FINAL REPORT

Bicycle Justice or Just Bicycles? Analyzing Equity in Baltimore's Bike Share Program

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16. Abstract

Bike share systems have become a common feature of the modern urban landscape and provide residents and visitors with an active transportation mode. Yet these systems have sustained equity-focused criticism for serving a narrow demographic band of residents and visitors, while others lack access and face barriers to usage. The City of Baltimore, Maryland, launched a bike share system in 2016. This study evaluates Baltimore's new system from an equity-focused lens using two complementary approaches. The first approach, which is a GIS-based equity gap analysis, develops a population-density-normalized Bike Equity Index to quantitatively assess the spatial distribution of the city's bicycle infrastructure supply and how it serves (or doesn't serve) Baltimore's transit-dependent and environmental justice communities. The second analytic orientation, which applies a user and barrier analysis, utilizes survey data to identify the low-equity groups and the variables that limit (or don't limit) their demand for the city's bike share program. When combined, the two perspectives—one top-down and the other bottom-up—present a more comprehensive picture and nuanced understanding of the current system's equity performance.

The research findings demonstrate that Baltimore Bike Share infrastructure is unevenly distributed across the city's many communities and is undersupplied in areas with residents who are transit-dependent. Furthermore, the results support claims of a demographic mismatch between current bike share system users and the general population. The communities underrepresented among Baltimore Bike Share users are less educated, lower-income, non-whites, Hispanics, and females. The research indicates that females express concern over certain barriers to

accessing and using Baltimore Bike Share, including how to use the system, personal safety, helmet use, harassment, and hygiene. No significant barriers were identified for the other underrepresented demographic groups.

To enhance the equity of the system, the research team recommends that the City of Baltimore prioritize bike share system expansion into the neighborhoods east and west of the downtown corridor. A robust community outreach strategy that targets underrepresented populations is also recommended and should include initiatives such as a grassroots bike share ambassador program and organized community rides. The bike share docking stations can also be leveraged for their advertising potential and should contain marketing materials that speak directly to underrepresented communities.

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Preface

While this report was in the final stages of copy editing, the City of Baltimore announced that it will end its two-year experiment with a docking-style bike share system (Campbell & Richman, 2018). The City is now moving toward a dockless network containing a mixture of bicycles and scooters, all operated and maintained by private vendors. While this development does render several of the report's recommendations out-of-date, it does not void the analytic approach, methodological novelty, or the critical policy recommendation to proactively engage underrepresented communities in alternative mobility systems. While the dockless bicycles and scooters will be more equitably distributed because the vendors are required to place a certain percentage in low-income areas, this will not ensure that these communities will enjoy the benefits and utility of the dockless options. This research shows that common concerns such as worrying about personal safety, not having a helmet, or being unsure about bicycle/scooter liability are significant barriers that are not overcome by more equitable placement of bikes or scooters in low-income neighborhoods. The authors therefore contend that the City of Baltimore—as well as other cities operating bike share systems—can still learn from this analysis to enhance urban transportation equity.

1. Introduction

Cities across the United States, both large and small, are embracing bicycling and its shared mobility counterpart bike sharing as an essential public service and quality-of-life enhancer. Bike share systems typically involve fixed docking stations strategically positioned within the urban environment.[1] Each docking station can house multiple bicycles, and users pay a fee to check out a bicycle for a fixed amount of time—eventually returning the bicycle to another docking station. Bike share usage is popular among residents, commuters, and visitors. At the end of 2016, 55 cities in the United States had docking-style bike share systems with a total of 42,000 bikes in operation (National Association of City Transportation Officials, 2018). Advocates frequently cite sustainable benefits of these systems such as improved public health, decreased carbon emissions, reduced traffic congestion, and enhanced economic development (Shaheen, Cohen, & Martin, 2013).

Yet bike share programs are not beyond criticism. The most common critique levied against bike share is that the systems serve a narrow segment of a city's population while failing to reach other individuals, some of whom may already experience mobility challenges. For instance, research shows that bike share users are predominately white, non-Hispanic, male, highly educated, employed, and high-income earners (Buck et al., 2013; Goodman & Cheshire, 2014; Shaheen, Elliot, Chan, Cohen, & Pogodzinski, 2014; Smith, Oh, & Lei, 2015; Ursaki & Aultman-Hall, 2015). Others argue that biking in general, and bike share systems in particular, are responsible for gentrification and displacement of longtime residents (Hoffmann, 2016; Rodriguez, 2017). This raises questions of bike share fairness and equity—an often overlooked aspect of sustainable urbanism (Agyeman, 2013; Mercier, 2009).

