Building cycling equity in Montreal

Overcoming barriers in accessing Bixi

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Executive summary

In light of record ridership and increasing adoption of bikeshare in Montreal, there is a growing need for an evaluation of Bixi's practices to ensure the service is designed for and accessible to all Montrealers. While Bixi currently has no explicit equity goals or mandates, aligning its strategy with equity goals set out by the city of Montreal should be a priority if the city seeks to develop an equitable and sustainable transportation system.

This report summarises findings on bikeshare barriers and enhancements derived from a cycling survey conducted in Montreal in May and June 2024, highlighting barriers and pathways for improvements for municipal actors and transportation agencies in Montreal based on precedents from around the world.

Key findings:

Barriers

- Bixi users are particularly concerned by traffic safety when cycling.
- The weight and size of Bixi's bicycles are important inhibitors both for users and non-users.
- The cargo capacity of Bixi's bicycles is insufficient.
- Women are hindered by the lack of child's seats on Bixis.

Enhancements

- Lighter bicycles, increases in cargo capacity, and child-caring solutions are likely to increase Bixi use.
- A network density of 10-16 stations per square kilometer is ideal to sustain bikeshare.
- A comprehensive and thought-out outreach and communication strategy is needed.
- Lessons, workshops, and consultations with a range of actors support greater bikeshare use.
- Concertation with transit agencies and higher government levels are needed to ensure bikeshare's success.

Recommendations:

1. Appoint an equity program manager to outline a strategy, oversee Bixi's equity efforts, and conduct outreach.
2. Prioritise the establishment of an equity strategy with clear goals and metrics by which to measure equity gains.
3. Develop programming, including classes, lessons, collective rides, and a participatory consultation process.
4. Target a station density of minimum 10 stations per square kilometer prioritising areas with greater equity needs.
5. Crowdsource cycling infrastucture data and conduct awareness campaigns to increase cycling safety.
6. Assess fare structure and payment methods, as well as discount options to facilitate financial access to Bixi.
7. Evaluate mechanisms to access and unlock bicycles to increase flexibility and convenience when using Bixi.
8. Supplement Bixi's fleet with lighter and smaller bicycles to support the adoption and use of bikeshare by women.
9. Review basket design and cargo options including cargo bikeshare, racks, and trailers.
10. Implement alternatives supportive of childcaring responsibilities such as mini bikeshare and child's seats.

Sommaire

Considérant l'achalandage record et l'adoption croissante de Bixi à Montréal, il est important d'évaluer les pratiques de Bixi afin d'assurer que son service est conçu pour et accessible à tous les montréalais. Bixi n'a actuellement pas d'objectifs d'équité explicites, ainsi, aligner sa stratégie afin de combler les objectifs d'équité de la ville de Montréal devrait être une priorité si la Ville cherche à développer un réseau de transport durable et équitable.

Ce rapport résume les résultats d'un sondage sur le cyclisme et les vélos en libre-service (VLS) à Montréal. Ce sondage mené entre mai et juin 2024 illustre les barrières et les solutions qui pourraient être mises en œuvre par les agences et organismes municipaux de Montréal, basées sur des précédents de vélos en libre-service à travers le monde.

Résultats:

Barrières

- Les usagers de Bixi sont préoccupés par la sécurité routière.
- Le poids et le format des Bixis limitent l'utilisation et l'adoption des VLS.
- La capacité de cargaison des Bixis est insuffisante.
- Le manque de sièges pour enfants sur les Bixis restreint leur utilisation chez les femmes.

Solutions

- Des vélos légers, des paniers plus grands et des solutions pour enfants peuvent augmenter l'utilisation de Bixi.
- Un réseau avec une densité de 10-16 stations par kilomètre carré est idéal pour soutenir l'utilisation de VLS
- Une stratégie compréhensive de sensibilisation et de communication est nécessaire.
- Des cours, ateliers, et consultations avec une variété d'acteurs contribuent à augmenter l'utilisation de VLS.
- La concertation avec les agences de transport et le gouvernement est requise pour assurer le succès des VLS.

Recommendations:

1. Nommer un directeur de programme d'équité pour développer une stratégie d'équité et mener des consultations.
2. Prioriser l'établissement d'une stratégie d'équité claire avec des indicateurs précis pour mesurer les gains d'équité.
3. Développer un programme de cours, leçons, balades à vélo collectives, et de consultations participatives.
4. Atteindre une densité d'au mínimum 10 stations par kilomètre carré en priorisant les zones les plus vulnérables.
5. Récolter des données sur les infrastuctures cyclables et sensibiliser les usagers pour améliorer la sécurité routière.
6. Examiner la structure tarifaire, les méthodes de paiement, et l'adoption de rabais pour faciliter l'accès à Bixi.
7. Évaluer les mécanismes de débloquage des vélos afin d'augmenter la flexibilité et la facilité d'utilisation de Bixi.
8. Ajouter des vélos plus légers et plus petits à la flotte de vélos Bixis afin de promouvoir les VLS auprès des femmes.
9. Réviser le design des paniers Bixis en étudiant des options tel le VLS cargo, les supports à vélo, et les remorques.
10. Adopter des alternatives qui favorisent l'utlisation du VLS pour ceux et celles avec des responsabilités familiales.

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Cycling equity: "a situation where cycling is a safe, secure mode of travel that improves mobility and accessibility fairly, enabling all people to participate in socio-economic life [by recognising and addressing] the needs and concerns of disadvantaged groups, [and including] these groups throughout the entirety of the planning process." (1)

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Introduction

Introduced in Montreal in 2008, the Bixi bikeshare system was the first of its kind in North America (2). Originally financed by the city of Montreal, Bixi acted as a branch of the para-municipal firm Public Bike System Company (PBSC) which ultimately filed for bankruptcy in 2014 leading the city's administration to acquire PBSC's local assets to create the non-profit Bixi Montréal (3). Despite PBSC's initial failure, investors shored up the company in 2014 to form PBSC Urban Solutions, now owned by the ridesharing service Lyft (4), which manages 45 bikeshare systems across the world. Nonetheless, Montreal has continued to stand out among these cities since Bixi remains to this day a non-profit organisation independent from the Lyft-owned PBSC Urban Solutions – Bixi's manufacturer (4) – and because it receives millions of dollars in taxpayer money from the city of Montreal to sustain and expand its operations.

Although it has made great strides over the last decade, Bixi has only recently surged in popularity attaining record ridership levels in 2023 (5). This delayed success compared to other North American bikeshare systems has meant that Bixi is lagging in the services it offers and there are genuine concerns as to the equity of the distribution of its network and the services it offers. Recent research has indeed illuminated substantial disparities in bikeshare access across major US cities, rooted in factors such as income, race, and education (6–8), while demonstrating that users grapple with an array of barriers, ranging from age and disability to stigma, cost, and access to financial services (9). While multiple North American bikeshare systems have acknowledged these disparities by making transportation equity a guiding principle or have sought to address them through various financial incentives and discount programs, station siting policies, and by adapting their pricing structures (6), Bixi does not explicitly recognise the necessity to provide equitable service to all Montrealers. In fact, Bixi claims to site its stations based on three criteria: population density, travel generators (regular commute routes, retail centers, and transit nodes), and nearby bicycle paths (10). However, recent research found that Bixi network expansions between 2017 and 2022 primarily served lower income neighbourhoods and visible minority populations, concluding nonetheless that it is ambiguous whether this was a conscious choice or not (11). Additionally, Bixi has yet to adapt its pricing scheme to incorporate various financial needs including reduced fares, payment plans, and alternative payment options, relying on a monthly and seasonal membership structure and a single-use fare purchased using a credit card, while imposing 100$ credit card holds on single-use riders.

As a non-profit organisation that continues to receive millions of dollars in funding from the city of Montreal, and in light of its increasing popularity, a nuanced evaluation of Bixi's practices contextualized within the unique sociodemographic makeup of Montreal is needed to understand how equitable its services are and where they can be improved. This research therefore asks: How can Bixi enhance its operations and accessibility to ensure it is equitable for and inclusive of all residents of Montreal?

Relying on a mixed-methods approach, this research first explores equity-centered practices through a review of bikeshare systems across North America and around the world. This review provides a framework that informs a set of policy recommendations and equity guidelines for Bixi to provide a more equitable service based on potential gaps in Bixi's operations highlighted throughout this research. Second quantitative data collected through an online survey is analysed to provide a firsthand account of structural barriers faced by Bixi users, and the reasons Montrealers choose not to use Bixi encompassing considerations such as bicycle and station characteristics, fees and financial concerns, cycling infrastructure, and social norms. Lastly, the discussion section illuminates existing gaps in Bixi's approach and furnishes a set of actionable guidelines and recommendations for policymakers, the city of Montreal, and Bixi, with the hope to develop a more inclusive and accessible bikeshare system in Montreal.

Source: Bixi, 2024

Cycling equity

Research on transportation equity highlights that equity "is about how policy decisions shape societal levels of environmental externalities and what groups are more or less exposed to them, just as how they [...] access life-enhancing opportunities such as employment, healthcare, and education" (12). Indeed, transportation services have the potential to mitigate negative externalities by enhancing access to opportunities like jobs and services, should transportation resources be distributed fairly, which is not always the case (13).

Historically, studies show that vulnerable groups such as low-income populations and people of colour suffer significantly more from the negative externalities generated by transportation planning than other groups (12). These externalities include poor health outcomes related to air and noise pollution and sedentary lifestyles, as well as greater risks of death or injury from collisions, which result from poor land-use planning policies and low investment in active transportation infrastructure and traffic safety in neighbourhoods where these populations accrue (12). Conversely, studies show that higher-income populations account for a disproportionate share of private vehicle use which is one of the main generators of negative externalities from transportation (12).

A way to alleviate these inequities in transportation is through horizontal or vertical equity. While the former suggests a spatially equitable distribution of costs and benefits among a population without recognising the more pressing needs of certain groups like low-income populations, the latter advocates for "a fair distribution of resources [to provide] a greater variety of options to those with the least" (13). In other words, horizontal equity assumes that transportation resources should be equally spread out spatially in order to service the most amount of people equally, while vertical equity considers socio-economic differences and the needs of vulnerable populations when distributing costs and benefits. In mature and expansive systems, such as Montreal's transportation system, vertical equity is increasingly considered since the supply of quality transport options is already ample (14).

Within this context, cycling provides a low-cost transportation option that contributes to bridging the gaps within a city's transportation system (15,16), and increasing job accessibility (17), and that offers a plethora of health and environmental benefits while also reducing congestion (1,18,19). However, "a proper consideration of equity in planning practice is needed since empirical evidence [suggests] a shortcoming of equity-oriented practices in cycling planning and decision-making processes which may perpetuate distributional inequalities in cities" (15, p. 2). Research has in fact showed that the benefits associated with cycling are often ill-distributed and accrue to wealthier populations while vulnerable populations experience poor cycling conditions including more health risks, more collisions, lower access to safe cycling facilities, and a set of social circumstances that limit their ability to cycle despite being more reliant on this mode of transport (1,18–21).

As such, research finds that while the physical activity benefits of cycling outweigh the risks, the net benefits of shifting short driving trips to cycling are disproportionately low for marginalised groups, and mostly favour wealthier groups (18). They argue that this is most likely because marginalised populations tend to live closer to large vehicular infrastructure, have lower access to bicycle lanes protecting from tailpipe emissions, and live in neighbourhoods where bicycle crashes are disproportionately high (21). Furthermore, Researchers find that "the geographic distribution of cycling infrastructure is often biased, targeting privileged neighborhoods with existing and increasing socio-economic wealth [while] areas with a high concentration of socio-economic disadvantage and transport poverty remain systematically excluded" (16, p.578). This is despite the fact that residents in disadvantaged communities tend to make longer trips, particularly for utility cycling (16).

The type of infrastructure also matters, as reserachers highlight that, when they do have cycling infrastructure, low-income and racialised neighbourhoods are often equipped with the least safe infrastructure which correlates with the higher levels of pedestrian and cycling collisions experienced in lower income and vulnerable neighbourhoods (1). Nonetheless, there is an important paradox in that transportation-related investments and improvements in low-income neighbourhoods are cause for concern having been identified as drivers of gentrification and displacement (1,20). Indeed, research concurs that in Montreal, access to Bixi bikeshare stations increased multifamily unit mean sale values by up to 2.7% for example (22). However, while beneficial for municipal tax revenues, this also means that low-income residents may ultimately be priced out of their homes as land values and rents increase.

Beyond that, access to safe cycling facilities is often difficult for certain groups like seniors, children, women, and racialised populations, considering they have been historically excluded from the planning process, as cycling advocacy often represents white and wealthier groups (1,20). Additionally, research has demonstrated that women cycle significantly less than men due to concerns of safety and personal security, as well as gender roles and household responsibilities which hinder their freedom to cycle while racialised populations experience racism and discrimination from policing when cycling, which discourages them from cycling (1).

