Informações sobre viagens

Durante a pesquisa, você precisará usar um aplicativo no seu celular para registrar as rotas realizadas em bicicleta. A bonificação será concedida por quilômetro rodado, no formato de créditos inseridos diretamente nos Bilhetes Únicos nominais dos participantes. Serão consideradas somente as viagens em bicicleta realizadas entre os locais cadastrados neste formulário. A distância mínima da viagem para ser validada é de 1 km. Viagens acima de 8 km podem ser registradas, mas receberão o mesmo valor de teto calculado para a distância de 8 km. Para este piloto, de forma a considerar ida e volta, serão remuneradas as 2 primeiras viagens registradas por dia e até 42 viagens por mês. Viagens realizadas no final de semana também poderão ser consideradas (para pessoas que trabalhem ou estudem de final de semana).

Você pode cadastrar até três trajetos com origem e destino, além de 5 estações ou terminais de transporte, para serem consideradas na pesquisa. Todas as origens e destinos precisam estar dentro do território do município de São Paulo.

Cadastre apenas de onde você sairá (origem) e para onde pretende ir (destino). Não é preciso cadastrar o caminho de volta pois ele já será considerado como válido. Se você pretende, por exemplo, pedalar de casa até o local de trabalho ou de estudo, cadastre a sua residência como origem e o local de trabalho/estudo como destino (não faça um segundo cadastro do local de trabalho/estudo como origem e da casa como destino).

No caso das estações de trem, estações de metrô e terminais de ônibus, os trajetos para eles serão considerados como válidos desde que a viagem tenha origem em um dos destinos cadastrados e esteja dentro dos limites contidos no primeiro parágrafo.

Importante: se você for selecionada(o) para participar da pesquisa, não será possível mudar os trajetos cadastrados aqui.

B.4.1 Trajeto 1

Origem 1
Dê um nome para este local (por exemplo: casa, trabalho, universidade, escola): _____
Rua: _____
Número: _____
Complemento: _____
Bairro: _____
Região da cidade ( ) Leste ( ) Oeste ( ) Sul ( ) Norte ( ) Centro

Destino 1
Dê um nome para este local (por exemplo: trabalho, universidade, escola): _____
Rua: _____

Número: _____
Complemento: _____
Bairro: _____
Região da cidade ( ) Leste ( ) Oeste ( ) Sul ( ) Norte ( ) Centro

Sobre este trajeto Origem-Destino que você acabou de registrar: ( ) Eu já faço este trajeto frequentemente ( ) Vou passar a fazer este trajeto devido ao piloto

O objetivo dessa viagem é deslocar-se para:
( ) Local de trabalho - Indústria
( ) Local de trabalho - Comércio
( ) Local de trabalho - Serviços
( ) Local de estudos
( ) Outros _____

Quanto tempo (em minutos) você costuma levar neste trajeto? _____

Qual modo de transporte você utiliza nesse trajeto? (considere somente o trajeto entre a origem e destino informados) ( ) Inteiro a pé
( ) Combinação A pé + Transporte público
( ) Em bicicleta
( ) Em Combinação Bicicleta + Transporte público
( ) De ônibus
( ) De trem ou metrô
( ) Combinações entre diferentes transportes públicos (ex. Ônibus + Trem)
( ) De carro particular / aplicativo
( ) De moto
( ) Combinação Carro ou Moto + Transporte público
( ) Outro _____

Neste trajeto, se fosse/vai de bicicleta, você avalia que: ( ) usarei ciclovias e ciclofaixas por todo o caminho
( ) usarei ciclovias e ciclofaixas em boa parte do caminho
( ) usarei ciclovias e ciclofaixas somente em parte do caminho (metade ou menos)
( ) não há ciclovias e ciclofaixas, mas a maior parte do caminho é de vias tranquilas
( ) não há ciclovias e ciclofaixas no caminho e as vias são perigosas
( ) não saberia dizer neste momento

[REPETIÇÃO DA SEÇÃO DO TRAJETO 1 PARA TRAJETOS 2 E 3]

B.4.2 Estações e terminais de transporte público

Caso queira cadastrar locais de transporte público como possíveis destinos, escolha-os da lista a seguir:

Estação de transporte 1: [lista dropdown]
Estação de transporte 2: [lista dropdown]
Estação de transporte 3: [lista dropdown]
Estação de transporte 4: [lista dropdown]

Estação de transporte 5: [lista dropdown]

B.5 Seção 5: Possibilidade de migração

Caso você recebesse um incentivo de R$ 2,20 para cada 8 km percorridos, você consideraria realizar um ou mais dos seus trajetos atuais em bicicleta? ( ) sim ( ) não

Se respondeu não para a questão anterior, quais os motivos de não fazê-lo?
( ) insegurança viária (medo de compartilhar as ruas com veículos motorizados)
( ) insegurança pública (medo de assalto, assédio)
( ) falta de ciclovias ao longo do caminho
( ) o incentivo é baixo
( ) outros: _____

Se respondeu sim na questão anterior, quantas viagens você estima que faria por semana em bicicleta com o incentivo financeiro? _____

Caso você recebesse um incentivo de R$ 4,40 para cada 8 km percorridos, você consideraria realizar um ou mais dos seus trajetos atuais em bicicleta? ( ) sim ( ) não

Se respondeu não para a questão anterior, quais os motivos de não fazê-lo?
( ) insegurança viária (medo de compartilhar as ruas com veículos motorizados)
( ) insegurança pública (medo de assalto, assédio)
( ) falta de ciclovias ao longo do caminho
( ) o incentivo é baixo
( ) outros: _____

Se respondeu sim na questão anterior, quantas viagens você estima que faria por semana em bicicleta com o incentivo financeiro? _____

B.6 Seção 6: Finalização

Estou ciente que o preenchimento deste formulário não garante a minha seleção para o projeto piloto: ( ) sim

Estou ciente que se for selecionada(o), o registro das rotas para bonificação requerem estar com o aplicativo ativo e conectado à internet durante as viagens: ( ) sim

Declaro que as informações contidas neste formulário e preenchidas por mim são verídicas: ( ) sim

Appendix C

Free and Informed Consent Form (TCLE)

Título do documento: Termo de Consentimento Livre e Esclarecido

1. **Natureza da pesquisa:** o(a) Sr.(a.) está sendo convidado(a) a se candidatar para participar da pesquisa "Política de bonificação a ciclistas: Um estudo de caso na cidade de São Paulo", que tem como finalidade avaliar o impacto que recompensar pessoas por andar de bicicleta tem sobre a migração modal. Durante o estudo, também referido neste termo como projeto piloto, o(a) Sr.(a.) registrará suas viagens de bicicleta em um aplicativo desenvolvido especialmente para esse fim e receberá créditos no seu Bilhete Único por quilômetro rodado. Os créditos recebidos poderão ser utilizados normalmente no pagamento das tarifas de transporte público. A bonificação será variável durante a pesquisa, ficando entre zero e R$ 0,55 por quilômetro rodado em alguns momentos. A dinâmica do projeto está descrita nos itens abaixo:

(a) De forma a demonstrar seu interesse em participar da pesquisa, o(a) Sr.(a.) deverá preencher um formulário de cadastro, informando dados pessoais e relativos às viagens em bicicleta que pretende fazer durante o intervalo de vigência do estudo (6 meses). O objetivo do formulário é determinar seu perfil demográfico e socioeconômico e a validade de sua candidatura. O(a) Sr.(a.) se responsabiliza pela veracidade das informações fornecidas, estando ciente de que o preenchimento do cadastro não garante a seleção para o projeto piloto.