In 2016, Baltimore, Maryland, joined other cities across the United States by launching its own bike share system with then-Mayor Rawlings-Blake announcing that the new program was a critical part of the city's "network of sustainable transportation options" (Campbell, 2016a). Almost immediately, there were charges of an ill-conceived and inequitable public service program with racially charged claims that Baltimore's "bike-share perpetuates [the city's] transit apartheid" (Kinney, 2016). Does the Baltimore Bike Share program mirror other cities' systems and narrowly serve the white, mobile, wealthy, educated, urban elites, or are the benefits more broadly distributed to larger demographic groups? If bike share injustice is present, what can be done to ameliorate this undesirable condition?

This study offers a dual-perspective evaluation of equity in Baltimore Bike Share that is akin to supply-side and demand-side analytic orientations. The first approach, which is a Geographic Information System (GIS)-based equity gap analysis, develops a population-density-normalized Bike Equity Index to quantitatively assess the spatial distribution of the City's bicycle infrastructure supply and how it serves (or doesn't serve) Baltimore's transit-dependent and environmental justice communities. The second analytic orientation, which

[1] In the last year, dockless bike share systems proliferated rapidly with several private vendors operating fleets in cities around the United States.

applies a user and barrier analysis, utilizes survey data to identify the low-equity groups and the variables that limit (or don't limit) their demand for the City's bike share program. When combined, the two perspectives—one top-down and the other bottom-up—present a more comprehensive picture and nuanced understanding of the current system's equity performance. The combined full analysis offers deeper insights into opportunities for Baltimore Bike Share improvements that will enhance equity, and it strengthens the credibility of the subsequent policy recommendations.

The research findings demonstrate that Baltimore Bike Share infrastructure is unevenly distributed across the city's many communities and is undersupplied in areas with residents who are transit dependent. Furthermore, the results support claims of a demographic mismatch between current bike share system users and the general population. The communities underrepresented among Baltimore Bike Share users are less educated, lower-income, non-white, Hispanic, and female. The research indicates that females express concern over certain barriers to accessing and using Baltimore Bike Share, such as knowing how to use the system, personal safety, helmet use, harassment, and hygiene. No significant barriers were identified for the other underrepresented demographic groups.

To enhance the equity of the system, the research team recommends that the City of Baltimore prioritize bike share system expansion into the neighborhoods east (Franklin Square, Lexington) and west (Washington Hill, Butcher's Hill, Highlandtown) of the downtown corridor. A robust community outreach strategy that targets underrepresented populations is also recommended and should include initiatives such as a grassroots bike share ambassador program and organized community rides. The bike share docking stations can also be leveraged for their advertising potential and should contain marketing materials that speak directly to underrepresented communities.

2. The Baltimore Bike Share Program

The City of Baltimore occupies an urban area of 92.3 square miles and contains approximately 620,000 inhabitants. Within the city, approximately 47% of land is residential, 13% is park/open spaces, 6% is commercial, and 34% is other non-residential.

2.1 History of Baltimore Bike Share Program

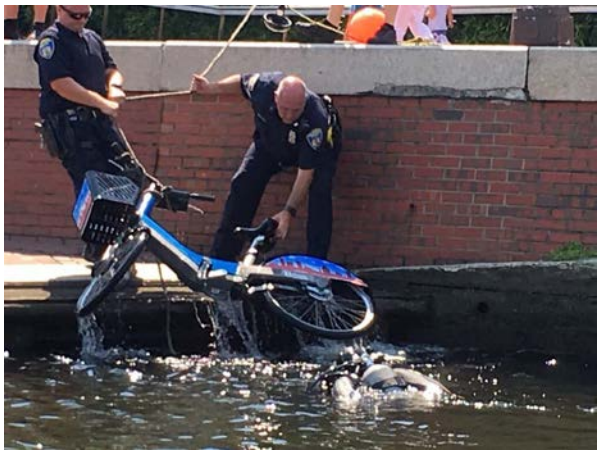
The Baltimore Bike Share Program's history is marked by consecutive periods of starts and stops. Initial efforts were hampered in 2012 by lack of vendor interest and again in 2014 by vendor bankruptcy. After these two unsuccessful attempts to find a bike share vendor, the City's system finally launched on the third try. The City of Baltimore submitted a third Request for Proposals in 2015 and received four credible bids, eventually selecting Bewegen Technologies to operate the system. Bewegen was chosen in part because they offer pedal electric (pedelec) assistance bicycles that augment a cyclist's manual power with an electric motor, making it easier for users to navigate through Baltimore's hilly streets.