Bikeshare equity

Given the significant yet uneven role of cycling in improving health outcomes, lowering carbon emissions, and increasing accessibility, attention should be given to ways in which we can facilitate access to cycling, particularly for disadvantaged populations. Bicycle sharing (bikeshare) systems indeed yield the same benefits as cycling while providing the convenience to use a bicycle whenever needed without some of the associated costs and responsibilities of owning a bicycle, including the purchase, but also the maintenance, and the risk of theft and vandalism, which makes it suitable for short distance trips (6,23–25). Bikeshare provides the benefits of increasing access to transport systems particularly in low-demand areas and increasing transportation sustainability and safety by encouraging modal shift away from motorised vehicles thus reducing air pollution and traffic accidents (24,25). Bikeshare hence provides a flexible, affordable, and accessible way of cycling for most, which demonstrably increases cycling (26).

Despite the obvious benefits of bikeshare, these are not equitably distributed. Research on bikeshare equity has established that bikeshare in North America predominantly serves white, middle- to high-income communities with higher levels of education (6,8,27,28). Additionally, women, people of colour, people with low-income, and people with lower levels of education are underrepresented among bikeshare users in the United States (27,28). In Montreal, a study found that advantaged neighbourhoods have greater access to the bikeshare system, however noting an improvement between 2009 and 2017 whereby the percentage of dissemination areas (DAs) in Bixi's service area that are from the most deprived quintile rose from 9.5% to 15.8% (29). Other research concurs that although Bixi's intentions are unclear in that regard, DAs with a higher proportion of low-income residents and visible minorities are associated with a higher likelihood of expansion efforts from Bixi, between 2017 and 2022, and that these efforts were not in areas with the greatest demand, highlighting the need for greater transparency regarding Bixi's equity goals (11). The study concludes that Bixi should explore equity efforts through financial incentives to overcome some of the many barriers that exist in bikeshare systems (11), which are explored in the following section.

Barriers to bikeshare

Research highlights that in shared mobility, there are two types of barriers: "those that deter users from accessing the systems and those that deter operators from adequately expanding systems into low-income communities" (30, p.12). The types of barriers users may encounter with bikeshare can be classified as spatial, operational, social, or physical, while operator barriers are usually financial.

Spatial barriers

Spatial barriers refer more specifically to the siting of stations, which are often inaccessible to residents from marginalised communities. This is because the success of bikeshare systems depends heavily on their ability to ensure financial viability by optimising their network to respond to demand based on factors such as population density, employment opportunities, and proximity to cultural, recreational, and retail centres (25,31,32). The most used station location-allocation approaches thus currently focus either on minimising impedance – in other words minimising the distance between supply and demand by covering an area uniformly – or maximizing the population coverage within a station's area by concentrating stations in zones with the greatest potential demand (31,32). Since urban downtowns and the surrounding areas are dense in population and in destinations, they are often prioritised in the siting of stations (31). These areas however tend to be inhabited by wealthier more well-off populations and are generally where these populations tend to work (31). This further marginalises underserved populations that are already more likely to experience travel difficulties and lower accessibility (31), even though bikeshare users from lower socioeconomic groups have been shown to make a higher number of trips after controlling for station density (32).

In Montreal, Bixi currently sites its stations based on population density, travel generators (regular commute routes, retail centres, and transit nodes), and proximity to bicycle paths (10). Research on Bixi ridership in Montreal indeed highlights that the integration of cycling with rail transit by locating stations near metro and commuter rail stations for example can significantly increase cycling-transit rates, and that the presence of cycling infrastructure increases use of Bixi (33,34). Furthermore, restaurants and the central business district are both great

attractors for Bixi trips, with the former generating stronger attraction in the evenings, a practical finding for the rebalancing of the system (34). Similarly, population density and job density, as well as the proximity of stations to a home location and regular destinations, are responsible for the generation and attraction of an important number of Bixi trips in Montreal, while increasing the number of stations without increasing total capacity (i.e. the number of docks) in an area, has been shown to have a greater impact than increasing capacity as much as an average station (34).

Nonetheless, there is no explicit equity concern in Bixi's siting of its stations in Montreal while other bikeshare operators directly address siting concerns by prioritising public housing complexes and access to retail and job centres, establishing station quotas in low-income and minority neighbourhoods, crowdsourcing locations for expansions, and by expanding in underserved neighbourhoods using grants (30,35). Research notes that most operators consider these efforts to have a considerable impact on equity outcomes (35), although there is a need for more than station expansion in vulnerable neighbourhoods and targeted discounts, but rather a combination of measures including community events and partnerships with community actors and local advocates to genuinely improve the equity of bikeshare systems (6). Indeed, despite having lower access to bikeshare stations, low-income users and non-auto owners are severely dependent on bikeshare to travel, using it at a higher frequency and primarily for utilitarian trips (28). A study in London, UK in fact showed that users from the city's most deprived areas make more bikeshare trips per month and that ridership rose 8% in those areas after the city's bikeshare system expanded in deprived neighbourhoods (29).

Operational barriers

Beyond that, users oftentimes face operational barriers when using bikeshare systems, primarily because of the financial cost and requirements to access this service. Financial barriers can be as simple as the outright cost of a fare or membership, the time limit after which rides have a cost per minute, or the payment method, but they also refer to unbanked individuals who may not have access to a credit or debit card account.

Indeed, a study finds that access to credit or debit, daily prices, and credit card holds are major deterrents for the use of bikeshare in Birmingham, Alabama, because they significantly impact the ability of low-income populations to access bikeshare systems (9). A study additionally finds that in Chicago, employment rates and job opportunities limit ridership because they render the bikeshare system unaffordable, whether because of membership fees or trip costs (37). They suggest that discount programs for marginalised populations and a better understanding of the mobility needs of these specific groups are needed and that removing the time limit could be part of the solution since this group of users already maximise their 30-minute trip limit without additional costs (37).

Nevertheless, some bikeshare systems address cost concerns by reorganising their fee structure, offering discounts, and removing or reducing holds and deposits (35). Some of the strategies employed include adding more membership and fare options, introducing a payment installment structure or a cash payment option, offering discounts to targeted populations, and collaborating with credit unions and cellphone providers to provide service to unbanked individuals (30,35). In most cases, discounts are offered to individuals who receive public assistance or fall below an income threshold, as well as students (35,38). Additionally, the unavailability of docking stations and duration of rentals have shown to refrain users, a problem that was solved in Brazil and New Orleans by adding locks to bikeshare rentals and restructuring the rental period offers (38). Moreover, access to a cellphone and to internet is cited as a barrier that prevents certain populations from accessing bikeshare services, which Bixi addresses by allowing users to tap their credit card at the booth, or by ordering a key to unlock bicycles. Interestingly, since research finds that transit users, multimodal users, and people with driver's licenses are more likely to use Bixi (23), multimodal fares combining Bixi and the OPUS card could help remove this barrier for users, not unlike the carshare operator Communauto which allows users to unlock a car with their OPUS card and offers memberships with combined OPUS fares. Although Bixi previously trialed a system to unlock bicycles using an OPUS card, this service is no longer offered.

Physical barriers

Physical barriers refer primarily to users' disabilities and to the physical characteristics of the bicycles which tend to be heavy and large, do not have child's seats, and have limited basket and cargo capacity. In that regard, it has been noted that most children and some parents do not use bikeshare because children cannot ride the bicycles and the lack of child's seats prevents parents from bringing their children with them (9). Additionally, cargo capacity has been shown to be important for bikeshare considering that low-income individuals, people of color, and people who do not own cars rely on bikeshare for utilitarian trips such as grocery shopping and other shopping activities (28). In both cases, the role of cargo bikeshare is highlighted as a possible solution considering that they are well suited to carry multiple passengers, grocery bags, and other goods, and that cargo bicycles are usually too cumbersome to store for most people (38). Research in fact shows that cargo bicycles are especially important for women's uptake of cycling because they offer a travel alternative that is compatible with child-caring responsibilities and replaces trips by foot (38). Furthermore, disabilities are a big concern when it comes to bikeshare considering that the bicycles do not leave much room for accommodation. Nonetheless, there are examples of bikeshare systems that have made strides in adapting for disabilities, as is the case in Portland, Oregon, where the Portland Bureau of Transportation launched in 2017 the Adaptive Biketown program, run in collaboration with a non-profit organisation, aimed at renting out adapted bicycles to people with varying disabilities (43) and in Detroit, where MoGo has developed an adaptive bikeshare program, offering a variety of bicycles adapted to different disabilities that can be rented at two different locations (44)

Social barriers

Lastly, the social barriers that users may face refer generally to cultural factors, stigma, and awareness of bikesharing. Surveys conducted on bikesharing highlight that stigma associated with cycling and bikeshare is a barrier to its use, particularly for vulnerable populations who fear that their socioeconomic standing may make them appear as "captive" users compared to users of higher socioeconomic status who are seen as "environmentalists" when they use bikeshare systems (9). Additionally, negative perceptions of bikeshare as well as of cycling safety and cultural factors limit the uptake of bikeshare (35) and cycling in and of itself, as a study finds that a common theme among immigrants in Portland is that they have never learned to cycle (39). These potential users often don't know the "rules" of cycling, their rights, responsibilities,

and liability as cyclists and towards the bikeshare operator, and anticipate the potential issues they may face when cycling, such as conflicts with cars and pedestrians, mechanical issues, policing and harassment, or poor hygiene and an uneasy feeling from sweating on their way to their destination (1,39). Traffic safety is in fact often the number one concern regarding bikeshare regardless of race or income (27) and although there are no measures that can directly solve these situations, awareness campaigns, learn-and-ride lessons, targeted outreach, organised rides, and media have all successfully been used to familiarise potential bikeshare users with the realities of cycling (27).

In that regard the Bikeshare Planning Guide recommends formalising these types of community outreach practices by creating a position dedicated to outreach and community engagement, citing Atlanta's Relay bikeshare as a good example of an inclusive bikeshare model in that capacity (40). Boston Bikes which runs the Bluebikes bikeshare system – previously Hubway – also benefits from a dedicated program manager whose job consists in growing the subsidised membership program through outreach, ambassador groups, and community events (41). As noted by NACTO, the success of Hubway's income-based discount program was largely reliant on this program manager and outreach efforts to make this program known (41).

Similarly, researchers highlight Philadelphia's Indego bikeshare system, who's outreach strategy focuses on targeting key community agencies and representatives to facilitate outreach work in specific areas, as well as using a team of young adults roaming the streets and interacting with local residents during community events (27). They also mention the ambassador program where local leaders are tasked to strengthen community support for bikeshare through pop-ups at various events such as festivals, fairs, markets, and block parties, a strategy also used by Atlanta's Relay Bikeshare (40).

Another strong example of the significant impact of consultations, outreach, and collaboration with community organisations, the partnership between Citi Bike, the Bedford-Stuyvesant Restoration Corporation, and the New York City Department of Transportation, successfully doubled Citi Bike trips in Bedford Stuyvesant, increased memberships in the neighbourhood at a higher rate than in the rest of the system, and improved perceptions of Citi Bike in this low-income neighbourhood (42). Supported by grants from the Better Bikeshare Partnership, this initiative reached over 2,500 participants in over a year with a series of measures that included station siting workshops, community events and rides, helmet giveaways, and collaborations with youth and community groups, and health, housing and employment agencies (42).

In highlighting keys to their success, the Bedford Stuyvesant Restoration Corporation and NACTO report that:

1. A deeper engagement is needed from residents, healthcare providers, employment, housing, and transportation agencies, local government, and bikeshare operators.

2. Local champions and high-level leaders matter in rallying residents and communities around the same goal.

3. Efforts should focus on providing solutions to existing problems for these communities, not simply marketing to them. Concerns related to unemployment, housing displacement, and financial insecurity were addressed through Citi Bike employment programs, organised rides showcasing existing services, offering free Citi Bikes to workforce development program participants, and linking Citi Bike members with financial counselors.

4. It is important to build on existing long-standing relationships with and between organisations and resources to bring credibility and to work efficiently. Ensuring nearby access to a station is also mandatory to ensure success.

5. Building trust between organisations and with residents takes time and documenting the process with data and recurrent meetings is key.

6. Money matters and its impact cannot be understated. Hiring full-time staff and ensuring financial stability to small organisations that commit time and resources to partnership efforts as well as organising community events is necessary for a successful partnership.

Source: Bixi, 2024

Data and methods

Data

This study uses data from a bilingual online survey of Montreal cyclists prepared and conducted with the help of Transportation Research at McGill (TRAM). The survey was online from the middle of May to the end of June 2024 and relied on an email mailing list of cyclists in Montreal collected by TRAM over previous surveys, as well as advertisements in social media, to recruit additional participants.