(b) Caso seja selecionado(a) para participar do projeto piloto, o(a) Sr.(a.) deverá instalar o aplicativo desenvolvido para a pesquisa, no celular informado no momento do cadastro, e realizar uma viagem de validação em bicicleta, de forma a assegurar que o aplicativo está funcional. O registro da viagem servirá como confirmação de sua entrada no projeto piloto. O não cumprimento desse passo até a data comunicada por endereço eletrônico (e-mail) resultará na não aceitação de sua participação na pesquisa e exclusão do(a) Sr.(a.) da lista de pessoas que farão parte do projeto piloto. Também caso seja selecionado(a), o(a) Sr.(a.) poderá, de forma opcional, participar do curso online gratuito "Pedalar com Segurança", ministrado pelo Centro de Treinamento e Educação de Trânsito - CETET da Companhia de Engenharia

de Tráfego (CET), em uma das datas disponíveis, a serem informadas pelos(as) pesquisadores(as) e/ou pela Secretaria Municipal de Mobilidade e Trânsito (SMT). A participação no curso é optativa, mas resultará em um bônus de R$ 22,00 (vinte e dois reais) em créditos no Bilhete Único.

(c) A partir da data de início do projeto piloto, a ser informada pelos(as) pesquisadores(as) por endereço eletrônico (e-mail), o(a) Sr.(a.) poderá registrar suas viagens em bicicleta entre as origens e destinos cadastrados no momento de preenchimento do formulário de interesse para que sejam validadas pelo aplicativo e tenham suas quilometragens somadas. Todas as viagens devem estar dentro do território do município de São Paulo para que sejam validadas. Ao final de determinados períodos, definidos pelos(as) pesquisadores(as), a soma dos quilômetros válidos será convertida em créditos, inseridos diretamente no seu Bilhete Único pessoal, sem que seja necessária qualquer ação de sua parte neste sentido. Os quilômetros já convertidos em créditos serão zerados. A distância mínima da viagem para ser validada é de 1 km. Viagens acima de 8 km podem ser registradas, mas receberão o mesmo valor de teto calculado para a distância de 8 km. A bonificação por quilômetro será variável durante a pesquisa, podendo chegar a zero em alguns momentos. Para este piloto, serão consideradas as 2 primeiras viagens registradas a cada dia e até 42 viagens por mês. Trajetos que não estejam entre as origens e destinos cadastrados serão desconsiderados.

(d) O projeto piloto será dividido em três períodos de 2 meses, somando um total de 6 meses. A remuneração prevista por quilômetro rodado poderá sofrer alterações em qualquer um desses momentos e será avisada à pessoa participante no momento da modificação. Ao final de cada período de 2 meses, o(a) Sr.(a.) será recompensado(a) com um valor adicional de créditos em passagens de Bilhete Único caso responda a um questionário a respeito da sua percepção do projeto piloto. Sua participação nesta pesquisa irá durar até o término do projeto piloto.

2. **Participantes da pesquisa:** qualquer pessoa maior de idade, residente na cidade de São Paulo, com Bilhete Único ativo em seu nome, que possua smartphone com pacote de dados e que pretenda realizar viagens em bicicleta a trabalho ou para locais de estudo dentro do território do município durante a duração da pesquisa.

3. **Envolvimento na pesquisa:** ao participar deste estudo, o(a) Sr.(a.) permitirá que sejam coletadas, armazenadas e analisadas as suas viagens registradas no aplicativo, assim como suas respostas nos questionários solicitados ao longo da pesquisa. Também é obrigatório o fornecimento do seu número de Bilhete Único, que será tratado de forma confidencial e repassado somente para a Secretaria Municipal de Mobilidade e Trânsito (SMT), da Prefeitura do Município de São Paulo, para a transferência dos créditos a serem recebidos, junto com os demais dados mínimos exigidos para a validação dos créditos. Todos os dados pessoais coletados serão tratados de forma confidencial. Toda publicação científica relacionada a esta pesquisa usará os dados do experimento de maneira agregada de forma que não seja possível identificar participantes individuais. Ao participar da pesquisa, o(a) Sr.(a.) também permitirá que os(as) pesquisadores(as) responsáveis utilizem esses dados apenas para manipulação computacional, sem que sejam manipulados ou acessíveis diretamente por indivíduos fora da equipe de pesquisa explicitada neste documento. Por fim, lembre-se que o(a) Sr.(a.) tem a liberdade de se recusar a participar e, ainda, de se recusar

a continuar participando em qualquer fase da pesquisa, sem necessidade de qualquer explicação. Essa recusa ou desistência não trará prejuízo algum para o(a) Sr.(a.) e deverá ser comunicada aos pesquisadores pelo e-mail de contato. Os créditos que o(a) Sr.(a.) tiver acumulado até o momento da desistência serão transferidos para o seu Bilhete Único.

4. **Riscos e Desconforto:** A atividade de pedalar em bicicleta, apesar de seus diversos benefícios à saúde, e assim como ocorre com outros meios de transporte, também envolve riscos de lesões e morte, e deve ser feita com atenção e cuidado. Para participar do programa, o(a) Sr.(a.) terá a possibilidade de fazer um curso online sobre segurança cicloviária, que será disponibilizado de maneira gratuita pelo Centro de Treinamento e Educação de Trânsito - CETET da Companhia de Engenharia de Tráfego (CET). No entanto, é importante ressaltar que os(as) pesquisadores(as) e a Prefeitura Municipal de São Paulo não se responsabilizam por quaisquer incidentes ocorridos nas viagens feitas durante o projeto piloto.

5. **Garantia de Indenização:** os(as) pesquisadores(as) responsáveis e a Prefeitura Municipal de São Paulo, representada pela Secretaria Municipal de Mobilidade e Trânsito (SMT), não se responsabilizam por qualquer eventual dano material, moral ou estético sofrido pelas pessoas participantes ou pelas bicicletas durante as viagens relacionadas ao projeto.

6. **Confidencialidade:** todas as informações coletadas neste estudo são estritamente confidenciais. Somente os(as) pesquisadores(as) responsáveis terão acesso direto aos dados, que não serão disponibilizados publicamente em nenhum website na Internet ou armazenados em qualquer pasta ou servidor publicamente acessível. Outros pesquisadores que se interessarem em utilizá-los, apenas para fins científicos, poderão ter acesso aos dados anonimizados se e somente se fizerem o comprometimento formal com estas mesmas regras mediante a assinatura de um acordo de confidencialidade, da forma como o(a) Sr.(a.) tiver autorizado, e segundo o controle estrito do pesquisador responsável.

7. **Benefícios:** ao participar desta pesquisa, o(a) Sr.(a.) terá o benefício de receber créditos em seu Bilhete Único por se deslocar em bicicleta durante o período do projeto piloto e por responder aos questionários apresentados. Adicionalmente, este estudo tirará conclusões que permitirão analisar a reação dos cidadãos de São Paulo sobre a bonificação de ciclistas e, assim, embasar possíveis próximas fases da implementação do programa Bike SP (Lei Municipal 16.547/2016).

8. **Despesas e Pagamentos:** o(a) Sr.(a.) receberá a bonificação correspondente às suas viagens de bicicleta por meio da transferência direta de créditos para o seu Bilhete Único pessoal, informado no momento do preenchimento do formulário de cadastro de interesse pela pesquisa. Despesas para a obtenção, o acesso e/ou a manutenção da bicicleta ou de equipamentos utilizados são de sua responsabilidade.

9. **Formas de Acompanhamento:** a sua participação se resumirá a este projeto piloto, não sendo necessária qualquer intervenção futura ou nova coleta de informações da sua parte. Os resultados desta pesquisa serão publicados após sua conclusão pelos(as) pesquisadores(as), sempre com os dados agregados e de forma a não permitir a identificação de nenhum(a) participante do projeto piloto. Em caso de cancelamento do projeto piloto, por qualquer que seja o motivo, todos os dados coletados serão imediatamente descartados de forma completa e irrecuperável. Para a sua garantia de que o que foi aqui estabelecido será

devidamente cumprido, o(a) Sr.(a.) receberá uma cópia digital deste documento, assinada e datada pelo pesquisador responsável ou por seu assistente autorizado – ambos devidamente identificados no final deste documento. Além disso, sempre que quiser, o(a) Sr.(a.) poderá pedir mais informações sobre a pesquisa, entrando em contato por e-mail ou por telefone com qualquer um dos pesquisadores do projeto.