Armed with a vendor, the City initiated a process to determine station placement. They created a bike share Technical Advisory Committee (TAC) comprising an external consultant, local subject matter experts and cycling advocates, academics, City representatives, and members of the Mayor's bicycle committee (membership appointed by Baltimore's mayor). The City, along with the TAC, researched best practices in docking station placement and decided that a dense network near employment centers, recreational opportunities, and transit would be needed for a successful launch. This led to a two-phased rollout plan, with 20 docking stations slated for installation in 2016 (Phase 1A) and another 39 stations scheduled for installation thereafter (Phase 1B). The TAC's proposed docking station locations were presented to the public through meetings in each of the four quadrants of Baltimore and the feedback received was used to tweak the final system design.

Unlike other bike share programs, the Baltimore system did not begin with a corporate sponsor. Despite the lack of corporate sponsorship, the price for a single ride is $2.00 and monthly pass is $15.00, which is less expensive than neighboring systems. By comparison, Philadelphia's bike share costs $4.00 per single trip or $17.00 for a monthly pass, while Washington D.C.'s system costs $2.00 per single trip or $28.00 for a monthly pass. Additional charges are incurred after 45 minutes in Baltimore, which is comparable to other systems. Baltimore did take some proactive steps to enhance the equity of the system by offering a cash payment option for unbanked users (see Section 3.2.2.5), and they offered an 80% monthly pass discount ($3.00/month) plus a free helmet for individuals enrolled in the State of Maryland's Supplemental Nutrition Assistance Program.

2.1.1 Phase 1A

The first 20 docking stations were installed in the downtown and Inner Harbor area in the summer of 2016 and the system went live in October of that year (Campbell, 2016b). Initial data suggested that usage was robust. During the winter months of 2016 and into 2017, ridership numbers dropped as expected, and then began to pick up as the weather warmed in the spring of 2017. Then, during the summer of 2017, the system experienced a maintenance backlog as well as an increase in theft whereby individuals could remove a locked bicycle from a docking station simply by yanking it out (Campbell, 2017a, 2017b). The ability of users to find bikes within the system quickly became a serious challenge for the City of Baltimore (Seel, 2017).



2.1.2 Phase 1B

Figure 1 – Baltimore Police recovering a bike share bicycle (image credit: Baltimore Police Department)

The rollout of the remaining stations for Phase 1B was delayed because of supply chain challenges and the theft issue, and in September 2017 the City shut the system down to give Bewegen time to design and install more secure locks on docking stations (Campbell, 2017c; Munshaw, 2017). One month later in October, the system reopened, and the docking station expansion began soon thereafter. At the time of writing (mid-August, 2018) there are a total of 39 docking stations. The City did secure a sponsorship agreement with Lyft in early 2018 that partially funded five of the new stations and branded them as Lyft (Hawkins, 2018). Figure 2 shows the existing (blue [permanent], brown [temporary], and pink [Lyft]) and planned (orange) station locations in August 2018.