The total number of responses for this survey was 1503, but only 1337 respondents were used in the final sample after removing errors and responses from outside of the island of Montreal. Respondents were asked to report their travel behaviour, their use of Bixi, their perception of various barriers to Bixi and potential improvements, as well as their cycling attitudes, travel preferences, and personal characteristics in 107 questions, including open-ended questions for further comments on Bixi and cycling in general.

Respondents to this survey were categorised based on income, education, and gender. An analysis based on visible minorities was excluded considering the very small sample of respondents that identified as visible minorities.

For the purposes of this analysis, those with a household income below the median household income for the Montreal census metropolitan area in 2020 of $76,000 are considered to have lower income. This includes respondents with a household income below $30,000 or between $30,000 and $59,999. Those with a household income between $60,000 and $149,999 are considered medium-income and those with a household income over $150,000 are considered high-income.

In terms of education level, those who have attained no more than a trade, technical degree or college diploma are categorised as having a lower education level, those who have an undergraduate degree are categorised as having a medium education level, and those with a graduate degree are categorised as having a high education level.

Only the responses of those who identify as “man” or “woman” were kept for gender-based analyses due to the small number of respondents who identify to another gender or who preferred not to answer.

The respondents were ultimately separated into two groups: Bixi users (those who used Bixi at least once in the last year) and non-users (those who did not use Bixi in the last year). The summary of respondents can be found in Figures 8 and 9 and Table 6 in the appendix.

Lastly, the GIS analysis conducted to assess the equity of Bixi’s service area relies on the georeferenced station locations from the 2023 Bixi trip history dataset, station capacity from Bixi’s General Bikeshare Feed Specification (GBFS) data, and home locations taken from this survey and georeferenced with Google Earth Pro, while four variables from the 2021 Canadian census are examined: median household income in 2020, prevalence of low income based on low-income measure after tax, total population with a bachelor’s degree or higher, and total visible minority for the population in private households.

Methods

Differences between means were compared using t-tests in R Studio. Respondents with lower income were compared to the high-income group, those with lower levels of education were compared to those with higher levels of education, and men were compared to women. This process was undertaken for the barriers encountered by Bixi users, the suggested improvements for Bixi users, and the suggested improvements for non-users. Differences in means with a p-value below 0.05 are considered statistically significant.

For the first part of the GIS analysis, home locations were mapped out on QGIS along with Bixi stations and their dock capacity. Consistent with previous research, 300-meter buffers were created around each home location representing a 5-minute walk (8), and the number of stations inside each buffer was counted. The mean number of stations within 300 meters of a home location was then obtained based on whether each household considered proximity to a station, or the availability of docks and Bixis to be a barrier.

In the second part, dissemination blocks (DB) were used as the statistical area of analysis and centroids were created for each DB with a buffer of 300 meters within which the number of stations was counted for each DB. Consistent with research on bikeshare station siting (40,45), a density of 10 stations per square kilometre was used to assess the equity of Bixi’s network. The DBs that met a threshold of 3 stations within the 300-meter buffer were considered as “well-serviced”, and obtained a score of 1, and those that did not were considered “underserved” and received a score of 0. This data was then aggregated to dissemination areas (DA), where the service level of a DA corresponds to the proportion of its area that is represented by well-serviced DBs (e.g. a DA covered 40% by “well-serviced” DBs and 60% by “underserved” DBs has a service level of 40%)

In the third part of this analysis, the means of 100% serviced DAs and underserved DAs were compared for the following variables: median household income, prevalence of low income, proportion of the population with a bachelor’s degree or higher, and proportion of the population that is a visible minority.

Bixi users

Barriers

The results in Table 1 show that the most important barriers for Bixi users are trafic safety (37%), the extra cost of E-Bixis (32%) and the mandatory helmet law (31%) for E-Bixis, whereby those who ride e-bicycles in Montreal are required to wear a helmet or expose themselves to a hefty fine. Beyond that, the availability of Bixis near the home and the workplace (28%), the availability of docks near the workplace (26%), the weight of the bicycles (26%), the cost of a single-ride (23%), and the proximity of stations (20%) are also very important barriers for users. When comparing between income groups, education level, and gender, we observe that Bixi users have very different experiences based on income and gender, but that experience does not vary significantly based on education level. There are indeed statistically significant differences between users with lower income and high-income users who consider the cost of E-Bixis (41% vs 25%), the availability of Bixis near the workplace (15% vs 26%), the cost of a single ride (32% vs 16%), and access to credit (8% vs 2%) as barriers.

Furthermore, there is a statistically significant difference between women and men who consider the availability of Bixis near the workplace (34% vs 25%), the weight of Bixis (33% vs 21%), the lack of helmets provided with Bixis (23% vs 15%), the lack of Bixis with child's seats (19% vs 11%), and the size of Bixis (17% vs 9%) to be barriers.

As respondents were also able to specify any barrier they may encounter through an open-ended question, the results additionally show that out of the 236 comments, 23% mentioned locking and unlocking issues with broken docks, 19% mentioned that Bixis are often broken, 15% mentioned the lack of Bixi or available docks, 14% mentioned the limited basket size and cargo capacity of Bixis, and 12% mentioned the lack of stations (see Table 2).

"The [basket is awkward] and rarely fits the items I need to carry". "They are often damaged and dirty". "I can't afford it anymore". "There is a lack of stations". "Biking is stressful and dangerous". "It is not adapted to my morphology". "The docks are faulty". "[I'm concerned] it's not safe or comfortable".

Enhancements

Although respondents who are Bixi users mostly agree that the suggested improvements are likely to increase their use of Bixi (see Table 3), combining Bixi fares with the OPUS card (72%), improving the cargo capacity of Bixis (67%), and introducing a day-pass (64%) stand out as the three improvements that are most likely to increase their use of Bixi. Nonetheless, adding more docks (63%) and more Bixis (58%) are also two very important factors in increasing this group's use of Bixi, followed by lighter Bixis (56%), and extending the 45-minute time limit (48%), (48%), whereby Bixi members can use standard bicycles for free for the first 45 minutes of their ride after which they start paying per minute. Lastly, introducing various fare options like a family pricing (44%), a weekly pass (44%), and income-based discounts (33%) are also important enhancements for Bixi users.

Looking at these improvements in terms of income, we observe statistically significant differences between those with lower income and high-income respondents particularly regarding financial improvements such as income-based discounts (56% vs 20%), extending the time limit (59% vs 34%), removing credit holds (31% vs 18%), and introducing alternative payment methods (29% vs 15%). In terms of gender, we only observe statistically significant differences where a bigger proportion of female users responded that they are more likely than male users to increase their use of Bixi if the time limit is extended (59% vs 34%), credit holds are removed (31% vs 18%), and alternative payment methods are introduced (29% vs 15%). In terms of gender, we only observe statistically significant differences where a bigger proportion of female users responded that they are more likely than male users to increase their use of Bixi if the time limit is extended (54% vs 43%) and if Bixi adds bicycles with child's seats to its fleet (28% vs 19%). Lastly, looking at education, the only statistically significant differences regard the introduction of family discounts (53% vs 40%), the removal of credit holds (34% vs 19%), and the introduction of lighter Bixis (66% vs 53%).

Table 1: Barriers for Bixi users*

Barriers	Users	Income		Education		Gender	
		Lower	High	Lower	High	Men	Women
Sharing roadspace with cars	37.46%	35.29%	27.78%	37.66%	34.87%	36.39%	38.53%
Cost of an E-Bixi ride	31.98%	41.18%	25.00%	31.17%	31.58%	32.72%	29.82%
Mandatory helmet law for e-bicycles	31.27%	31.76%	33.33%	29.87%	30.26%	35.78%	23.85%
Availability of Bixis near the workplace/school	28.25%	15.29%	26.11%	26.67%	30.18%	24.65%	33.86%
Availability of Bixis near home	27.74%	30.59%	26.67%	29.87%	28.29%	25.38%	30.73%
Availability of docks near the workplace/school	26.02%	18.82%	25.00%	31.67%	26.91%	25.35%	28.04%
Weight of Bixis	25.97%	29.41%	23.89%	28.57%	27.96%	21.10%	32.57%
Cost of a single-trip	22.61%	31.76%	16.11%	23.38%	22.37%	25.69%	17.89%
Proximity of stations near home	20.14%	28.24%	18.33%	19.48%	18.75%	19.27%	21.10%
Proximity of stations near workplace/school	20.12%	10.59%	16.67%	23.33%	17.82%	18.31%	23.81%
Availbility of docks near home	19.26%	20.00%	18.33%	14.29%	21.05%	17.13%	22.48%
No helmets provided with Bixis	18.20%	20.00%	15.00%	15.58%	17.11%	14.98%	22.94%
No Bixis with child's seats	14.49%	14.12%	16.11%	7.79%	13.49%	11.01%	19.27%
Large size of Bixis	12.37%	16.47%	11.11%	18.18%	12.50%	9.48%	16.51%
Cost of a monthly membership	11.48%	15.29%	9.44%	14.29%	10.86%	12.54%	10.09%
Cost of a seasonal membership	10.42%	12.94%	8.89%	12.99%	11.51%	10.40%	10.55%
Sharing roadspace with cyclists	10.25%	12.94%	7.78%	14.29%	9.21%	10.70%	9.63%
Credit card holds	8.83%	15.29%	7.78%	16.88%	8.22%	8.87%	9.17%
No access to data on cellphone	6.54%	5.88%	4.44%	5.19%	8.22%	4.28%	8.26%
No access to a cellphone	5.65%	7.06%	1.67%	6.49%	6.58%	4.59%	6.42%
Unclear instructions	5.30%	9.41%	3.89%	5.19%	6.25%	5.50%	4.59%
No access to credit	3.71%	8.24%	1.67%	6.49%	3.29%	3.67%	3.21%
Physical disability	1.41%	3.53%	1.11%	3.90%	1.64%	1.53%	0.92%

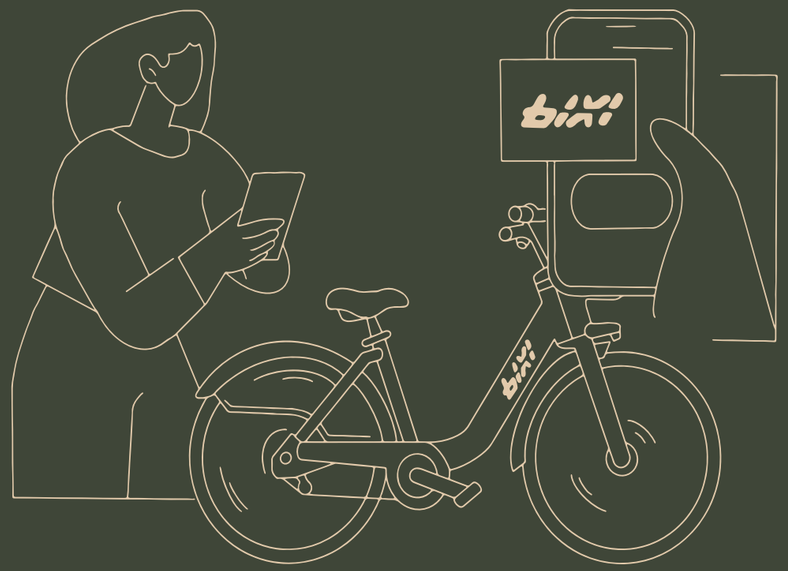


Table 2: Additional barriers for Bixi users*

Other barriers	%
Docks are often broken or disabled	23.31%
Bixis are often broken	19.07%
There are no Bixis or docks available	14.83%
The basket is not suitable	13.98%
There are not enough stations	12.29%
Unsuitable seat adjustment height	8.90%
Bixi is expensive	6.78%
Bugs on the app	5.93%
I feel unsafe when cycling	4.66%
Bixis only have 3 gears	4.66%
Bixi users don't respect cycling rules	4.24%
Other	4.24%
I cannot ride an E-Bixi without a helmet	3.39%
The Bixi's design prevents me from using it	2.97%
Bixis are often sticky and uncomfortable	2.54%
I don't understand how to use Bixi	2.12%
I don't have access to a phone or data	1.27%

Enhancements	Users	Income		Education		Gender	
		Lower	High	Lower	High	Men	Women
Integration with OPUS card	72.44%	67.06%	66.11%	74.03%	72.70%	68.81%	76.15%
Increased cargo capacity/cargo bike rental	67.49%	72.94%	62.78%	64.94%	66.78%	68.81%	65.60%
Day pass option	64.84%	63.53%	56.67%	59.74%	63.82%	63.61%	66.97%
Docks are added	62.54%	61.18%	57.78%	64.94%	62.50%	61.77%	64.22%
Bixis are added	57.60%	58.82%	55.00%	57.14%	56.91%	57.19%	59.17%
Lighter Bixis are added	55.65%	43.53%	54.44%	66.23%	53.29%	51.99%	60.09%
The 45-minute time limit is extended	48.23%	58.82%	34.44%	49.35%	43.75%	43.12%	53.67%
Family fare option	44.17%	35.29%	45.00%	53.25%	40.13%	42.81%	45.87%
Weekly pass option	43.82%	43.53%	33.33%	45.45%	43.09%	41.28%	46.33%
Income-based discounts	33.39%	56.47%	20.00%	38.96%	29.93%	29.66%	36.24%
Credit holds are removed	22.61%	30.59%	17.78%	33.77%	19.08%	22.63%	21.56%
Bixis with child's seats are added	22.26%	23.53%	22.22%	20.78%	20.07%	18.65%	28.44%
Alternative payment options are introduced	20.49%	29.41%	15.00%	28.57%	19.41%	20.18%	20.64%

Table 3: Enhancements for Bixi users*

* Values highlighted in beige indicate a statistically significant difference with a p-value < 0.05

Non-users

Reasons

When asked why they do not use Bixi, most respondents unsurprisingly stated that it is because they have their own bicycle. However, many of them also reported other reasons, among which the weight of Bixis (43%), the size of Bixis (27%), the number of things they have to carry (17%), access near the home (17%), and the fact they are travelling with children (11%), are important inhibitors (see Table 4).