Este documento segue as normas da Resolução CNS Nº 510/2016.

Após estes esclarecimentos, solicitamos o seu consentimento de forma livre para participar desta pesquisa. Este documento é emitido em duas vias, das quais uma ficará com o(a) Sr.(a.). Por favor, preencha os itens que seguem. Marque com um X o item abaixo.

Obs.: Não assine este termo se ainda tiver dúvidas a respeito.

Tendo em vista os itens acima apresentados, eu, de forma livre e esclarecida, manifesto meu consentimento em participar da pesquisa. Declaro que recebi cópia deste termo de consentimento, e autorizo a realização da pesquisa e a divulgação apenas dos resultados obtidos neste estudo.

Eu autorizo a coleta e a utilização computacional das informações das viagens que eu registrar no aplicativo do programa e das minhas respostas aos formulários e questionários apresentados.

Assinatura do(a) participante da pesquisa:

Assinatura: _____

Data: _____

Assinatura do pesquisador responsável:

Nome: _____

Assinatura: _____

Data: _____

Appendix D

Qualitative data forms

Título do documento: Questionários intermediários e final

(mandar questionário 10 dias antes de encerrar o período e fechar no dia da mudança)

D.1 Dados pessoais

Nome: _____
Telefone (usar o mesmo cadastrado na pesquisa): _____
Número do bilhete único: _____

D.2 Sobre o aplicativo

Como tem sido a sua experiência com o uso do app? (1 - 5 estrelinhas)

Aplicativo deixou de registrar alguma viagem que você fez? ( ) SIM ( ) NÃO
Se sim, qual o motivo? (marque todas as que se aplicam)
( ) aplicativo não entendeu a origem ou destino como cadastrado;
( ) aplicativo entendeu que usei outro modo que não a bicicleta;
( ) aplicativo falou que eu andei menos que a quilometragem mínima (1km);
( ) outros: _____

Você fez alguma viagem de bicicleta e não registrou no aplicativo? ( ) SIM ( ) NÃO
Se sim, qual o motivo? (marque todas as que se aplicam)
( ) aplicativo não funciona bem;
( ) não estou recebendo remuneração, então não registro as viagens;
( ) me esqueci de registrar;
( ) não tinha dados móveis (4G) para registrar a viagem;
( ) outros: _____

Observações que queira fazer sobre este tema: _____

D.3 Tempo de recebimento dos créditos

Em que prazo você acharia aceitável receber os créditos? (essa resposta não influencia no tempo de recebimento de créditos para esta pesquisa)
Sendo:
4 estrelas - cenário ideal
3 estrelas - muito bom
2 estrelas - aceitável
1 estrela - muito ruim

_____ Imediatamente após finalizar a viagem em bicicleta
_____ Em até 1 dia
_____ Em até 1 semana
_____ Em até 1 mês
_____ Em até 3 meses

Se marcou "1 estrela" em algum dos prazos da questão anterior, você deixaria de registrar uma viagem se o tempo de recebimento dos créditos fosse o mesmo desse período que você considerou "muito ruim"? ( ) SIM ( ) NÃO

D.4 Sobre a remuneração daquele período

Qual o seu grau de satisfação com a remuneração variável (R$ por km) recebida nesse período?
( ) 4 estrelas - extremamente satisfeito
( ) 3 estrelas - satisfeito
( ) 2 estrelas - um pouco insatisfeito
( ) 1 estrela - extremamente insatisfeito

Pense que o seu deslocamento é de 5 km (cerca de 30 minutos). Qual o número de viagens que você numa semana faria com essas diferentes remunerações? _____

D.5 Experiência de andar de bicicleta / rotas / segurança viária

O que te motiva a andar de bicicleta? (elencar do mais importante para o menos importante, sendo 1 o item mais importante e 4 o menos importante)
( ) saúde/exercício físico ( ) tempo de deslocamento ( ) economia de dinheiro (passagem de transporte público e/ou carro ou moto é caro) ( ) remuneração recebida nesse piloto

Que tipo de bicicleta tem usado? ( ) própria ( ) emprestada ( ) compartilhada outros: _____

Você teve algum problema com a sua bicicleta durante esse período do projeto (desde o dia DD/MM/AAAA) que te impediu de fazer viagens? ( ) SIM ( ) NÃO
Se sim, qual? Marque todas as que se aplicam.

( ) problemas mecânicos
( ) roubo/furto da bicicleta
( ) precisei emprestar/devolver a bicicleta
outros: _____

Para ir ao seu destino final, você faz paradas ao longo do caminho? ( ) SIM ( ) NÃO
Se sim, onde?
( ) escola do/a filho/filha
( ) supermercado
( ) comércio/serviços
( ) academia
( ) estação ou terminal de transporte público
outros: _____

Tendo como base a sua experiência em pedalar recentemente, quais são os fatores que você considera mais importantes ao escolher um caminho? (de 1 a 4 estrelas)
4 estrelas - extremamente importante
3 estrelas - importante
2 estrelas - pouco importante
1 estrela - nada importante
_____ iluminação
_____ segurança pública
_____ existência de ciclovias/ciclofaixas
_____ arborização
_____ volume de tráfego
_____ velocidade do tráfego
_____ existência de ruas comerciais
_____ inclinação das ruas (subidas e descidas)

Você usa a bicicleta para acessar alguma estação de metrô ou trem, ou terminal de ônibus?
( ) SIM ( ) NÃO
Se sim, onde tem parado a bicicleta?
( ) na rua
( ) bicicletário público do metrô/trem/terminal
( ) bicicletário privado
( ) estacionamento privado
( ) casa/estabelecimento de amigo/conhecido/no local de trabalho

Você chegou a desistir de andar de bicicleta em algum trajeto que costuma fazer desde o início da pesquisa?
( ) SIM ( ) NÃO

Se sim, por quê?
( ) fui atropelado(a) ou quase atropelado(a) ( ) tenho medo de ser atropelado(a) ( ) tenho medo de sofrer um assalto ( ) tenho medo de sofrer assédio ( ) outros: _____

[PERGUNTAS SEGUINTES SÃO EXTRAS PARA O FORMULÁRIO FINAL]

Nos trajetos que você fez de bicicleta durante o período da pesquisa, você avalia que:
( ) usou ciclovias e ciclofaixas por todo o caminho
( ) usou ciclovias e ciclofaixas em boa parte do caminho
( ) usou ciclovias e ciclofaixas somente em parte do caminho (metade ou menos)
( ) não há ciclovias e ciclofaixas, mas a maior parte do caminho é de vias tranquilas
( ) não há ciclovias e ciclofaixas no caminho e as vias são perigosas
( ) não fiz nenhuma viagem de bicicleta durante a pesquisa

O que você avalia como sendo mais importante na melhoria de ciclovias/ciclofaixas? (elencar do mais importante para o menos importante, sendo 1 o item mais importante e 4 o menos importante)

_____ Criar uma ciclovia ou ciclofaixa onde ainda não existe
_____ Melhorar uma ciclovia ou ciclofaixa que já existe
_____ Melhorar a segurança nos cruzamentos para quem está em bicicleta
_____ Melhorar conectividade entre as ciclovias e ciclofaixas
_____ Aumentar a quantidade de árvores pelo caminho

Appendix E

Ethical Approval - Detailed project description

Título de pesquisa: Política de bonificação a ciclistas: Um estudo de caso na cidade de São Paulo

Área: Mobilidade Urbana

E.1 Resumo

O uso de bicicletas como meio de transporte traz inúmeros benefícios para a sociedade, sendo fundamental que haja políticas públicas que o fomentem. Dentre as iniciativas existentes para essa promoção há o incentivo monetário para quem pedala, presente em alguns países em que o ciclismo é proeminente. Em 2016, como forma de estimular a migração modal para a bicicleta, a Prefeitura de São Paulo aprovou uma lei para que uma política similar fosse implementada na cidade — é o chamado "Bike SP", um programa voltado para dar créditos de mobilidade para quem se desloca usando este meio. No entanto, a iniciativa nunca chegou a ser regulamentada. Um dos motivos é a carência de estudos que embasem o programa e ajudem a determinar como ele será executado. Dessa forma, como parte da pesquisa para fundamentar a política cientificamente, será feito um projeto piloto com moradores da cidade de São Paulo. No experimento, busca-se verificar a hipótese de que remunerar ciclistas leva ao aumento do número de viagens funcionais (com motivo de origem ou destino trabalho ou estudo) feitas em bicicleta. A execução do projeto será acompanhada pela Secretaria Municipal de Mobilidade e Trânsito (SMT) da Prefeitura de São Paulo, e será conduzida em parceria com especialistas em ciclomobilidade.