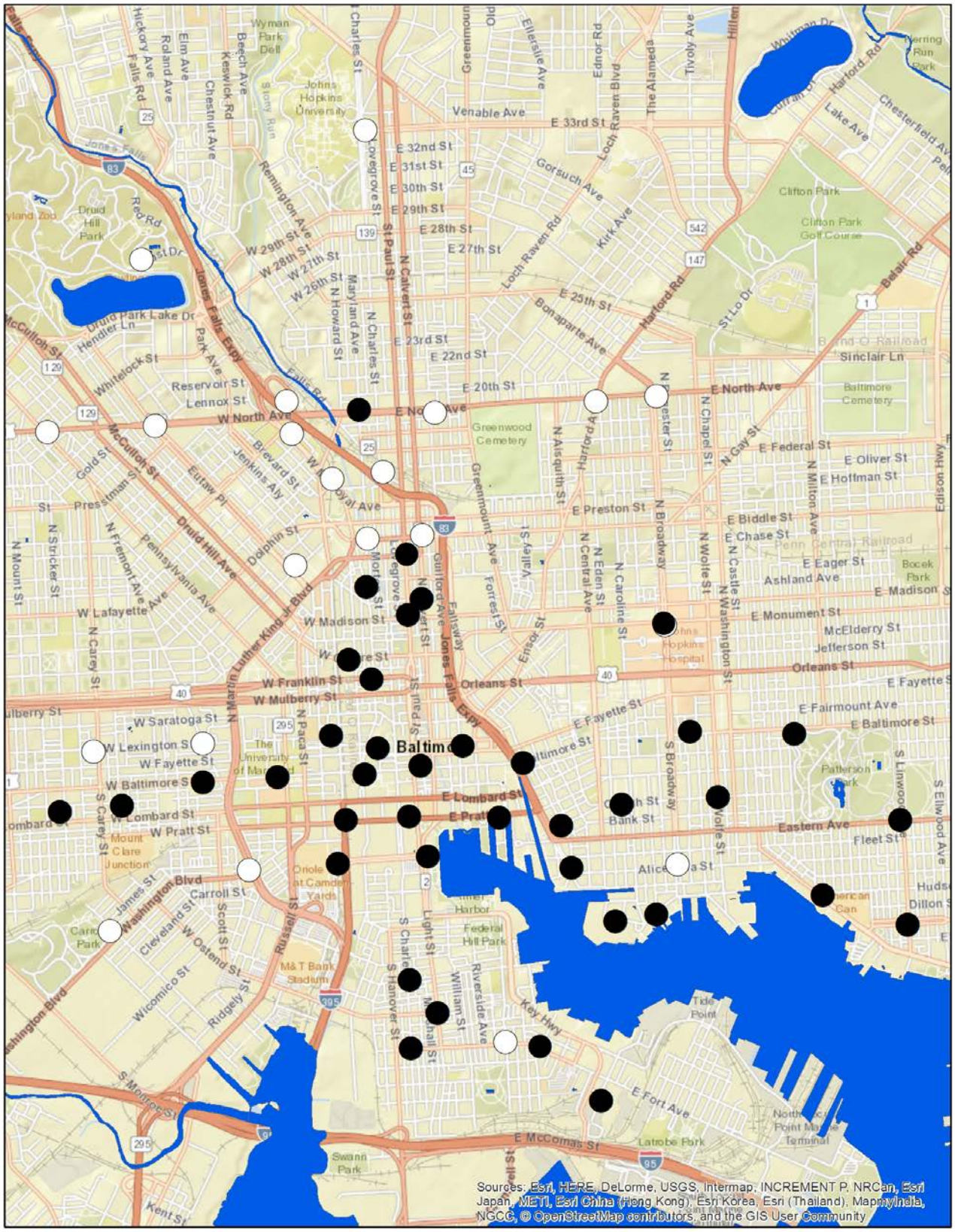


Figure 2 – Baltimore Bike Share docking stations

2.1.3 Toward Dockless Bike Share

On August 15, 2018, the City of Baltimore announced that it would discontinue its bike share program in favor of dockless modes (Campbell & Richman, 2018). A six-month trial period will allow vendors Bird and Limebike, to place approximately 1,000 scooters or bikes in Baltimore with the requirement that a quarter of the bikes are positioned in neighborhoods where 40% or more of the households earn less than $25,000.

3. Literature Review

3.1 Equity in Transportation

Equity is conceptualized as fair and impartial treatment toward communities and a just distribution of costs and benefits across communities. The concept of equity and its evaluation in public programs has increased significantly and environmental justice regulations require equity analyses for all government-funded investments including infrastructure (Konow, 2003). At the present time, equity is considered in most transportation planning practice, yet very few projects explain how equity is measured and included in performance evaluations; perhaps this is due to the difficulty of evaluating and interpreting transportation equity (Marsh & Schilling, 1994; Martens, Golub, & Robinson, 2012). Equity evaluations are dependent on the values and concerns of stakeholders: policies and decisions may seem equitable when evaluated one way but inequitable when evaluated another (Litman, 2003).