Table 4: Reasons for non-users*

Reasons not to use Bixi	%
Bixis are too heavy	43.65%
Bixis are too big	26.62%
I have too many things to carry	17.49%
I don't have access to Bixi near my home	16.73%
I don't know	12.55%
I can't bring my child with me	11.03%
Bixi is too expensive	8.37%
I don't have access to Bixi near my work	5.70%
I don't have access to data on my phone	5.70%
I don't have access to a phone	3.80%
I don't have access to credit	3.04%

Enhancements

In terms of suggested enhancements, almost half of non-users responded that merging Bixi fares with the OPUS card (49%) is likely to make them use Bixi, while about one third of them agree that introducing a day pass (34%), introducing lighter Bixis (34%) and extending the time limit (33%) will yield the same effect. They also highlight the addition of stations (29%) , the addition of Bixis (24%), and a weekly pass option as substantial enhancements.

Regarding income, non-users with lower income demonstrate that they are significantly more likely than the high-income group to start using the bikeshare system if Bixi implements measures such as the integration of fares with the OPUS card (60% vs 47%), the addition of a day (49% vs 24%) or weekly pass (35% vs 13%), the introduction of lighter Bixis (48% vs 31%), the extension of the time limit (50% vs 29%), the removal of credit holds (28% vs 7%), and the use of alternative payment methods (27% vs 5%). In terms of gender, women are statistically significantly more likely than men to start using Bixi if the time limit is extended (37% vs 30%), if the fares are merged with the OPUS card (54% vs 46%), and if lighter Bixis are introduced (41% vs 29%). Lastly, regarding education, income-based discounts (19% vs 11%), the removal of holds (24% vs 14%), and alternative payment methods (20% vs 8%) are significantly more likely to convert non-users with lower levels of education to Bixi (see Table 5).

Enhancements	Users	Income		Education		Gender	
		Lower	High	Lower	High	Men	Women
Integration with OPUS card	48.83%	59.68%	47.12%	52.08%	48.96%	45.58%	54.36%
Day pass option	34.29%	49.19%	24.08%	36.11%	33.43%	30.79%	37.98%
Lighter Bixis are added	33.90%	47.58%	31.41%	34,72%	34.93%	29.36%	41.11%
The 45-minute time limit is extended	32.86%	50.00%	28.27%	34.03	34.33%	29.83%	37.28%
Stations are added	28.57%	35.48%	27.23%	29.17%	28.66%	25.06%	33.45%
Bixis are added	23.90%	26.61%	22.51%	23.61%	25.37%	21.72%	27.53%
Weekly pass option	21.69%	34.68%	12.57%	28.47%	20.30%	20.05%	24.39%
Family fare option	16.88%	14.52%	21.99%	13.89%	20.00%	15.75%	18.47%
Credit holds are removed	16.62%	28.23%	8.38%	23.61%	14.03%	14.80%	17.77%
Bixis with child's seats are added	12.99%	20.16%	13.61%	13.19%	14.93%	11.46%	16.03%
Income-based discounts	12.60%	27.42%	6.81%	19.44%	11.04%	10.74%	13.59%
Alternative payment options are introduced	12.21%	26.61%	4.71%	20.14%	8.06%	9.79%	13.24%

Table 5: Enhancements for non-users*

* Values highlighted in green indicate a statistically significant difference with a p-value < 0.05

Building equity

The survey demonstrates that respondents experience and interact with Bixi differently based on income, education, and gender. Results show that users encounter barriers relating to comfort, convenience, safety, accessibility, and finance. Conversely, those who do not use Bixi are also restricted by some of these barriers and are limited in their mobility options.

Although, some of these barriers are universally experienced, there are also important disparities as those with lower income face difficulties monetary difficulties in accessing the system compared to those with high income, and women are discouraged by the level comfort and convenience of the bicycles that is incompatible with their physical needs and social responsibilities. These discrepancies are particularly evident when considering some suggested improvements. The consensus among Bixi users is that improvements to Bixi's financial structure and modifications to the bicycles should be prioritised.

Those with lower income unsurprisingly differ from high-income respondents prioritising financial improvements similarly to those with lower levels of education and non-users. Additionally, women demonstrate that they are more likely to use Bixi if child's seats are introduced, suggesting that child-caring continues to affect their travel behaviour.

Although these results tend to confirm that Bixi has made important progress in expanding its network and increasing accessibility for those with lower income, more improvements are needed to ensure that those with lower levels of education and areas with a higher proportion of visible minorities are also serviced by the network. These results also suggest that the pathway towards a more equitable Bixi bikeshare system relies not necessarily on further network expansion and station additions, but rather on a layered approach targeted at introducing financial incentives, adding a variety of bicycles to the fleet, and conducting awareness campaigns, outreach, and training that support the current system and help generate further demand in target areas.

Weight and size

The current standard bicycle that Bixi uses is the "Iconic" model sold by PBSC Urban Solutions (46). This bicycle weighs around 48 pounds (47) and the E-Bixis weigh around 60 pounds (48). While the weight of Bixis is a barrier experienced by 26% of respondents who use Bixi, and the size by 12%, regardless of personal characteristics, the weight and size disproportionately affect women (33% and 17% respectively) compared to men (21% and 9% respectively). The survey conversely shows that 56% of current Bixi users would use the bikeshare system more often if lighter bicycles were introduced.

Similarly to Bixi users, 43% of respondents who do not use Bixi claim that the weight is one of the reasons why they refrain from using it, while 27% state that the size is one of the reasons. Furthermore, 34% of those who don't use Bixi agree that adding lighter Bixis would make them start using Bixi. Among them, this improvement could likely benefit those with lower income and women, considering that 41% of respondents with lower income and of women agree they would start using Bixi if lighter bicycles were introduced compared to 31% of high-income respondents and 29% of men.

Considering the design of the bicycles has important implications regarding gender disparities, it is crucial that Bixi seek to address these inequities by researching and trialing lighter bicycle options to add to its fleet. Although many lighter alternatives exist, a convenient solution could be PBSC Urban Solutions' lighter and slightly smaller bicycle, the "Fit" model, which weighs almost 15 pounds less than the current Bixis at around 34 pounds (48,49). Predominantly used in South America by the bikeshare operator Tembici, the "Fit" offers a lighter yet durable alternative to Bixi's current bicycles which not only impede current

Figure 1: PBSC's "Fit" model (Source: PBSC, 2018).

users, but also limits the adoption of Bixi in Montreal. Furthermore, because these bicycles share the same locking mechanism that Bixi uses, introducing this lighter alternative would not require stations to be adapted or retrofitted to match the new model, making this a convenient, efficient, and cost-effective solution. Indeed, regardless of the model that is chosen by Bixi, testing out lighter bicycles and collecting data to compare with the current model is a major step in diversifying Bixi's offer to Montrealers, and addressing gender disparities. While it provides the important benefit of facilitating micromobility for women, this measure also promises to increase ridership and the adoption of Bixi by new users that are currently deterred by the weight of the bicycles.

Basket and cargo

Although not questioned on the size of the Bixi front basket, many respondents specified in an open-ended question that the size and design of the basket, as well as the inability to rent cargo bicycles, was a challenge when using Bixi. In fact, out of the 236 comments recorded from Bixi users, 14% mentioned that the cargo capacity of the bicycles was insufficient, while 17% of non-users stated that they have too many things to carry which prevents them from using Bixi. Furthermore, 73% of users with lower income agree that they would use Bixi more often if the cargo capacity was increased, concurring with research which shows that this feature of bikeshare bicycles is highly influential in supporting and increasing ridership for low-income groups and other vulnerable populations who rely on bikeshare for utilitarian trips such as grocery shopping (28).

While research suggests that front baskets are preferable to rear racks to discourage carrying excessively heavy loads or riding with a passenger on the back of the bicycle (40), the current design of the basket is limiting and offers little flexibility. Compared to a closed basket, the current basket does help with carrying larger luggage with its open-sided design; however, the depth of the basket and the sturdiness of the design are restrictive. Considering there exists few guidelines for the design of bikeshare baskets, exploring flexible basket design options with Bixi's supplier could benefit those with lower income and facilitate the use of bikeshare for utilitarian trips. Alternatively, innovative solutions such as the Bixi Cargo envisioned by students at the University of Montreal (50), or cargo bikeshare, could generate similar benefits considering the increasing use of bicycles to transport larger loads than what they have commonly been used for. Such systems are already widespread in Switzerland, Austria, Germany (51), and London (52), where users can find and rent cargo bicycles at a low-price that provides them with

Figure 2: Carvelo's cargo bicycle (Source: Mobility, 2024).

the ability to carry large and heavy loads, and even children, something that is discussed in the next section.

Child's seat

When questioned on child's seats, almost 15% of Bixi users agree that this is a barrier they encounter when using the bikeshare system. There is a statistically significant difference between men and women, where 19% of women consider it a challenge compared to 11% of men. Conversely, 22% of Bixi users agree they would use Bixi more often if child's seats were added, once again with a statistically significant difference between women (28%) and men (19%).

Child's seats are indeed not only an important barrier to bikeshare, but also one that has hardly been solved or mitigated. While a promising solution was invented by a Washington D.C. couple in 2014, the contraption – consisting of a seat attached to the downtube of a Capital Bikeshare bicycle (the same model as Bixi) – was quickly shut down by the operator because it violates its terms of use (53). Nonetheless, this invention showed the potential of bikeshare attachments, and the growing need for a solution to child's seats, considering the interest it generated among parents in D.C. (53). It is hence worth considering how Bixi can collaborate with manufacturers on the development of attachments compatible with its bicycles, whether they are child's seats, trailers, racks, or any other contraption. While there may be liability issues associated to the safety risks that children may face when riding Bixi, it is an interesting solution to consider that can make the bikeshare system more accessible to parents and families.

Nevertheless, the Better Bikeshare Partnership

considers that cargo bicycles and adaptive bicycles like those provided by MoGo in Detroit are a big part of the solution to this problem (54). They also highlight the Mini Bicicletar program in Fortaleza in Brazil, which provides children with an easy access to children's bicycles through a bikeshare system and a fleet of bicycles with retractable wheels dedicated to children (55). Similar to the P'tit Vélib program introduced in Paris and ultimately terminated in 2017 (56), the Mini Bicicletar system provides children with bicycles with which they can learn to cycle, and provides parents with a financially accessible means to teach their children how to cycle, instead of buying a bicycle that their children will soon outgrow (38). Although this only serves parents with children who are old enough to ride a bicycle, it is still an important step in making bikeshare accessible to families, and as noted by the Better Bikeshare Partnership, Mini Bicicletar recorded over 6,000 trips in 6 months with only 50 bicycles in service in five stations, demonstrating the potential of such a system (55).

Considering Montreal's standing as a cyclist-friendly city, the genuine interest to combine cycling with child-caring responsibilities, and the important disparities engendered by this lack of options for those travelling with children, the research and development of a pilot program, whether for a child's seat attachment, cargo bicycles, or mini bicycles, should be one of Bixi's priorities as an innovator in the field of micromobility.

Figure 3: Mini Bicicletar (Source: Diario de Nordeste, 2021).

Safety and awareness

The single most important barrier for Bixi users is sharing the road space with cars or in other words, traffic safety, which is highlighted by 37% of Bixi users who responded to the survey consistent with research that shows that traffic safety is generally the main barrier to bikeshare (27).This result highlights the need for more quality cycling infrastructure in Montreal, and although investments in cycling infrastructure are beyond Bixi's control and competence, the Bixi app provides an interesting opportunity to collect trip data and survey users on the quality of roads and cycling infrastructure. This crowdsourced data could ultimately inform the investment of resources into the cycling network by the city of Montreal and its boroughs (40,57). Efforts should also target awareness campaigns, learn-and-ride lessons, and outreach programs organised in partnership with community and cycling advocacy groups which research shows to be one of the most important factors in increasing ridership for equity populations and vulnerable groups since they "raise the profile of the system and contribute to overall cyclist safety" (40). In that regard, Philadelphia's Indego bikeshare, LA Metro Bike Share, New Orlean's Bike Easy, and the Bedford Stuyvesant Restoration Corporation partnership are all cited as models to follow, although many other bikeshare systems use similar strategies.