E.2 Introdução

O ciclismo promove benefícios significativos, tangíveis e intangíveis, tanto para indivíduos quanto para a sociedade, atuando como uma solução de baixo custo para problemas climáticos e de mobilidade, além de resultar na melhoria da saúde dos que o praticam.

Estudos mostram que o investimento necessário para aumentar a parcela de viagens feitas por bicicleta e ter um impacto significativo na mudança climática é pequeno se comparado a outros modos e estratégias, apresentando um alto retorno sobre investimento (ITDP, 2020). Diante disso, percebe-se que a promoção do uso de bicicletas é um componente essencial nas políticas públicas de uma cidade que deseja melhorar a qualidade de vida de seus habitantes.

Na cidade de São Paulo, de acordo com estimativa feita pela pesquisa Origem Destino de 2017 (OD 2017[1]), apenas 0,8% de todas as viagens foram feitas em bicicleta em 2017. Por conseguinte, visando estimular a criação de um hábito de pedalar na população, a Prefeitura de São Paulo vem implementando medidas como a expansão da rede cicloviária, a implantação de paraciclos e bicicletários, a consolidação de um sistema de bicicletas compartilhadas e a promoção das ciclofaixas de lazer aos finais de semana e feriados. No entanto, a comparação com cidades em que a proporção de viagens feitas por bicicleta é maior mostra que São Paulo ainda tem um longo caminho a percorrer para se tornar de fato uma cidade bike-friendly[2]. Ao observar as políticas presentes nessas cidades, uma das iniciativas encontradas é a presença de um incentivo monetário a ciclistas, seja na forma de remuneração por quilômetro rodado, de dedução de impostos ou de auxílio para a compra de bicicletas (Lobo, 2015; H.R.384 - 117th Congress, 2021; Chandler, 2020; Governo da Holanda, 2020; Department for Transport - Reino Unido, 2019).

Na Holanda, país em que 27% de todas as viagens são feitas por bicicleta, funcionários que a utilizam para ir ao trabalho recebem um subsídio de EUR 0,19 por quilômetro rodado (Governo da Holanda, 2020), concretizado por meio de parcerias governamentais com empresas. Já no Reino Unido, há um esquema denominado 'salary sacrifice' que visa incentivar a compra de bicicletas. Nesse sistema, trabalhadores podem comprar a bicicleta e ter um abatimento das prestações diretamente em seus salários pré-imposto, diminuindo, assim, a quantidade a ser paga de tributos (Department for Transport - Reino Unido, 2019). No Brasil, a cidade de Itajaí criou uma moeda digital própria e um aplicativo, o MovItajaí, para que as pessoas sejam remuneradas ao adotarem modos de locomoção que não o automóvel particular — a moeda pode ser utilizada na rede local de comerciantes e prestadores de serviços cadastrados.

Tendo em vista a implementação desses e de outros casos bem-sucedidos, a prefeitura de São Paulo sancionou, em setembro de 2016, a Lei 16.547 (Legislação Municipal, 2016), que institui o Programa Bike SP, que prevê a concessão de créditos de mobilidade àqueles que utilizarem a bicicleta como meio de transporte. Tais créditos poderiam ser convertidos em bens e serviços ou utilizados para pagamento por serviços públicos. A lei deveria ter entrado em vigor em 1° de janeiro de 2017. No entanto, há diversas questões que foram deixadas em aberto pelo texto da legislação e que devem ser formalizadas pela redação de um decreto de regulamentação, tais como o critério de elegibilidade, o valor do benefício, a forma de fiscalização das distâncias percorridas pelos ciclistas etc. Até hoje o decreto não está finalizado, dependendo de base científica para a tomada de decisões. A principal delas se refere à remuneração adequada a ser repassada a ciclistas por quilômetro

[1] Pesquisa Origem e Destino, organizada pela empresa Metrô de São Paulo.

[2] O termo se refere a uma cidade que possui infraestrutura, políticas de transporte e consenso social suficientes para tornar a bicicleta um dos principais meios de transporte (Zayed, 2015)

percorrido.

O único estudo que se debruçou sobre este tema até o momento foi uma pesquisa de Preferência Declarada conduzida pelo Banco Mundial em 2022 (Banco Mundial, 2022). A pesquisa não teve como objetivo estabelecer a remuneração a ser dada para participantes do Bike SP, mas o de compreender o potencial de migração de outros modos de transporte para a bicicleta, dada uma percepção de remuneração como incentivo. Das conclusões, destaca-se que, para almejar ser bem sucedido, o projeto piloto deve considerar prever uma remuneração percebida entre R$ 2,00 e R$ 3,00 por viagem (o que aumenta as chances de escolha do modo bicicleta quase tanto quanto a existência de ciclovias e ciclofaixas); focar em um público pertencente às classes B2/C1 ou C2/D/E; permitir a participação de estudantes, especificamente em seus trajetos para o local de estudo; atentar que locais de integração com o transporte público tenham bicicletário gratuito com zeladoria; priorizar quem já possui bicicleta própria, ou então permitir que seja possível à pessoa participante buscar adquirir ou ter acesso a uma bicicleta para participar da pesquisa (o que inclui bicicletas compartilhadas, onde houver); e atentar que as chances de escolha da bicicleta para mulheres é significativamente mais baixa do que para homens, o que sugere a adoção de uma remuneração maior para o público feminino em relação ao masculino.

Motivados por esses fatores, e em parceria com órgãos da prefeitura, este estudo desenvolverá um projeto piloto para avaliação de resultados que embasem a regulamentação do programa. O projeto será inserido dentro do grupo de pesquisa INCT InterSCity[3], que já vem desenvolvendo diversos projetos voltados à análise e à melhoria da mobilidade cicloviária em ambientes urbanos. A execução do projeto será feita em parceria com a Secretaria Municipal de Mobilidade e Trânsito (SMT). Além disso, o projeto contará com a colaboração de cicloativistas e também com a coorientação dos consultores em ciclomobilidade Flavio Soares e Tainá Pacheco.

O projeto piloto será implementado na cidade de São Paulo, com previsão de início para o segundo semestre de 2023, com duração de 6 meses, e consistirá na bonificação dos participantes pela realização de viagens em bicicletas dentro do território da cidade de São Paulo via inserção de créditos no Bilhete Único. Tal remuneração será responsabilidade da SMT, sendo feita diretamente nos cartões de Bilhete Único das pessoas participantes. Os créditos recebidos poderão ser utilizados normalmente no pagamento das tarifas de transporte público nas redes de ônibus, trem e metrô da cidade de São Paulo. Para se candidatar ao programa, o indivíduo precisa ser maior de idade, morador da cidade e possuir um Bilhete Único ativo. Os inscritos serão selecionados de acordo com critérios detalhados na seção “Metodologia Proposta e Desenho do Experimento”.

E.3 Hipótese

A hipótese deste projeto de experimento é que remunerar indivíduos por quilômetros rodados de bicicleta incentiva-os a migrar de meios de transporte motorizados para esse modo ativo, e que uma diferença na remuneração (aumento ou diminuição) impacta no número de viagens de bicicleta feitas pelo participante.

[3] https://interscity.org

Esse projeto piloto possui duas principais hipóteses:

1. Remunerar indivíduos por suas viagens funcionais em bicicleta faz com que aumentem o número médio de viagens funcionais realizadas em bicicleta no mês;
2. Remunerações mais altas promovem uma média de viagens funcionais realizadas em bicicleta maior do que remunerações mais baixas.