Although equity is a subjective concept, it is generally understood in terms of horizontal equity and vertical equity. Horizontal equity means fairness in the equal distribution of impacts between groups that share the same ability and needs (Litman, 2003; Madi, Wiegmann, Parkany, Swisher, & Symoun, 2013). Most transportation policies are horizontally equitable if they are fairly distributed among the servicing area, with all groups of people receiving similar allocations of resources and bearing equal cost. This indicates that the spatial distribution of public transport facilities be equally accessible to all residents. However, accomplishing equal distribution in cities is often problematic because the built environment and land use naturally develop into centers and peripheries (Manaugh & El-Geneidy, 2011; Martens et al., 2012). Vertical equity, often referred to as outcome equity, is concerned with spreading across social groups that diverge in their ability and/or need. If transportation policies are redistributive favoring disadvantaged communities and compensating for overall inequalities to achieve a level playing field, vertical equity is fostered (Litman, 2003; Madi et al., 2013). This equity principle requires identifying disadvantaged groups that may be in greater need of alternative transportation choices or subject to particular barriers in utilizing existing ones.

The distribution of transportation infrastructure facilities is often measured by accessibility. Accessibility is widely used in transportation planning and policy decisions as it indicates one's ability to reach desired services or infrastructure, and it illustrates how much effort is required from a given location (Morris, Dumble, & Wigan, 1979). Access is mostly concerned

with a person's or area's convenience to transportation infrastructure, and it is typically a measurement of distance and/or cost based on origin-destination (Murray & Davis, 2001).

Equity gap analysis categorizes people in need by demographic and geographic factors and evaluates vulnerability indicators of disadvantaged populations. The indicators are useful to estimate the status of the groups within a geographic boundary and groups most likely to experience unfair costs or benefits from a given transportation system (Litman, 2003). Transportation-disadvantaged populations can be categorized in two ways: (1) environmental justice vulnerable groups, and (2) transit dependent vulnerable groups. The environmental justice framework advocates for addressing inequalities across communities when environmental properties are not evenly distributed and access to environmental goods are stratified by race, ethnicity, and social class. For the transit dependent framework, minority persons (non-white) and low-income (below poverty level) households are less likely to own a car and therefore depend on public or non-motorized forms of transportations (Litman, 2003; McConville, 2013). When transportation policies are car-centric, these groups face difficulties in accessing needed alternative transportation infrastructure, affecting economic inequality patterns (Sanchez, Stolz, & Ma, 2003). Transit dependent populations also have a greater need for affordable mobility modes and, from a transportation equity perspective, these communities should be prioritized in public transportation policy and investments (Zelalem et al., 2009).

When transportation equity is considered at the individual level, a single person can be characterized by more than one indicator. Thus, the degree of disadvantage should be taken into consideration in equity assessments, recognizing the problem of identifying the right scale for these indicators (Litman, 2003). Most studies consider the percentage of the total population for each indicator within given administrative boundaries, typically census blocks (Prelog, 2015). Yet these studies ignore safety concerns and population density, which are important considerations in transportation planning.

3.2 Bicycling, Barriers, and Equity Communities

As bike sharing systems become common in U.S. cities, evidence is growing that certain demographic groups are underrepresented among users (Buck et al., 2013; Goodman & Cheshire, 2014; McNeil, Dill, MacArthur, Broach, & Howland, 2017; Shaheen et al., 2014; Smith et al., 2015; Ursaki & Aultman-Hall, 2015). Underrepresented communities, what we call "equity communities," may face unique challenges and barriers that factor into low participation rates.[2]

3.2.1 Barriers to Biking in Equity Communities

[2] These communities are currently experiencing bike share inequity and could legitimately be conceptualized as "inequity communities." We use this term "equity community" to denote that public policy or private sector interventions may be necessary to enhance bike share equity in the particular community. "Community" refers to a collection of individuals who share common social characteristics, as opposed to a collection of individuals located in a geographically defined area such as a neighborhood.

The literature review below summarizes the barriers to biking that are faced by equity communities. Barriers are categorized in two distinct ways: those associated with biking in general and those associated with accessing and using bike share systems.