One of the first beneficiary of the Better Bikeshare Partnership – a non-profit born in Philadelphia that supports bikeshare equity initiatives – Indego has hosted "urban riding basics" lessons open to all, adult learn-to-ride classes and monthly rides through different neighbourhoods of Philadelphia (40) as well as digital literacy and cycling courses, where those who complete the course qualify for a 6-month free bikeshare pass (27). This is similar to Bike Easy's strategy which promotes bikeshare in underserved communities through gender- and workplace-activities, lunch-and-learn lessons, collective and night rides, and free passes (38), and LA Metro Bikeshare's bicycle safety classes, and lessons on incorporating cycling within travel routines in partnership with local cycling non-profit groups (58). Beyond familiarising users with riding basics and the rules of cycling, these measures have the benefit of increasing ridership and generating safety in numbers, where a greater number of cyclists reduces the number of cars on the road and increases the visibility of cyclists hence enhancing safety for this group.

(Source: Bixi, 2024)

Beyond lessons, classes, and events, station design and placemaking can help garner interest for Bixi in underserved communities with low demand while making streets safer through station placement and street enhancements (59). Although these interventions do spur fears of gentrification, particularly in low-income and vulnerable neighbourhoods with a majority of renters, accompanying them with the right support and programs is an important pathway to connect with underserved communities and build ridership from the ground up. Streetscape interventions combining safety with design such as painted bulb-out designs or street closures can enhance public space by providing safety, promoting local artistry, and strengthening Bixi's image as a community partner, if well-integrated with programming and learning

opportunities (40). They can also be used for tactical community interventions as was done in Battery Park City in New York City where residents worked with planners to address safety concerns related to speeding and U-turns by installing a double-sided station in the median, exemplifying how cities can achieve traffic safety goals with the limited resources they have (59). Creating these types of hubs can also be beneficial for outreach purposes, considering that research indicates that most bikeshare users get their information at the station, and that there is a crucial lack in the communication between bikeshare systems and their users, who are often unaware of the benefits of certain measures that are implemented by bikeshare systems (41) which may ultimately lead to the failure of pilot initiatives. Bixi information centres and permanent stations, with tools and resources for Bixi users and other cyclists, as well as repair equipment and mechanics can help bridge the gap experienced by those that are unaware or unsure about Bixi and cycling in general, while establishing a link to collaborate with cyclists that do not use Bixi. Lastly, wayfinding interventions around permanent stations and important cycling infrastructure with signage, markings, and painting, can help direct cyclists towards Bixi stations, and reduce the need for phones and GPS to find nearby stations (58), thus limiting distractions when cycling.

Figure 4: Citi bike station used to close a road (Source: ITDP, 2018).

Financial accessiblity

The results of the survey suggest there might be disparities between those with lower income and high-income groups. Although it is hard to draw definite conclusions based strictly on the sample of respondents to this study, improvements to Bixi's fee structure could have important effects in increasing ridership and accessibility to Bixi's service for those with lower income. In general, Bixi users find to a varying extent that certain aspects of the financial structure are barriers, notably the cost for an E-Bixi ride (32%), the cost for a single-ride (23%), the cost for a monthly pass (11%), the cost for a seasonal pass (10%), credit card holds (9%), and access to credit (4%). More specifically, respondents with a lower income find the cost for a single-ride (32% vs 16%), an E-Bixi ride (41% vs 25%), and access to credit (8% vs 2%) to be barriers, more so than high-income respondents.

Conversely, improvements related to the financial structure obtained high scores suggesting they are likely to impact ridership. The combination of fares with the OPUS card (72%), the introduction of a day pass (65%), the removal or extension of the time limit (48%), the addition of a family discount (44%), the introduction of a weekly pass (44%), income-based discounts (34%), the removal of credit holds (23%), and alternative payment methods (20%) are all likely to increase ridership among current Bixi users. More specifically, there are statistically significant differences between users with lower income and high-income users who would use Bixi more often if income-based discounts are introduced (56% vs 20%), if the time limit is extended (58% vs 34%), if credit card holds are removed (31% vs 18%), and if alternative payment options are introduced (29% vs 15%). A statistically significant number of women would also use Bixi more often if the time limit were extended suggesting they may be using bikeshare for longer trips or for trip-chaining, at least more than men (54% vs 43%). Lastly, respondents with a lower level of education find that family discounts (53% vs 40%) and the removal of credit holds (34% vs 19%) would be most impactful on their use of Bixi.

Although the financial barriers seem to be low for respondents of this survey, implementing some of the suggested improvements could have a substantial impact on ridership, especially for those with lower income. In particular, the implementation of income-based discounts could significantly increase access to Bixi's services for this group. The model could emulate what is currently done by other bikeshare systems whereby those who qualify for a low-income discount pay a largely discounted annual membership fee and receive additional benefits, such as waiving or extending the time limit to an hour, the provision of a free helmet, and learn-to-ride lessons for example (40). Many systems offer these discounts to residents whose income is below a set poverty threshold income, live in social housing, or receive some sort of social benefits. In Montreal, this is akin to the system used by some boroughs to offer parking stickers at a discounted rate for residents with low revenue, who earn less than a threshold income based on the poverty income level set by the *Institut de la statistique du Québec*. The required documents could be verified either internally by Bixi through an online procedure, or in person at a Bixi service point or the Access Montreal Office which already offers an array of services that includes the verification of documents and emission of parking stickers.

What's more, introducing day passes and weekly passes can benefit those with lower income who may not be able to afford the lump sum of a monthly

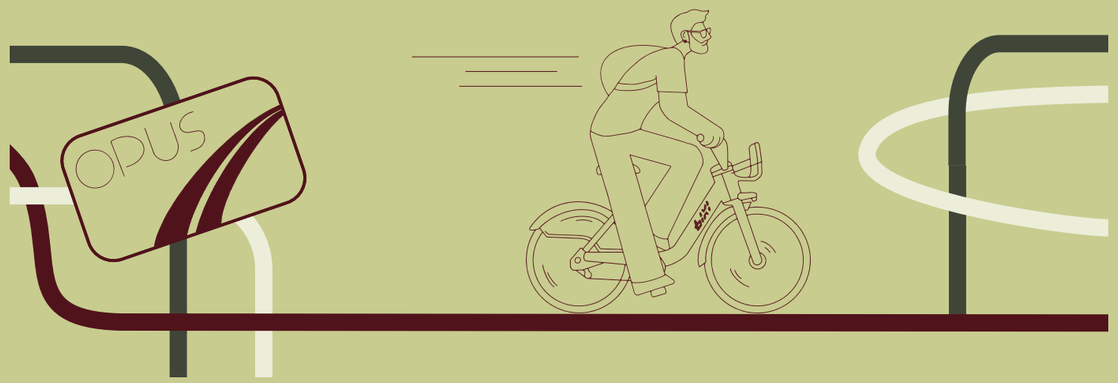
Figure 5: Access Montreal office (Source: Montreal, 2024).

pass or seasonal pass, and student discounts can benefit many students who tend to live with fewer funds. Similarly, alternative payment options such as cash payments or payment plans may facilitate access for this group by limiting the necessity of a credit account or lump-sum payments to access Bixi services. This would require once again the integration and streamlining of Bixi services with in-person service points such as the Access Montreal Office or convenience stores as is done by other bikeshare operators (Philadelphia's Indego, Cincinnati's Cincy Red Bike, and Detroit's MoGo) and by the STM with the OPUS card. Furthermore, reevaluating the need for credit card holds, or the amount that is held may significantly increase ridership among those with lower income who face important financial challenges when using Bixi. Indeed, credit card holds, financial penalties, and other user liability mechanisms have been shown to be major deterrents in using bikeshare systems (27,40). The necessity of this measure should be reevaluated to ensure that the protection it provides Bixi against vandalism and theft adequately represents the burden it places on users.

Lastly, the integration of Bixi fares with the OPUS card presents an interesting opportunity to streamline transit options in Montreal in two important ways. First, the OPUS card, as exemplified with the carshare service Communauto, provides a physical means

to access Bixi that can replace the Bixi key and reduce the need for a credit card, a phone, or data to unlock a Bixi, which are all barriers encountered to various extent by those with lower income. Although it requires retrofitting or modifying the current stations, respondents to this survey find that the integration of Bixi fares with the OPUS card is the improvement that is most likely to make them use bikeshare more often or even to start using it, and this was also already trialed by Bixi in the past. Second, the integration with the OPUS card can boost the reach of Bixi by providing first and last mile connectivity to OPUS users. A system whereby weekly or monthly OPUS passes also provide a 15-minute free Bixi transfer for example could greatly improve accessibility, particularly in areas located far from large transit stops like exo train stations, metro stations, REM stations, and important bus lines. OPUS members could also receive discounts on Bixi memberships, similar to what Communauto offers to annual OPUS fare holders. Some good examples are Portland's Transportation Wallet program which offers users a bundle of transit options including transit passes and credits on certain micromobility options like E-scooters and Biketown bikeshare, or the ConnectCard transit pass in Pittsburgh which allows for 15min of free bikeshare ride for transfers (17). Los Angeles Metro's TAP card similarly provides access to the metro and bus system, as well as 23 other systems including Metro Bike Share, and Breeze Bike Share in Santa Monica (58). Notwithstanding the financial considerations that such a system may entail, it is worth exploring in collaboration with transit agencies in the greater Montreal such as the STM, and the ARTM, how transit and Bixi fares could be combined or complemented to understand the benefits and drawbacks of a streamlined service, as research has shown that this particular measure is likely to increase bikeshare use (27).

It is important to consider however that implementing these types of measures does not guarantee success in increasing ridership for lower-income groups. Financial incentives must be supported by outreach, marketing, and campaigns targeted at equity populations, and a well-balanced network to ensure the adoption of bikeshare (41). The key to attracting this demographic is providing them with convenience and flexibility with their payment options and methods for accessing the system, which means providing more fare options as well as physical keys or cards with which they can unlock a bicycle, rather than relying on a phone (41).



Network accessiblity

As it pertains to network accessibility, poor station access is the fourth most cited reason for not using Bixi, cited by 17% of non-users, while 29% of this group state that they would use Bixi more often if stations were added. Furthermore, there is a statistically significant difference between non-user women (33%) and men (25%) who would start using Bixi if more stations were added, while the addition of Bixis does not yield a statistically significant difference between the two groups, suggesting there may be concerns of safety in accessing a Bixi station for women who would hence prefer to travel less distance to access a bikeshare station. This is line with research that shows that women are more likely to experience a fear for personal safety shaped from experiences of street harassment (60), and that although this fear is also experienced while cycling (1,60–62), it is attenuated by the ability to escape quickly that is provided by the bicycle compared to travelling by foot or transit (63). Alternatively, this might also reflect the fact that women tend to trip chain and make more stops than men when cycling (1,64), and a greater number of stations is better suited to their travel behaviour.

More importantly, 20% of users consider that access to a station is a barrier either near their home or their work location. In exploring whether this finding correlates to the actual distribution of the network and station siting, this research indeed finds that there is a statistically significant difference in the mean number of stations located within 300 meters – the equivalent of a 5-minute walk – of the home location of Bixi users who consider the accessibility of stations to be a barrier and those that do not. Indeed, Bixi users who find that access to a station is a barrier have on average access to 1.7 stations within 300 meters of their home, while those that do not consider it a barrier have access to 2.8 stations. This is equivalent to a station density of 10 stations per square kilometer. Importantly, there is no statistically significant difference in the number of docks within 300 meters of a home location for those who find that access to a Bixi or a dock is a barrier and those who do not.

Concurring with previous research, these results suggest that the capacity of stations, meaning the number of docks, is not as influential compared to the number of stations (34) and that Bixi users thus prefer more stations of smaller sizes than few large stations. When looking at the equity of Bixi's service area, this research finds there is a statistically significant difference in the median household income of DAs that meet the prescribed density of 10 stations per square kilometer ($59,980) versus those that don't ($77,208), as with the prevalence of low-income residents (21% vs 15%). However, there are also statistically significant differences with regard to the proportion of the population with a bachelor's degree or higher (50% vs 33%) and the proportion of the population that are visible minorities (29% vs 42%). This means that the areas that are well-serviced by Bixi do in fact serve populations with lower income, but they also significantly favour those with higher levels of education and disfavour those that are visible minorities.