E.4 Objetivo Primário

O objetivo do experimento é compreender qual o valor adequado a ser pago como bonificação por quilômetro rodado em bicicleta de forma que seja, ao mesmo tempo, atraente para quem o recebe (promova o uso da bicicleta) e resulte em um programa bem sucedido para o poder público (sem haver pagamento em excesso). O experimento pretende responder às seguintes perguntas:

1. A política de remuneração desperta interesse nos cidadãos de São Paulo em migrar para a bicicleta? Essa pergunta será respondida levando em consideração o número de pessoas inscritas para participar do projeto piloto e a porcentagem de participantes que declararem, por meio de questionários aplicados no momento da pesquisa, que parte ou todas as suas viagens realizadas em bicicleta teriam sido feitas com outros modos de transporte;
2. Considerado um mesmo período de tempo, há diferença no número de viagens entre a amostra de pessoas que está sendo remunerada e a que não está? E entre a amostra que está recebendo mais dinheiro por quilômetro e a que está recebendo menos?
3. Aumentar ou diminuir a remuneração para um mesmo indivíduo ao longo do programa altera o seu padrão de viagens de bicicleta registradas?

Por meio dessas perguntas, será possível avaliar o impacto da bonificação de ciclistas na migração modal e embasar as próximas fases de implantação do programa Bike SP.

E.5 Metodologia Proposta e Desenho do Experimento

Após uma fase de preparativos, que envolve o desenvolvimento de um aplicativo mobile de registro de rotas em bicicleta pelo Instituto de Matemática e Estatística (IME-USP), o projeto piloto começa com a divulgação para pessoas interessadas em participar da pesquisa, liderada pela Secretaria Municipal de Mobilidade e Trânsito (SMT) e apoiada pelo IME-USP e por grupos de ciclistas e cicloativistas interessados.

Poderão se inscrever para participar do piloto pessoas maiores de idade, residentes na cidade de São Paulo, com Bilhetes Únicos ativos em seu nome, que possuam smartphone com pacote de dados e que pretendam realizar viagens funcionais em bicicleta dentro do território do município durante a duração da pesquisa. Todas as pessoas interessadas em participar deverão responder a um questionário (Apêndice A) com perguntas sobre seu perfil socioeconômico e demográfico e seu padrão atual de viagens. Também deverão

pré-cadastrar as origens e destinos relacionados a casa, trabalho ou estudo para os quais pretendem fazer os deslocamentos funcionais em bicicleta. Além disso, precisarão assinar um Termo de Consentimento Livre e Esclarecido (TCLE), que permitirá coletar e analisar as viagens de bicicleta feitas por elas durante a execução do projeto.

Será feita uma análise das pessoas inscritas e serão selecionadas aproximadamente 660 a 810 pessoas para participarem do experimento, levando em consideração o atendimento de critérios socioeconômicos e de mobilidade, de forma a balancear o número de participantes com diferentes perfis de gênero (mulheres e homens), renda/classe social, modo de transporte atualmente utilizado para fazer os trajetos pretendidos e residência dentro ou fora do centro expandido. Serão priorizadas pessoas cujas origens e destinos contêm em seu trajeto estimado infraestrutura cicloviária de circulação (ciclovias ou ciclofaixas) e/ou percorram principalmente vias de trânsito menos intenso, tais como vias coletoras ou locais. As pessoas que não forem selecionadas serão colocadas em uma lista de espera, sendo ativadas em caso de desistência do grupo selecionado.

Para serem confirmados no programa, os selecionados precisarão se registrar e fazer uma viagem de validação no aplicativo de celular desenvolvido pelo IME[4], de forma a assegurar que o aplicativo está funcional. Quem não fizer a viagem de validação no intervalo de duas semanas terá seu cadastro removido e sua vaga será repassada a outra pessoa da lista de espera. Uma vez cumprida esta tarefa inicial (viagem de validação) o participante terá a vaga no experimento garantida até o final da sua duração, não sendo condicionada ao registro de outros deslocamentos. As pessoas selecionadas poderão, também, participar do curso online gratuito “Pedalar com Segurança”[5], ministrado pelo Centro de Treinamento e Educação de Trânsito - CETET da Companhia de Engenharia de Tráfego (CET), recebendo um bônus em crédito por isso. O propósito tanto de priorizar pessoas cujos trajetos cadastrados sejam mais seguros quanto de estimular a participação no curso é o de minimizar a possibilidade de acidentes com participantes do projeto piloto.

O experimento será dividido em três períodos de 2 meses, somando um total de 6 meses, conforme as tabelas abaixo. No primeiro período, os participantes serão divididos aleatoriamente em 3 grupos, que receberão diferentes tipos de bonificação. O grupo controle não receberá nenhuma remuneração por quilômetro rodado, enquanto o grupo experimental 1 receberá metade da remuneração estabelecida para o grupo experimental 2. Para o segundo e terceiro períodos, os três grupos iniciais serão subdivididos de forma aleatória em 2 ou 3 grupos cada, tendo sua bonificação alterada ou mantida constante.

As tabelas 1 e 2 a seguir ilustram as diferentes remunerações por grupo e período. A diferença entre elas está na remuneração do terceiro período, que dependerá da quantidade de pessoas inscritas e orçamento disponível para a pesquisa: no primeiro cenário, com cerca de 660 participantes, há remuneração para todos os grupos; no segundo, com cerca de 810 participantes, haverá remuneração somente para os grupos que não a receberam no segundo período.

A mudança de remuneração será mencionada no formulário de cadastro e também será

[4] Por meio do aplicativo, usuários poderão registrar suas viagens. O app validará se a rota foi de fato feita em bicicleta e entre as origens e destinos pré-cadastrados.

[5] http://www.cetsp.com.br/consultas/educacao/cursos/condutores/pedalar-com-seguranca.aspx

Grupo	Período 1	Período 2	Período 3
Controle	NADA	$	$
	NADA	$	$
Experimental 1	$	NADA	$
	$	$	$
	$	$$	$
Experimental 2	$$	NADA	$
	$$	$	$
	$$	$$	$$

Table E.1: *Primeiro cenário, com 660 participantes.*

Grupo	Período 1	Período 2	Período 3
Controle	NADA	$	NADA
	NADA	$	NADA
Experimental 1	$	NADA	$
	$	$	NADA
	$	$$	NADA
Experimental 2	$$	NADA	$
	$$	$	NADA
	$$	$$	NADA

Table E.2: *Segundo cenário, com 810 participantes.*

avisada no momento da modificação ao participante, durante a execução do programa. Ademais, após a divisão, cada grupo conterá uma amostra suficientemente grande para que seus resultados individuais possuam validade estatística.

A bonificação será concedida por quilômetro rodado, no formato de créditos inseridos diretamente nos Bilhetes Únicos nominais dos participantes. Serão consideradas somente as viagens em bicicleta realizadas entre as origens e destinos pré-cadastrados registradas e validadas pelo aplicativo desenvolvido pelo IME, com distância mínima de 1 km. O cálculo para a remuneração considera a distância máxima de 8 km, sendo que viagens acima dessa quilometragem podem ser registradas, mas receberão o mesmo valor de teto de 8 km.

Para este piloto, de forma a considerar ida e volta, poderão ser remuneradas até 2 viagens por dia, considerando sempre as duas primeiras viagens realizadas no caso do participante realizar mais de duas viagens no dia. Será estabelecido o limite máximo de 42 viagens remuneradas por mês, equivalente ao dobro de dias úteis (segunda a sexta-feiras), em média, existentes em um mês. As pessoas poderão registrar e validar deslocamentos realizados em bicicleta mesmo aos finais de semana, desde que sejam entre as origens e destinos pré-cadastrados e que somem até 42 viagens ao mês. O objetivo é ser inclusivo com pessoas que trabalham ou estudam aos finais de semana.