3.2.1.1 *Infrastructure and Safety*

A pre-bike share study in Milwaukee revealed that most stakeholders are concerned about the safety of riding on the streets, clearly marked bike lanes, and lack of a cycling infrastructure (Ketchman, 2015). Focus groups convened to discuss a planned expansion of bike share in a low-income community in Minneapolis identified similar concerns (Kretman Stewart, Johnson, & Smith, 2013). This was also the primary issue for a mixed-race group and among females in general in a series of focus groups held in Philadelphia in advance of its bike share roll out (Hoe, 2014). Likewise, the most frequent claim made during community outreach ahead of a planned bike share expansion into underserved communities in Kansas City, Missouri, was that the average person is still afraid to bike in Kansas City (Kansas City B-Cycle, 2014). According to a resident survey in Brooklyn, 42% indicated that they would be more likely to purchase an annual bike share membership if there were more bike lanes in their neighborhoods (Fillen-Yeh & Chaney, 2017). A Portland State University study of residents living near bike share stations placed in underserved neighborhoods in Philadelphia, Chicago, and Brooklyn found that the biggest barrier to bicycling, in general, is concern about traffic safety (McNeil et al., 2017).

3.2.1.2 *Experience*

In focus groups exploring barriers to bicycling in Portland, a common theme among immigrants was that some never learned to ride a bike (Community Cycling Center, 2012). Most of the respondents in this study also discussed a desire to better understand the rules of the road, bicyclist rights and responsibilities, and legal liability. The Philadelphia study noted concerns about biking in inclement weather and what would happen if mechanical issues arose on a bike share bike (Hoe, 2014). Other concerns raised in this study centered on the potential impact of additional cyclists on the road (pedestrian conflicts, inexperienced riders). Another study found that for respondents who were lower-income people of color, barriers to bicycling included becoming sweaty (17%), having inappropriate clothing (15%), and messed-up hair or appearance (10%) (McNeil et al., 2017). In addition, 20% of respondents indicated concern over possible mechanical issues with a bicycle.

3.2.1.3 *Perceptions*

In Minneapolis, clients of social services organizations associated bicycle use with professional business people, whereas students and residents of low-income housing associated bicycle use with lack of success (Kretman Stewart et al., 2013). Likewise, in Milwaukee, some stakeholders cited a perception among Latino or African American low-income residents that riding a bike meant you were poor or unsuccessful (Ketchman, 2015). Indeed, the Portland State University survey found that 10% of lower-income respondents of color stated that people thinking they could not afford a car was a big barrier to bike share

(McNeil et al., 2017). Bicycles have also been associated with drug dealers and perceived as symbols of gentrification (Community Cycling Center, 2012; Hoffmann, 2016; Howland, McNeil, Broach, Rankins, & MacArthur, 2017). In a survey of bike share operators, a quarter reported negative perceptions around bicycling in general as a significant barrier to bike share usage (Howland et al., 2017).

3.2.1.4 Law Enforcement, Personal Safety

Several studies have revealed concerns among equity communities about potential interactions with police while using bike share (Brown, 2016). Discomfort with contact with law enforcement agents was expressed by low-income and minority focus group respondents in Philadelphia, even in cases of theft, accidents, or injuries related to biking (Hoe, 2014). In a study of residents in Chicago, Brooklyn, and Philadelphia, race was determined to be an important factor in whether respondents feel their personal safety is a concern while biking, as either a victim of crime or target of police attention (McNeil et al., 2017). Latino/Hispanic and African immigrants noted a fear of racial profiling and deportation in the Portland study (Community Cycling Center, 2012).

3.2.2 Barriers to Bike Share in Equity Communities

3.2.2.1 Docking Stations

Several studies point to the need for convenient and useful docking station locations (Fillen-Yeh & Chaney, 2017; Hoe, 2014; Howland et al., 2017; Ketchman, 2015; Kodransky & Lewenstein, 2014). Nearly all (95%) survey respondents in Chicago, Philadelphia, and Brooklyn reported a bike share station in their neighborhoods, yet 19% of lower-income respondents cited a lack of docking stations near important destinations (Howland et al., 2017). Concerns over a lack of bikes or open docks at stations were also cited as barriers by this group.