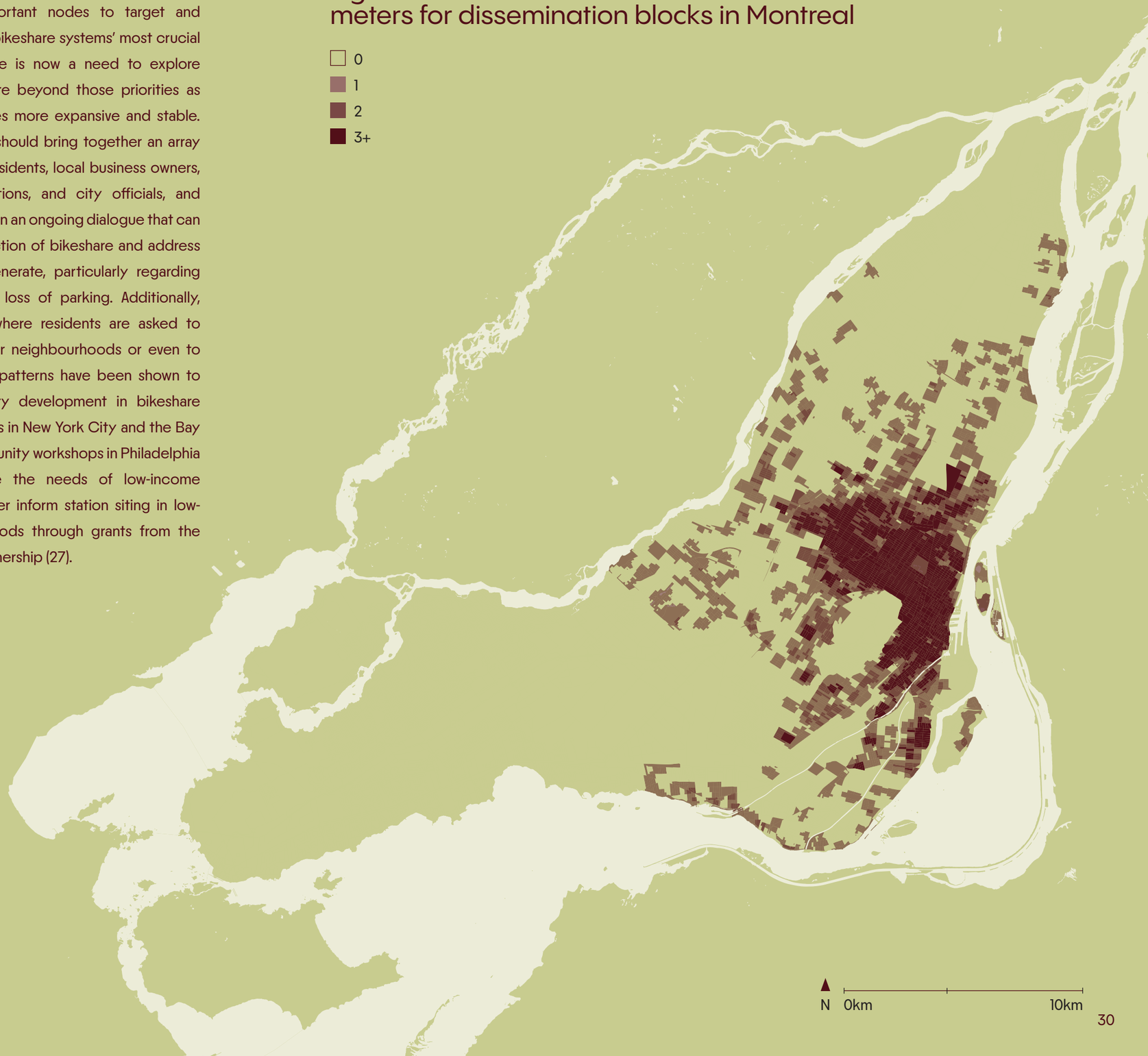
On a macro scale, there is hence a need for Bixi to identify the gaps within its network, which this research determines to be areas with a station density below 10 stations per square kilometer, a number that is in line with the 10-16 station per square kilometer target set out in the Bikeshare Planning Guide (40). This is of particular importance when addressing inequities in the service area as research finds that "a higher station

density correlates with higher market penetration, and has an even stronger relationship with increased use of bikeshare bikes" (40). With that in mind, the following map provides a more granular portrait of the distribution of the network and the service at the dissemination block level, and a direction for Bixi to guide investments, and the mobilisation of resources to organise its network. As Bixi's network continues to grow in new areas in the next few years, attention must therefore be paid to ensure that expansions not only fill those gaps but also target and prioritise areas with higher proportions of residents that are visible minorities or that have lower levels of education. Additional metrics should be used to explicitly outline equity goals and ensure that resources are correctly invested in furthering these objectives. Examples of these metrics include:

- Proportion of residents in the service area that are low-income, low-education, and are visible minorities.
- Number of low-income jobs accessible in the service area.
- Station density in DAs with low-income populations, lower levels of education, and a high proportion of visible minorities.
- Average daily trips starting or ending in DAs with low-income populations, lower levels of education, and a high proportion of visible minorities.
- Proportion of all trips made by women, visible minorities, and people with low-income, and lower levels of education.

On a more micro scale, a continuous public consultation process and a set of crowdsourcing activities must be developed to better understand the needs of vulnerable populations and inform equity-based station siting, and other measures. Different populations travel differently and a monolithic and misinformed approach to bikeshare may inhibit the use of Bixi by these populations. Although transit stops, and job and retail centers are particularly important nodes to target and respond to some of bikeshare systems' most crucial demand needs, there is now a need to explore siting options that are beyond those priorities as the network becomes more expansive and stable. These consultations should bring together an array of actors including residents, local business owners, community organisations, and city officials, and engage stakeholders in an ongoing dialogue that can facilitate the introduction of bikeshare and address fears that it may generate, particularly regarding gentrification or the loss of parking. Additionally, workshop sessions where residents are asked to place stations in their neighbourhoods or even to map out their travel patterns have been shown to enhance participatory development in bikeshare with notable examples in New York City and the Bay Area (40), while community workshops in Philadelphia have helped outline the needs of low-income communities to better inform station siting in low-income neighbourhoods through grants from the Better Bikeshare Partnership (27).

Figure 6: Number of stations accessible within 300 meters for dissemination blocks in Montreal



Guiding principles

Collectively these findings and precedents lead to the formulation of a set of guiding equity principles with which Bixi can achieve higher levels of equity and improve mobility for all in Montreal:

01

Comfort

Bixi bicycles should be comfortable and safe to handle and ride. Lighter bicycles must be added to the fleet to ensure the system is adequately accessible, especially for women.

02

Capacity

Bixi bicycles should allow for the transportation of multiple bags and goods. Basket design, racks, and cargo bikeshare must all be examined to enhance the capacity of bicycles and facilitate utilitarian trips, particularly for low-income people and women.

03

Childcare

Bixi bicycles should accommodate toddlers and children. Bicycle attachments, child's seats, racks, trailers, adaptive bicycles and mini bikeshare must be explored as options to facilitate traveling with children.

04

Collective safety

Riding Bixi should be a safe and enjoyable experience. Collaborating with the city of Montreal to crowdsource data on infrastructure and route quality, and organise programming to raise awareness on cycling and bikeshare must be envisioned to develop a safe bikeshare and cycling system for everyone.

05

Affordability

Bixi should be affordable to all. Income-based discounts must be implemented to facilitate financial access to cycling for those with lower income.

06

Convenience

Bixi should be convenient to access financially and physically. Additional fare and payment options, as well as a full integration with the OPUS card must be evaluated to improve the flexibility of the fee structure and the multimodal compatibility of Bixi, with a focus on low-income populations.

07

Accessibility

Bixi bicycles should be accessible to all. Meeting station density requirements in targeted equity areas and at large must be prioritised to ensure that the system is readily available as a mobility option for all Montrealers.

08

Leadership

Bixi should formally recognise equity needs in Montreal. An equity program manager must be appointed to provide guidance, rally actors, and further bikeshare and cycling equity efforts in Montreal.

09

Strategy

Bixi should plan for various equity needs in Montreal. An equity strategy with clear goals, metrics, and targets must be established to measure equity gains based on current needs.

10

Participation

Bixi should reflect the needs of all Montrealers. Workshops and consultations in collaboration with local leaders, community groups, elected officials, residents, and members from equity populations must be conducted to understand and plan for travel patterns and cycling needs, and address concerns generated by bikeshare.

Implementing change

Considering these principles, a priority chart can be elaborated based on the importance and feasibility of these recommendations within a short to long timeframe.

This research suggests that the allocation of funds and resources towards the creation of a full-time position for an equity program manager should be the number one priority considering the role they can play in developing various outreach programs and campaigns, establishing an equity strategy, petitioning various levels of governments and organisations, and conducting research in collaboration with other bikeshare systems and suppliers.

In conjunction with the creation of this position, establishing a meticulously planned outreach and consultation strategy should be prioritised to ensure the needs of vulnerable populations are taken into account in Bixi's planning decisions and guide future investments and the mobilisation of resources. Nonetheless, research and discussions with Bixi's supplier and other bikeshare systems can begin on a short- to medium-term basis in order to determine the feasibility and transferability of certain measures to the Montreal context. In particular, lighter bicycle models, basket designs, child-caring alternatives, discounts, a review of the fare structure, and the integration with the OPUS card are all small-scale improvements that can and should be explored and implemented within this timeframe.

Lastly, although very important, network accessibility and meeting density requirements are largescale efforts that require both time and important investments that require a longer and non-negligible timeframe.

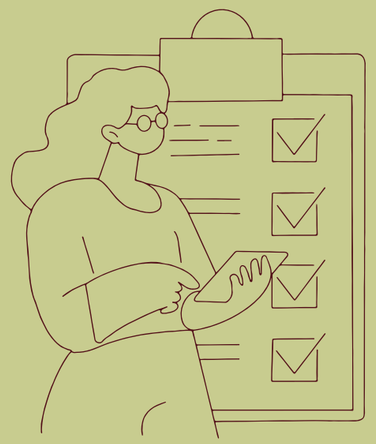
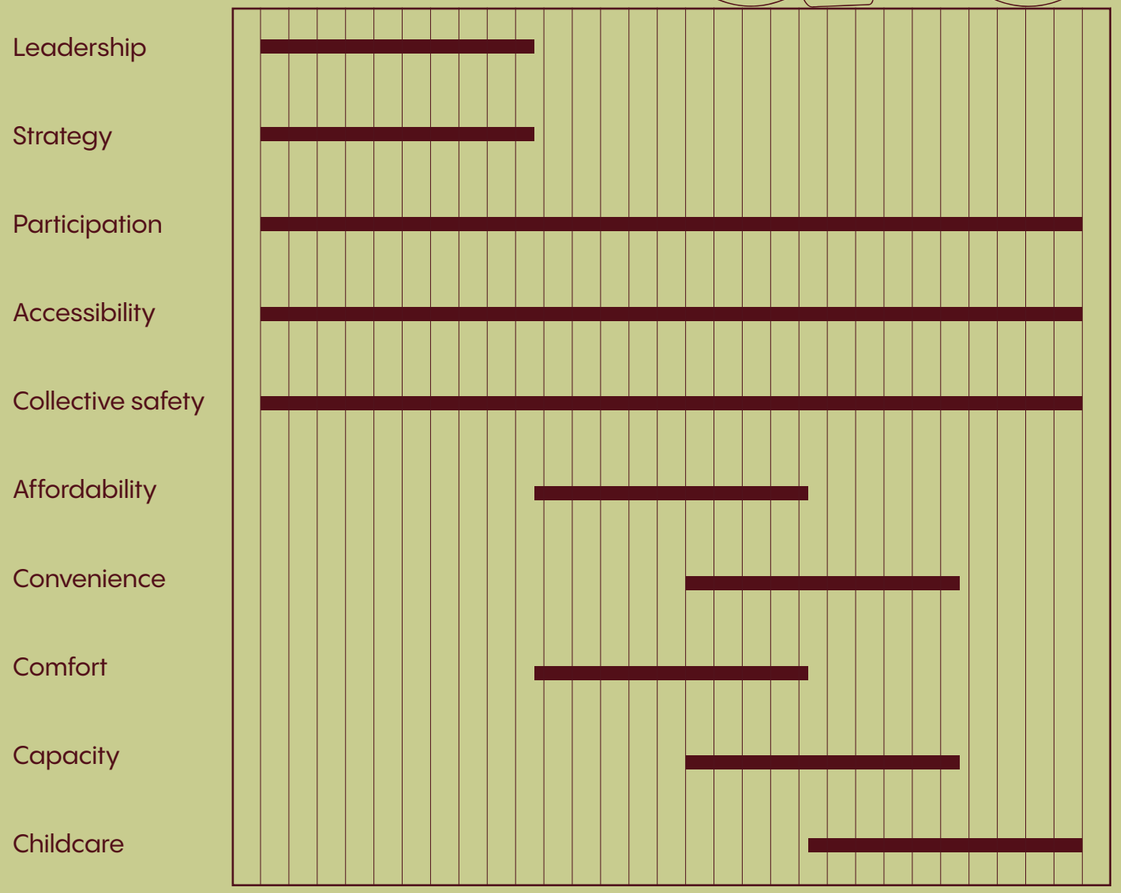