De forma a estimular que as pessoas permaneçam no experimento, principalmente as assinaladas ao grupo controle (que não recebe nada no primeiro momento), os integrantes receberão bônus extras ao final de cada período de 2 meses, em valores equivalentes a uma certa quantidade de passagens do transporte público. Para obter o valor, bastará responder

a um questionário a respeito da sua percepção do programa (Apêndice B deste documento). Mesmo as pessoas que não registraram viagens entre os períodos poderão preencher o questionário e receber o bônus. Dessa forma, pretende-se evitar que o incentivo adicional interfira nas decisões diárias de viagens dos participantes. Todas essas informações serão indicadas de maneira clara para os participantes no formulário de cadastro e no início do piloto.

Por fim, se após a realização da primeira ou segunda fase do projeto for percebido um comportamento muito discrepante do esperado, uma adaptação da distribuição dos grupos ou da remuneração poderá ser realizada, de forma a limitar os gastos ao orçamento disponível e/ou para garantir amostras estatisticamente significantes. O monitoramento será feito por meio de um acompanhamento semanal entre os valores previstos e os efetivamente designados como bonificação. A principal ação corretiva será adequar a remuneração do terceiro período.

O experimento termina com o preenchimento do último questionário, ao final dos 6 meses. O preenchimento do questionário final também gerará uma remuneração para os participantes, mesmo que eles não tenham realizado nenhuma viagem durante o projeto piloto.

E.6 Riscos

Os dados coletados podem identificar as pessoas participantes, uma vez que serão requisitados dados pessoais, o cadastro de origens e destinos e seus números de Bilhete Único. Ademais, o registro das rotas por meio do aplicativo constitui em mais um dado pessoal a ser protegido. Para impedir a identificação dos integrantes a partir desses e de outros dados fora do escopo do experimento, os resultados serão publicados somente de forma agregada, durante a escrita de artigos e do relatório final da pesquisa a ser publicado e encaminhado à Secretaria Municipal de Mobilidade e Trânsito (SMT).

Durante o projeto piloto, apenas a equipe de pesquisadores do IME terá acesso aos dados originais, que serão armazenados em um serviço de hospedagem privada na nuvem (e.g. Google Drive). De forma a possibilitar o depósito dos créditos nos Bilhetes Únicos, será compartilhada periodicamente com a SMT somente uma listagem com os dados mínimos necessários para comprovar os cadastros dos Bilhetes Únicos às pessoas participantes e o montante a ser creditado por cadastro por período (por exemplo, por mês). É preciso salientar que o IME possui acordo de parceria formal com a SMT. Outros pesquisadores poderão ter acesso aos dados originais somente mediante a assinatura de um acordo de confidencialidade e cada solicitação será avaliada pela equipe original de pesquisadores para determinar se o uso dos dados é adequado. Se houver compartilhamento de dados com outros pesquisadores, serão disponibilizados dados desidentificados.

Com relação aos riscos de as pessoas participantes sofrerem acidentes de trânsito, o projeto piloto buscará mitigá-los de duas formas. Primeiro, fazendo uma seleção que priorize interessados cujas rotas entre as origens e destinos informados possuam infraestrutura cicloviária de circulação (ciclovias ou ciclofaixas) ao longo das vias principais e/ou percorram principalmente vias de trânsito menos intenso, tais como vias coletoras ou locais. Segundo, abrindo a possibilidade a quem for selecionado de participar do curso de direção defensiva

"Pedalar com Segurança", ministrado pelo Centro de Treinamento e Educação de Trânsito - CETET da Companhia de Engenharia de Tráfego (CET), beneficiando tais pessoas por isso. Acidentes envolvendo participantes do piloto não deverão ser considerados como responsabilidade do grupo de pesquisa ou da Prefeitura. Portanto, os termos de participação estarão claramente expressos no TCLE.

E.7 Benefícios

Conforme mencionado, o único estudo envolvendo diretamente o Bike SP foi realizado pelo Banco Mundial em 2022 e é focado na intenção das pessoas em modificar suas escolhas a partir de alguns cenários prévios estabelecidos (pesquisa de preferência declarada). A execução de um projeto piloto tem como vantagem analisar o comportamento dos indivíduos a partir de bonificações reais concedidas como retorno por seus esforços em utilizar a bicicleta. Ademais, ao selecionar e limitar o número de participantes, o experimento ajuda a embasar a aplicação da política definitiva a um custo muito inferior, servindo como uma importante entrada para a definição da implantação das próximas fases do programa e permitindo a análise da reação de diversos perfis de usuário frente a diferentes valores de remuneração. Ao realizar as análises econométricas para ajudar a definir a remuneração mais adequada a ser concedida a quem participará do Bike SP, será possível fornecer dados preciosos para a tomada de decisão e regulamentação do programa por parte do poder público.

E.8 Metodologia de Análise de Dados

Após a realização do projeto piloto, será feita a avaliação dos seus resultados, com base nos indicadores coletados, de forma a aferir o que foi feito de forma satisfatória e o que deve ser aperfeiçoado.

Para entender como a remuneração muda o comportamento das pessoas, serão comparados os valores médios de viagens realizadas pelos grupos com diferentes remunerações. Também será avaliado, dentro de um grupo com a mesma bonificação, se houve mudança no comportamento de acordo com o perfil socioeconômico e demográfico. Serão utilizados testes estatísticos para averiguar se a diferença é estatisticamente significativa.

E.9 Desfecho Primário

A pesquisa proporcionará um importante embasamento para a definição de variáveis das próximas fases do Bike SP e, portanto, será significativo para a viabilização do programa como política pública.

Os resultados serão publicados em um artigo, além de fazerem parte da pesquisa de iniciação científica na qual o experimento está inserido. Todas as contribuições estarão descritas na tese final, e todo software e material produzido será disponibilizado sob licenças abertas na página web oficial da pesquisa.

E.10 Apêndice A: Formulário de candidatura e perfil do participante

Este formulário será fornecido por meio do Google Forms para os interessados se candidatarem a participar do experimento. Ele objetiva caracterizar o perfil socioeconômico e demográfico dos respondentes, bem como coletar informações sobre as viagens de bicicleta que estes pretendem fazer durante o programa.

(This section is located in Appendix B of this document).

E.11 Apêndice B: Formulários entre períodos e final

Estes formulários serão fornecidos por meio do Google Forms para coletar a opinião dos participantes sobre o programa até o instante do preenchimento. Os formulários entre períodos serão solicitados 2 vezes durante a pesquisa, entre cada período de 2 meses do projeto piloto. O final é o mesmo questionário dos intermediários, acrescido de duas perguntas sobre a infraestrutura cicloviária. A continuidade no programa não está condicionada à realização dos questionários. Porém, aqueles que o fizerem receberão uma recompensa adicional na forma de créditos no seu Bilhete Único.

(This section is located in Appendix D of this document).

Appendix F

Beta Test feedback forms

Título: Questionário de feedback - Beta testing

F.1 Dados pessoais

Nome: _____

Telefone (usar o mesmo cadastrado na pesquisa): _____

Número do Bilhete Único: _____

Qual o modelo do seu celular? _____

Qual a versão do seu sistema operacional (Android)? _____

F.2 Sobre o aplicativo

Como tem sido a sua experiência com o uso do app? (1 - 5 estrelinhas)

Você já contestou alguma viagem? ( ) SIM ( ) NÃO

Se não, abrir mais questões

Qual foi o motivo de não ter contestado nenhuma viagem?

( ) Não precisei contestar nenhuma viagem
( ) Não sabia que era possível contestar viagens/Não sei onde fica a tela de contestar
( ) Considerei que não valia a pena contestar a viagem
( ) Outro _____

Observações ou sugestões sobre a tela e o esquema de contestação: _____

F.3 Tela de extrato

Você tem tido algum problema para gerenciar o saldo do que tem ganhado com os testes? Tem alguma sugestão do que poderia ser feito para facilitar isso? _____

Você sabia que temos uma tela de extrato no aplicativo? (Histórico de viagens > Extrato)
( ) SIM ( ) NÃO

Observações ou sugestões de como poderíamos melhorar a comunicação de pagamentos e de saldos pelo aplicativo: _____

F.4 Perguntas extras

Para ir ao seu destino final, você faz paradas ao longo do caminho? ( ) SIM ( ) NÃO
Se sim, onde você faz paradas?
( ) Escola do/a filho/filha
( ) Supermercado
( ) Comércio/serviços
( ) Academia
( ) Estação ou terminal de transporte público
( ) outros: _____

Você chegou a desistir de andar de bicicleta em algum trajeto que costuma fazer desde o início do período de testes? ( ) SIM ( ) NÃO

Se sim, por quê?
( ) Fui atropelado(a) ou quase atropelado(a)
( ) Tenho medo de ser atropelado(a)
( ) Tenho medo de sofrer um assalto
( ) Tenho medo de sofrer assédio
( ) Outros: _____

Appendix G

Frequently Asked Questions for the pilot project

G.1 Perguntas relacionadas ao período de cadastro

Pergunta: Quem pode participar do projeto piloto?

Resposta: Pode participar qualquer pessoa que cumpra os seguintes requisitos:

- Ser maior de idade;
- Residir na cidade de São Paulo;
- Possuir Bilhete Único ativo em seu nome;
- Possuir celular Android;
- Ter acesso a uma bicicleta ao longo do período da pesquisa;
- Pretender realizar viagens em bicicleta a trabalho ou para locais de estudo dentro do território do município durante a duração da pesquisa.

Pergunta: Por que preciso pré-cadastrar locais para minhas viagens?

Resposta: Por ser um projeto piloto que envolve uma pesquisa, o objetivo de cadastrar os locais de origem e destino das viagens é compreender melhor os hábitos de deslocamento por trás de cada percurso. No futuro, o programa Bike SP pode não precisar realizar este pré-cadastro, considerando todas as viagens e estabelecendo um mecanismo de validação para a aprovação dos créditos a serem concedidos. Este passo ainda vai requerer algumas decisões sobre o programa e um desenvolvimento maior do aplicativo.

Pergunta: Poderei fazer qualquer trajeto de bicicleta para receber a bonificação?

No formulário de cadastro, você pode registrar até 5 locais (endereços) e 5 estações de transporte público. Durante o período do projeto piloto, só serão consideradas como viagens válidas para remuneração as viagens feitas em bicicleta entre esses pontos. Ou seja, a viagem deverá ser iniciada e terminada em um desses locais ou estações registradas.

Além disso, uma vez que o programa Bike SP é voltado para incentivar o uso da bicicleta para deslocamentos funcionais, ou seja, ao trabalho e a locais de estudo, somente estes tipos de destino podem ser cadastrados.

Para mais informações sobre esse cadastro, veja esse vídeo.

Pergunta: Não sei quais viagens farei durante o projeto piloto. Poderei mudar os locais de origem e destino cadastrados depois?

Resposta: Infelizmente, não. Não será possível alterar os locais de origem e destino após o cadastro ou durante o período do projeto piloto. Se você quer se inscrever mas tem dúvidas sobre quais percursos fará, procure registrar locais e trajetos utilizados por você regularmente. Lembre-se: o programa Bike SP é voltado para incentivar o uso da bicicleta para deslocamentos funcionais, ou seja, ao trabalho e a locais de estudo. Isso inclui a volta para a residência. Saber disso te dá uma dica sobre quais locais considerar.

Pergunta: Não sei o CEP de um local que quero registrar ou o local para onde vou não tem CEP. O que devo fazer?

Resposta: Para locais que possuem CEP, há duas formas de descobri-lo. A primeira, mais simples, é buscar o endereço via Google Maps e pegar o CEP de lá. A segunda, mais complexa, é pesquisar pelo site dos Correios. Este vídeo mostra como fazer isso <link>. Caso o local não tenha CEP, busque um local próximo a ele (por exemplo, de um endereço ao lado ou atravessando a rua) e pegue o CEP de lá. Isso porque o aplicativo vai considerar como pontos de origem e destino válidos uma área de entorno aos locais cadastrados. Veja na imagem abaixo o exemplo de como um local cadastrado aparece no aplicativo:

Pergunta: Como receberei os créditos do Bilhete Único?

Resposta: Os créditos serão associados semanalmente ao seu Bilhete Único, a partir do número que você tiver cadastrado no formulário e proporcionais à distância que você percorreu pedalando. Para você transferir o saldo para o seu cartão magnético, será preciso encostar o Bilhete Único em um equipamento de recarga que pode ser encontrado nos terminais de ônibus e em estações de trem e metrô. Para mais informações sobre como validar sua remuneração, veja esse vídeo <link>.

Pergunta: Por que o meu cadastro não garante minha seleção para participação do projeto piloto?

Resposta: Para fins de estudo, o projeto piloto do Bike SP será inicialmente implementado com um grupo de até 800 pessoas, que serão selecionadas com base em determinados critérios para otimizar a análise da pesquisa. Por essa razão, não será possível garantir que todo mundo que se cadastrou participe. Mas lembre-se: está prevista uma segunda chamada, aberta a partir das vagas que não forem preenchidas na primeira seleção. Fique atenta(o)!

Pergunta: Quando saberei que fui selecionada(o)?

Resposta: O período de cadastro será de 15 de setembro a 15 de outubro de 2023. Os primeiros resultados saem já no dia 17 de outubro de 2023, quando todas as pessoas que se inscreveram receberão uma mensagem enviada pelo email bikesp@ime.usp.br para os endereços cadastrados avisando sobre a seleção ou não para o projeto piloto. As pessoas

selecionadas terão até o final do dia 24 de outubro para seguir as instruções do email e confirmar a participação no piloto. Uma segunda chamada para vagas remanescentes será aberta no dia 25 de outubro dando até o final do dia 31 de outubro as pessoas confirmarem seu interesse. Todas as comunicações serão por email, então fique atenta(o) também à caixa de spam.

Pergunta: Não lembro mais quais locais cadastrei, como consultá-los?

Resposta: No aplicativo, isso pode ser feito de duas formas: na tela de locais e no mapa de navegação. Na "Tela Inicial > Locais Cadastrados", estarão listados todos os locais cadastrados a partir dos nomes/apelidos que você deu no momento de fazer o cadastro (ex. local de trabalho, local de estudo, Faculdade X etc.) e todas as estações/terminais de transporte público que você escolheu. Já pelo mapa acessado em "Tela Inicial > Iniciar Viagem", os locais aparecem como pontos coloridos: em azul os de origem e destino e em verde os de transporte público.

Pergunta: Por que preciso ler e consentir com o Termo de Consentimento Livre e Esclarecido?

Resposta: Uma vez que o projeto piloto também é um projeto de pesquisa, é uma obrigação legal que as pessoas leiam e manifestem sua concordância com as cláusulas descritas no Termo de Consentimento Livre e Esclarecido. Ao concordar com o termo, dentre outras coisas, você permite o armazenamento e a análise de suas viagens cadastradas no aplicativo — tudo será feito de forma anonimizada, confidencial e somente para fins científicos. Além disso, você concorda que a Prefeitura Municipal de São Paulo e os pesquisadores responsáveis não se responsabilizam por qualquer eventual dano material, moral ou estético sofrido durante as viagens relacionadas ao projeto. Por favor, leia o documento na íntegra antes de se cadastrar para o projeto piloto.

G.2 Perguntas relacionadas ao período do projeto piloto

Pergunta: Fui selecionado. Como faço para confirmar a minha participação no programa?

Resposta: Para confirmar a sua participação no programa, você deve instalar o aplicativo do Bike SP, se cadastrar, e fazer a viagem de validação.

Pergunta: Como faço para baixar o aplicativo?

Resposta: Procure por "Bike SP" na Google Play Store e instale o aplicativo. Assista esse vídeo para instruções mais detalhadas <link>.

Pergunta: O que é a viagem de validação?