Figure 7: Implementation timeline



Conclusion

With the important rise in interest for micromobility options and the surge in popularity that Bixi experienced in the last few years, this research sought to understand how Bixi can enhance its operations and accessibility to ensure it is equitable for and inclusive of all residents of Montreal. The results show that on a macro scale, Bixi's efforts are commendable in ensuring that stations are accessible to low-income Montrealers for example, but that those with lower education levels and visible minorities are underrepresented in the areas that are well-serviced by Bixi, and that there is no guiding principle behind Bixi's choice to service certain equity populations. On a micro-scale however, there are many barriers encountered by Montrealers when using Bixi, particularly users with lower income and women. Financial concerns and the physical characteristics of the bicycles are some of the most prominent barriers encountered by equity populations. Conversely, improvements to Bixi's financial structure and system innovations, whether lighter bicycles, adaptable bicycles for the transportation of children and goods, a review of station siting practices and Bixi's outreach strategy can all significantly impact ridership by improving the quality of service both for current and prospective users. Despite Bixi's responsibility and autonomy in implementing these measures, the support required from different level of governments cannot be understated. Financial, technical, and political support from the city of Montreal and transit agencies is key in developing a more equitable bikeshare system serving all residents of Montreal and ultimately the Greater Montreal. With the recognition of Bixi's importance within Montreal's public transit ecosystem comes a need to provide adequate resources for the continued and equitable expansion of its services, and while the current administration has made great strides in supporting and developing cycling culture and sustainable mobility across the island of Montreal, it should be within the scope of its mandate to invest some of its resources to improve Montreal's most important contribution to the field of transportation in North America.

Limitations

It is worth noting that this research faces certain limitations in its analysis. First, although over 500 respondents qualified as Bixi users, the majority of respondents to the survey already owned a bicycle and were thus not 'captive' users of Bixi who strictly rely on the bikeshare system as their preferred mode of cycling. This means their perceptions of and experiences with Bixi may not correlate to users who use the system frequently and rely on it as one of their main modes of transportation. Second, although there is a lot of variety in the level of education attained by respondents, most of them are white with higher incomes which both prevents a statistical analysis based on ethnicity, one of the main components of bikeshare equity highlighted in this research and limits the quality of the analyses regarding the differences between those with lower income and high-income groups. It must hence be stated that this research presents to a limited extent the barriers and experiences of lower income users and non-users, considering the groups of respondents with lower incomes are based on a household income bracket that includes household incomes up to 60,000$.

Source: Bixi, 2024

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Appendix

Figure 8: Home locations of respondents who are Bixi users

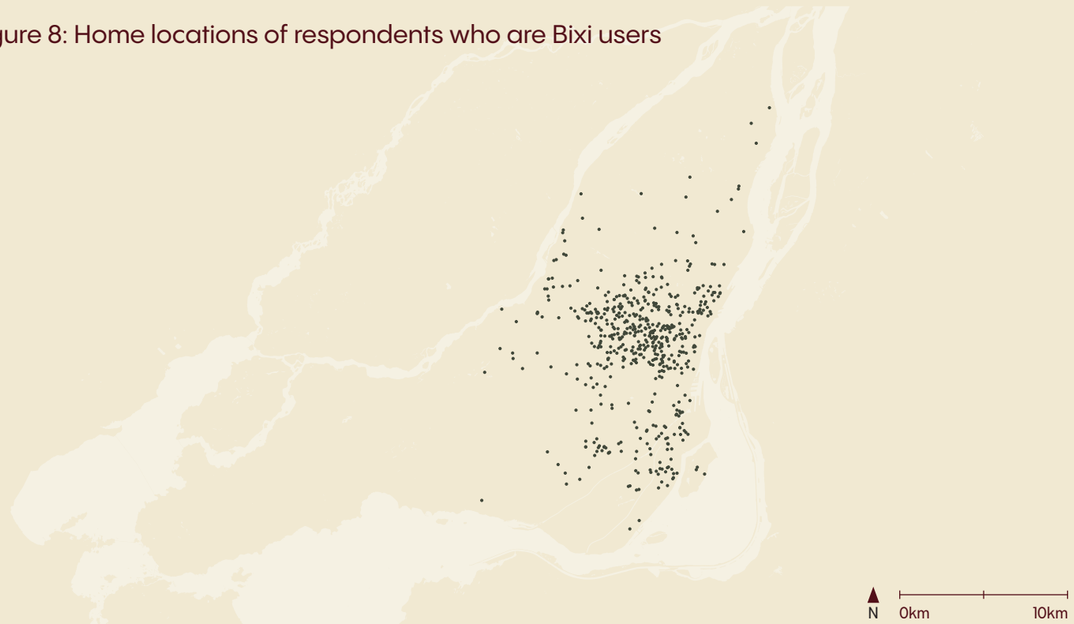

Figure 9: Home locations of respondents who are non-users

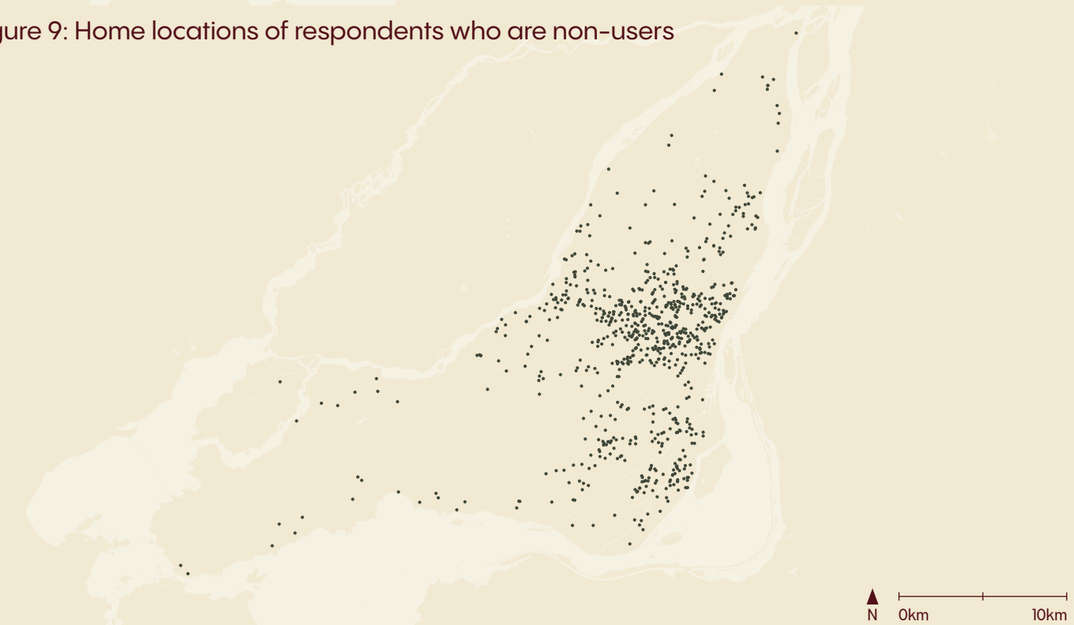

Table 6: Breakdown of respondents to the survey

Respondents	Bixi users	Non-users	Total
	566	**771**	**1337**
Income			
Lower income	15.02%	16.08%	15.63%
Less than $30,000	25	29	54
$30,000 to $59,999	60	95	155
Total	**85**	**124**	**209**
Medium income	43.83%	44.10%	43.98%
$60,000 fo $89,999	101	135	236
$90,000 to $124,999	96	130	226
$125,000 to 149,999	51	75	126
Total	**248**	**340**	**588**
High income	31.80%	24.77%	27.75%
$150,000 fo $199,999	95	103	198
More than $200,000	85	88	173
Total	**180**	**191**	**371**
N/A	9.36%	15.05%	12.64%
Total	**4**	**42**	**46**
Education			
Lower education	13.60%	18.68%	16.53%
Primary/Elementary school diploma	2	3	5
Secondary school diploma	20	19	39
Trade/Technical school or college diploma	55	122	177
Total	**77**	**144**	**221**
Medium education	31.98%	32.43%	32.24%
Undergraduate degree	**181**	**250**	**431**
High education	31.98%	32.43%	32.24%
Graduate degree	**304**	**335**	**639**
N/A	0.71%	5.45%	3.44%
Total	**4**	**42**	**46**
Gender			
Men	57.77%	54.35%	55.80%
Total	**327**	**419**	**746**
Women	38.52%	37.22%	37.77%
Total	**4**	**42**	**46**
Other	3.71%	8.43%	6.43%
Total	**21**	**65**	**86**

Survey questions

What year were you born?

Over the last 12 months, did you at least cycle once?

- Yes
- No

Do you own a bicycle?

- Yes, I own a traditional bicycle.
- Yes, I own an electric bicycle.
- Yes, I own both a traditional bicycle and an electric bicycle.
- No, I do not own a bicycle.

Have you used Bixi at least once in the last 12 months?

- Yes, I used a traditional Bixi over the last 12 months.
- Yes, I used an electric Bixi over the last 12 months.
- Yes, I used both a traditional Bixi and an electric Bixi over the last 12 months.
- No, I did not use Bixi over the last 12 months.

What type of bicycle have you used in the last 12 months?

- Traditional bicycle
- Electric bicycle
- Both traditional and electric bicycles

Why didn't you cycle over the past 12 months?

- I don't feel safe cycling
- I don't know how to cycle
- I don't like cycling
- My destination is too far for cycling
- I don't like to be at my destination after a physical activity
- I am not in shape enough for cycling
- I don't have the financial means to cycle
- I can't bring my children with me
- There's nowhere to park at my destination
- I am too scared to get my bicycle stolen
- I often have too many things to carry
- Other

What is your current employment status?

- Work full-time
- Work part-time
- Student
- Homemaker
- Retired and not working
- Not employed and looking for work
- Not employed and not looking for work
- Other:

Cycling Frequency
In this section we will ask you questions concerning the frequency of usage of different bicycle types over the last seven days for different purposes.

Over the last seven days, how many times did you visit your primary work location using the following types of bicycle?

- Personal traditional bicycle
- Personal electric bicycle
- Traditional Bixi
- Electric Bixi

Over the last seven days, how many times did you visit your study location using the following types of bicycle?

- Personal traditional bicycle
- Personal electric bicycle
- Traditional Bixi
- Electric Bixi

Over the last seven days, how many times did you visit a grocery store using the following types of bicycle?

- Personal traditional bicycle
- Personal electric bicycle
- Traditional Bixi
- Electric Bixi

Over the last seven days, how many times did you travel for leisure purposes using the following types of bicycle?

- Personal traditional bicycle
- Personal electric bicycle
- Traditional Bixi
- Electric Bixi

Last trip - Traditional bicycle
The following questions are about your last trip using a personal traditional bicycle.

Did your last trip by traditional bicycle begin at your home?

- Yes
- No

Where did your last trip by traditional bicycle start? On the following map, please adjust the zoom and drag the pin to the origin of your trip.

Did your last trip by traditional bicycle end at your home?

- Yes
- No

What was the destination of your last trip by traditional bicycle?
On the following map, please adjust the zoom and drag the pin to the destination of your trip.

What was the date of your most recent trip using your traditional bicycle?

At what time did your last trip using your traditional bicycle start?

At what time did your last trip using your traditional bicycle end?

Last trip - Personal Electric Bicycle
The following questions are about your last trip using a personal electric bicycle.

Did your last trip by electric bicycle begin at your home?

- Yes
- No

Where did your last trip by electric bicycle start?
On the following map, please adjust the zoom and drag the pin to the origin of your trip.

Did your last trip by electric bicycle end at your home?

- Yes
- No

What was the destination of your last trip by electric bicycle?
On the following map, please adjust the zoom and drag the pin to the destination of your trip.

What was the date of your most recent trip using your electric bicycle?

At what time did your last trip using your electric bicycle start?

At what time did your last trip using your electric bicycle end?

Last trip - Traditional Bixi
The following questions are about your last trip using a traditional Bixi bicycle.

Did your last trip by traditional Bixi begin at your home?

- Yes
- No

Where did your last trip by traditional Bixi start?
On the following map, please adjust the zoom and drag the pin to the origin of your trip.

Did your last trip by traditional Bixi end at your home?

- Yes
- No

What was the destination of your last trip by traditional Bixi?
On the following map, please adjust the zoom and drag the pin to the destination of your trip.

What was the date of your most recent trip using a traditional Bixi?

At what time did your last trip using a traditional Bixi start?

At what time did your last trip using traditional Bixi end?

Last trip - Electric Bixi
The following questions are about your last trip using an electric Bixi bicycle.

Did your last trip by electric Bixi begin at your home?

- Yes
- No

Where did your last trip by electric Bixi start?
On the following map, please adjust the zoom and drag the pin to the origin of your trip.

Did your last trip by electric Bixi end at your home?

- Yes
- No

What was the destination of your last trip by electric Bixi?
On the following map, please adjust the zoom and drag the pin to the destination of your trip.

What was the date of your most recent trip using an electric Bixi?

At what time did your last trip using an electric Bixi start?

At what time did your last trip using an electric Bixi end?

General Bixi Questions
In this section we will ask you questions on your usage of Bixi over the last 12 months.

Which time of the year did you use Bixi?

- Regular Bixi season (April 15 - November 15)
- Winter Bixi season (November 15 - April 15)

When using Bixi, what purpose do you use it for?

- Work/School
- Shopping
- Recreation
- Meeting friends
- Exercise
- Other:

What type of Bixi pass did you use in the regular Bixi season (April 15 - November 15)?

- Single-use
- Monthly
- Seasonal
- Group (Seasonal membership obtained through employer or by forming a group of 20 or more people)

Do the additional costs (11 cents / minute) after 45 minutes of riding a Bixi prevent you from making longer rides?

- Yes
- No
- Does not apply

On average, how often did you use Bixi during the regular season (April 15 to November 15, 2023)?

- More than once a day
- Once a day
- Multiple times during the week
- Once a week
- Multiple times a month
- Once a month
- Just once

On average how often did you use Bixi during the winter season (November 15, 2023 to April 15, 2024)?

- More than once a day
- Once a day
- Multiple times during the week
- Once a week
- Multiple times a month
- Once a month
- Just once
- Never

When do you usually use an electric Bixi?

- When I travel far (30-minutes + ride)
- When I am going uphill
- When I want to travel faster
- When it's the only available option
- Other:

Bixi Challenges
In this section we will evaluate any challenge you may have faced when using Bixi.

How often would you consider any of the following a challenge when using Bixi?
(Always - Often - Sometimes - Never)

- Size of the Bixis
- Weight of the Bixis
- There is a 100$ credit card hold for single-rides
- I do not have access to a smart phone
- I do not have access to internet on my phone
- The Bixi instructions are unclear

How often would you consider any of the following a challenge when using Bixi?
(Always - Often - Sometimes - Never)

- The law requires me to wear a helmet on an electric Bixi
- Sharing the road space with other cyclists
- Sharing the road space with cars

Do you find this price reasonable?
(Yes - No)

- Single ride regular Bixi fare (1.25$ + 15cents/minute)
- Single ride electric Bixi fare (1.25$ + 30cents/minute)
- Monthly Bixi membership (20$/month)
- Seasonal Bixi membership (99$ for period between April 15 and November 15)

How often would you consider any of the following a challenge when using Bixi?
(Always - Often - Sometimes - Never)

- There are no Bixi bicycles available near my home
- There are no Bixi bicycles available near my work/school
- There are no or not enough stations near my home
- There are no or not enough stations near my work/school
- There are no docks available in the Bixi station near my home
- There are no docks available in the Bixi station near my work/school

Are any of the following a challenge when using Bixi?
(Yes - No)

- Helmets are not provided with Bixis
- There are no Bixis with child's seats
- Bixis don't accommodate my physical disability
- I do not have access to a credit card

Are there any other challenges you encounter when using Bixi?

Are any of the following recommendations likely to make you use Bixi more often than you currently do?
(Yes - No)

- Family discount (membership discount for persons living in the same household)
- Income discount (membership discount for persons who receive welfare or earn less than a threshold income)
- Removing the 100$ credit hold on single rides
- Offering alternative payment methods (e.g. cash payments, payment plans)

Are any of the following recommendations likely to make you use Bixi more often than you currently do?
(Yes - No)

- Extending the time limit beyond the current 45-minute without additional costs
- Offering 15-minute free rides to all OPUS card members
- Offering a day pass
- Offering a weekly pass
- Introducing Bixis with child's seats
- Introducing lighter Bixis
- Introducing Bixi cargo bicycles
- Adding more Bixi bicycles near your home or destination
- Adding more docks near your home or destination

No Bixi
In this section, we will ask you about reasons why you did not use Bixi over the last 12 months.

Why do you not use Bixi?

- I have my own bicycle
- I don't know how Bixi works
- I don't have access to Bixi near my home
- I don't have access to Bixi near my work/school
- Bixis are too heavy
- Bixis are too big
- I don't have a credit card
- Bixis are not financially accessible for me
- I can't bring my children with me
- I often have too many things to carry
- I don't have access to a smartphone
- I don't have access to internet on my phone
- Other:

Are any of the following recommendations likely to make you use Bixi?
(Yes - No)

- Family discount (membership discount for persons living in the same household)
- Income discount (membership discount for persons who receive welfare or earn less than a threshold income)
- Removing the 100$ credit hold on single rides
- Offering alternative payment methods (e.g. cash payments, payment plans)

Are any of the following recommendations likely to make you use Bixi more often than you currently do?
(Yes - No)

- Extending the time limit beyond the current 45-minute without additional costs
- Offering 15-minute free rides to all OPUS card members
- Offering a day pass
- Offering a weekly pass
- Introducing Bixis with child's seats
- Introducing lighter Bixis
- Adding more Bixi bicycles near your home or destination
- Adding more docks near your home or destination

Cycling attitudes
The following section will probe into your attitudes towards cycling.

For how many years have you been cycling regularly (i.e., more than once a week in good weather)?

- I don't cycle regularly
- Less than a year
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 years or more

How important are the following factors in your decision to cycle now?
(Very important - Important - Not very important - Not important at all)

- Affordability
- Travel time from point A to point B.
- Flexibility in terms of doing multiple trips.
- Flexibility in terms of my time of departure.
- Predictability in terms of travel time.

How important are the following factors in your decision to cycle now?
(Very important - Important - Not very important - Not important at all)

- Fun
- Environmental friendliness.
- My physical health.
- My mental health.
- My self-identity / culture.
- My friends / family members cycle.
- My classmates / coworkers cycle.
- My employer / school encourages cycling.

Please state your level of agreement with each of the following statements. I do not cycle when...
(Strongly agree - Agree - Disagree - Strongly disagree)

- It is too cold
- There is snow, because of the additional effort.
- There is ice or snow, because of the risk of slipping.
- It is raining.
- It is too hot and / or humid.
- The route I have to take is too steep.
- I have to carry bag or heavy loads.

How important are the following factors in making a good bicycle route?
(Very important - Important - Not very important - Not important at all)

- There is a low number of cars driving on the road.
- Cars are going slowly.
- There is a low number of cars parked on the road.
- The cycling route is continuous
- There is a cycling path with physical barriers separating from car traffic.

As a child, to what extent did your parent(s) or guardian(s) encourage you to cycle for the following purposes:
(A lot - Somewhat - Not at all)

- As a way to reach destinations.
- As a sport or recreational activity.

Do you wear a helmet when you use the following types of bicyles?
(Always - Mostly - Sometimes - Never)

- Your own traditional bicycle
- Your own electric bicycle
- A traditional Bixi
- An electric Bixi

For each of the road users and mode of transportation below, please state whether you believe they should be using cycling lanes or not.
(Yes - No)

- Bicycle
- E-bike
- Kick scooter
- E-scooter
- Tricycle
- Rollerblades
- Skateboard
- Manual wheelchair
- Electric wheelchair
- Mobility scooter
- Moped scooter
- Runners

Why do you believe some road users should or should not be able to use cycling lanes?
Please provide a brief explanation of your choices in the previous question.

Dangerous intersection

On the following map, please adjust the zoom and drag the pin to the intersection you consider to be the most dangerous for cyclists in Montreal.

Your Neighbourhood
These questions will help us understand how you feel about your neighbourhood.

To provide us with the approximate location of your primary home location, which of the following would you prefer to do? This will help us to better understand the travel behavior of Montreal residents.

- Type my home postal code
- Place a pin on a map

Please enter your primary home postal code. Please use the format XXX XXX (for example: H3A 0C2).

On the following map, please adjust the zoom and drag the pin to your primary home location.

What year did you move into your current home? If you are unsure, estimate the closest year. If you do not know at all, select "Don't know."

Is your current primary residence owned by you or someone in your household?

- Yes
- No, I/we pay rent to the owner of the residence

What type of home is your current primary home?

- Apartment or condo
- Row-house or town-house
- Semi-detached house
- Detached, self-standing house
- Duplex, Triplex, etc.
- Other

When you moved into your current home, how important were the following factors in your decision?
(Very important - Important - Not very important - Not important at all)

- Being in a neighbourhood where it is pleasant to walk
- Being in a neighbourhood where it is practical to move around and park by car
- Affordability of housing
- Having a large home

When you moved into your current home, how important were the following factors in your decision (continued)?
(Very important - Important - Not very important - Not important at all)

- Being near the primary work location/school of a member of my household (including myself)
- Being near family and/or friends
- Being near shops and services
- Being near public transportation
- Being near bicycle infrastructure
- Presence of good schools for my children
- Presence of parks and green spaces

General travel
To what extent to do you agree or disagree with the following statements?
(Strongly agree - Agree - Disagree - Strongly disagree)

- I like travelling alone.
- I need a car to do many things I like to do.
- My daily travel positively impacts my quality of life.
- Overall, I am satisfied with my daily travel.

To what extent do you agree or disagree with the following statements? (Strongly agree - Agree - Disagree - Strongly disagree)

- As a child, I was regularly driven around.
- As a child, I regularly biked.
- As a child, I regularly took public transit.

Do you have a monthly transit pass?

- Yes
- No

Select all the following that apply to you:

- I have a driver's license
- I have a Communauto membership
- I have used a carpooling service in the past year
- I have used Uber in the past year
- None of the above

How many licensed drivers are in your household, including yourself?

- None
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8+

How many private automobiles do you have regular access to? Include only those owned, leased or borrowed on a long-term basis by you or someone else in your household and which you are permitted to drive. Do not include car-share, such as Communauto.

- None
- 1
- 2
- 3
- 4
- 5+
- Prefer not to answer

Personal Characteristics

In general, would you say your health is:

- Excellent
- Very Good
- Good
- Fair
- Poor
- Prefer not to answer

Do you have a disability or condition, whether temporary or permanent, that limits your mobility?

- Yes
- No
- Prefer not to answer

Which type of disability or condition do you have?

- Permanent
- Recurring
- Temporary
- Prefer not to answer

Are your daily transportation needs affected by your condition(s)?

- Yes
- No

If you wish, please let us know how your daily transportation needs are affected by your condition(s).

How do you identify yourself?

- Man
- Woman
- Non-binary or non-conforming
- Prefer not to answer
- Other

What is your marital status?

- Single (never married)
- Married (or common law)
- Separated or divorced
- Widowed
- Prefer not to answer

How many people are in your household, including yourself?

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8 or more

How many adults aged 18 or older live in your household, including yourself?
Please choose only one of the following:

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8 or more

Are there any children under the age of 18 in your household?

- Yes
- No

How many children between the age of 6 and 13 (inclusive) live in your household?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8 or more

How many children under the age of 6 (not including 6 years old) live in your household?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8 or more

Were you born in Canada?

- Yes
- No
- Prefer not to answer

When did you move to Canada?

To which ethnic or cultural group(s) did your ancestors belong?

- Aboriginal
- Asian
- Black
- White / Caucasian
- Latin American
- Middle Eastern
- Prefer not to answer
- I don't know
- Other:

How would you characterize the environment where you grew up?

- Urban
- Suburban
- Rural

Which category best describes your annual household income, taking into account all sources of income?

- Less than $30,000
- $30 000 to $59 999
- $60 000 to $89 999
- $90 000 to $124 999
- $125 000 to $149 999
- $150 000 to $199 999
- More than $200,000
- I don't know
- I prefer not to answer

What is your highest level of education obtained?

- Primary/Elementary school diploma
- Secondary school diploma
- Trade/Technical school or college diploma
- Undergraduate degree
- Graduate degree
- Prefer not to answer
- I don't know

Future participation
Thank you for your participation. We would like to ask you a few questions on your willingness to participate in other surveys in the future.

How did you hear about the Montreal Cycling Survey?

- Email list
- From employer
- Referral from family or friends
- Facebook/ Instagram
- Twitter
- Website
- Newspaper
- Other

Would you be interested in participating further in this research through additional surveys or interviews conducted by our research team in the future?

- Yes
- No

If you have not done so already, please provide us with a valid email address so that we can contact you for participation in other surveys conducted by our research group:

Parting thoughts?

Do you have any final thoughts about transportation issues in Montreal?

Thank you