Resposta: Essa viagem é para que possamos confirmar que tudo deu certo no seu processo de cadastro, login, e registro de viagens. Essa viagem não precisa necessariamente ser feita de bicicleta e ela não será remunerada. Basta iniciar uma viagem no aplicativo em um local válido (ou seja, previamente cadastrado) e finalizar a viagem em um local válido também.

Para essa viagem, você pode optar por iniciar a viagem em um local cadastrado e finalizar a viagem logo em seguida, nesse mesmo local.

Pergunta: Não consegui logar no aplicativo depois de instalá-lo. O que devo fazer?

Resposta: Antes de fazer o login pela primeira vez, você precisa se cadastrar no aplicativo. Na parte inferior da tela de login, há um texto "Não possui uma conta? Cadastre-se". Clique em "Cadastre-se" e forneça as informações pedidas. Caso o seu cadastro não esteja sendo validado, entre em contato conosco por bikesp@ime.usp.br, passando os seguintes dados: seu email (cadastrado no formulário), CPF e número do Bilhete Único cadastrado.

Pergunta: O aplicativo aponta como "Serviço GPS indisponível". O que fazer?

Resposta: Para utilizar o aplicativo e poder cadastrar as suas viagens, é necessário ativar o serviço de localização do seu celular. Isso porque o aplicativo precisa utilizar a localização/GPS para identificar os pontos de origem e destino das viagens e estimar a rota feita.

Pergunta: O aplicativo mostrou uma tela dizendo que não foi possível iniciar uma viagem e que devo mudar as permissões do app. O que devo fazer?

Resposta: O aplicativo necessita de permissão para acessar a localização do seu dispositivo. Ao instalar o aplicativo, um pedido de permissão de acesso à localização aparece. Você deve aceitá-lo. Caso tenha negado essa permissão, é necessário entrar nas configurações do seu celular e ativá-la para poder registrar suas viagens. Para mais instruções de como fazer isso, acesse esse vídeo <link>.

Pergunta: Como faço para registrar uma viagem intermodal? Ou seja, quero ir de bicicleta para uma estação de metrô ou trem ou terminal de ônibus, e depois pegar transporte público.

Resposta: Para isso, você pode iniciar o cadastro da viagem no seu ponto de origem (sua casa, por exemplo), se dirigir à estação ou terminal, e finalizar sua viagem no aplicativo ao chegar à estação. Em seguida, você pode seguir normalmente sua viagem por transporte público, mas essa parte do trajeto não será contabilizada na contagem de quilômetros para remuneração no programa. Para que isso seja possível, tanto o seu ponto de origem quanto a estação ou terminal devem ter sido pré-cadastrados no formulário de inscrição para o programa.

Pergunta: Posso entrar com a bicicleta no metrô/trem/ônibus e seguir viagem? Isso seria considerado uma viagem válida para o projeto piloto?

Resposta: Não, só serão contabilizadas viagens feitas pedalando a bicicleta. Isso não inclui o transporte de bicicletas por meio de outro veículo. Assim, finalize sua viagem antes de entrar no transporte público.

Pergunta: Fiz uma viagem de bicicleta de uma origem a um destino válidos (pré-cadastrados) e o aplicativo não identificou a viagem como sendo remunerável. O que pode ter acontecido?

Resposta: O aplicativo só remunera as primeiras duas viagens feitas no dia. Caso sejam

feitas mais de duas viagens no dia, as últimas não serão consideradas para remuneração. No entanto, se você tiver feito uma viagem de bicicleta entre uma origem e destino válidos, sendo essa uma das primeiras duas viagens do dia, e esta não foi considerada para remuneração, você pode reportar isso ao nosso time por meio da tela "Contestar viagem", que pode ser acessada indo para Histórico de viagens > detalhes da viagem que não foi considerada > botão no canto superior direito ("Contestar"). O mesmo é válido se você tiver feito uma viagem de bicicleta que por qualquer motivo foi avaliada pelo aplicativo como "Viagem não realizada em bicicleta". Conteste esta viagem para que possamos analisar o que pode ter acontecido.

Pergunta: Como receberei os créditos pelas minhas viagens?

Resposta: Os créditos serão depositados semanalmente na segunda-feira no número de Bilhete Único registrado no formulário de cadastro. Para que esse depósito seja feito, é necessário que um mínimo de saldo de R$ 10,00 seja acumulado. Assim, se esse saldo não for atingido em uma semana, o saldo atual será acumulado com o saldo da semana seguinte e o valor será depositado no depósito. Para você transferir o saldo para o seu cartão magnético, será preciso encostar o Bilhete Único em um equipamento de recarga que pode ser encontrado nos terminais de ônibus e em estações de trem e metrô.

Pergunta: Como é calculada a bonificação por quilômetro?

Resposta: A bonificação é calculada por quilômetro rodado de bicicleta. Essa quilometragem é baseada em uma rota estimada feita entre o ponto de origem e destino da viagem. Por se tratar de um projeto piloto com fins de pesquisa, a sua remuneração poderá variar a cada mês. Você pode consultar a sua remuneração por quilômetro atual na tela X no aplicativo <caminho para ela>. A viagem precisa ter um mínimo de 1 km para ser remunerada e um máximo de 8 km por viagem será remunerado.

Pergunta: Fiz uma viagem entre dois pontos, mas a remuneração indicada pelo aplicativo não condiz com a distância que eu realmente percorri. Por quê?

Resposta: A distância considerada para a remuneração é baseada em uma rota pré-calculada entre cada par de pontos origem e destino informado por você no momento do cadastro. Por este motivo, a distância entre tais pontos sempre será a mesma para fins de remuneração para o projeto piloto, independentemente da rota que você de fato utilizou (seja ela mais curta ou mais longa do que o pré-calculado). Esta abordagem pode eventualmente ser modificada no futuro, quando da implementação do programa Bike SP.

Pergunta: Esqueci minha senha e agora não consigo acessar o aplicativo. O que devo fazer?

Resposta: Na tela de login, clique em "Esqueceu a senha?" e siga as instruções do aplicativo para proceder com a redefinição de senha.

Pergunta: Quero solicitar que meus dados coletados sejam excluídos.

Resposta: Entre em contato conosco pelo email <email de contato>.

Pergunta: O aplicativo não remunera viagens com qualquer origem e destino. Por quê?

Resposta: Na fase de cadastro para o programa, os participantes puderam cadastrar endereços e estações como origens e destino das suas viagens. No projeto piloto só serão permitidas viagens entre esses lugares, para efeitos de simplicidade e análise.

Pergunta: Um dos meus locais que cadastrei não está com a localização correta no aplicativo. O que devo fazer?

Resposta: Entre em contato conosco em, usando o email cadastrado no programa, dizendo seu nome e CPF. Envie-nos o endereço cadastrado que está aparecendo incorretamente no aplicativo, para avaliarmos.

Pergunta: Minha viagem foi validada como sendo de bicicleta, mas não recebi nada por ela. Por quê?

Resposta: Para fins de pesquisa, os participantes são divididos em grupos, recebendo bonificações diferentes. Em determinados momentos, a remuneração pode ser zero. Mas não desanime ou desista do programa! Seu bônus vai variar ao longo do tempo.

Pergunta: Quanto eu recebo por quilômetro?

Resposta: Para fins de pesquisa, sua remuneração por quilômetro varia durante o programa. A cada mudança de remuneração, você será notificado por email. Você também pode consultar a sua remuneração por quilômetro atual na tela X no aplicativo <caminho para ela>.

Pergunta: O aplicativo indica que fui remunerado por uma viagem (o crédito está como concedido na página "Extrato" do app), mas o saldo do meu bilhete único não aumentou. O que devo fazer?

Resposta: Para que o dinheiro seja creditado no seu bilhete único, é necessário encostá-lo a um equipamento de recarga, que pode ser encontrado em alguns ônibus ou estações de trem e metrô. Para mais informações, veja esse vídeo <link>. Caso o seu dinheiro não seja creditado mesmo assim, entre em contato com a nossa equipe pelo email <email de contato>.

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