Related to station availability, questions concerning where residents ride have been identified. In a planned expansion into Kansas City's underserved communities, outreach efforts concluded that docking stations should provide connections to daily errand destinations like grocery stores, social services, recreation opportunities, and dense residential populations (Kansas City B-Cycle, 2014). Milwaukee's study highlighted concerns about where residents ride and concluded that placing stations to promote travel within their communities might be more successful than designing the bike share network to travel downtown (Ketchman, 2015). Respondents of color in the Portland State University study were much more likely than white respondents to cite travel distances as being too far to go by bicycle (40-44% to 17-23%) (McNeil et al., 2017).

Some research suggests a spatial mismatch between where low-income people live and their access to jobs (Berube, 2011; Kodransky & Lewenstein, 2014). Cohen (2016) notes that the disparity between the number of bike share users in poor versus wealthy wards in Washington, D.C., can be explained in part by this mismatch. Indeed, in cities, those living in

high-poverty and majority-minority neighborhoods between 2000 and 2012 experienced a 14% and 10% decline in the number of nearby jobs, respectively, far outpacing the 3% decline experienced by the average city resident (Holmes, 2015). In assessing the needs of lower-income residents of color in the Portland State University study, it was found that only 57% of this population were employed, as compared to 94% of higher-income people of color and 96% of higher-income white residents (McNeil et al., 2017). According to a survey of bike share operators, several systems saw limited ability to place stations in underserved areas because of the lack of residential density in such neighborhoods or said that target populations lived in neighborhoods too far from the existing bike share network (Howland et al., 2017). Other studies indicated that, because of this spatial mismatch, a 30-minute rental time limit is not long enough (Freedman, 2015; Ketchman, 2015; Kretman Stewart et al., 2013).

3.2.2.2 Awareness

Several studies point to the lack of information or misinformation about using bike share systems as barriers to participation. In the Portland State University study, 34% of lower-income respondents of color said lack of knowledge on how to use bike share was a big barrier (McNeil et al., 2017). Specific misconceptions included believing helmets are required, thinking that the bike locks would automatically lock if time limits were exceeded, and having questions about the cost of the service. To some community members in Minneapolis, the process of signing up and using the system was confusing (Kretman Stewart et al., 2013). A study in Boston found that many community members, most frequently immigrant parents, were under the impression that the membership price was higher than the actual cost (Murphy, 2014). Conversely, in a focus group in 2012, Emerson University students indicated that cost was not the limiting factor, but rather the confusing and inefficient method of making payments (National Association of City Transportation Officials, 2015). Lack of information was the most commonly reported reason for not using Indego in Philadelphia, despite the fact that 93% of people who agreed to answer the screening questions reported that they knew about the program (Hoe, 2015). Likewise, intercept surveys in Bedford Stuyvesant revealed that most (87%) had heard of Citi Bike, although there was little awareness (9%) of discounted annual membership options for New York City Housing Authority (NYCHA) residents (Fillen-Yeh & Chaney, 2017).

Kodransky & Lewenstein (2014) noted that lack of information about bike share benefits contributes to low usage rates in low-income communities. Similarly, outcomes of the Portland State University study suggest the need for making a better case for bike share's transportation utility among the large number of lower-income respondents of color who currently only see recreational value in bike share (McNeil et al., 2017). Likewise, in Kansas City, the biggest barrier to bike share is simply the perception of bicycling for utility (Kansas City B-Cycle, 2014).

In a study of bike share operators, 10 of 44 systems cited that limited usage in equity communities was due to confusing language in their instructions and fee structures as well as

poor educational outreach (Howland, McNeil, Broach, Rankins, & MacArthur, 2017). Language barriers in particular pose a significant challenge for encouraging the use of shared-mobility systems among non-English speakers (Howland et al., 2017; Ketchman, 2015; Kodransky & Lewenstein, 2014).

3.2.2.3 *Registration and Payment Method*

Several studies have identified lack of internet and mobile wireless access as a potential barrier for low-income populations (Howland et al., 2017; Kodransky & Lewenstein, 2014; Kretman Stewart et al., 2013). The Portland State University study of equity neighborhoods in Chicago, Brooklyn, and Philadelphia found that 56% of lower-income respondents of color do not have reliable internet access (McNeil et al., 2017), yet Freedman (2015) reports that the majority of low-income residents in Boston do have access to the web.

Most programs' business models require a credit or debit card to sign up, which allows for efficient billing of users and equally serves as collateral (Carney, 2012). Lower-income respondents of color in Chicago, Brooklyn, and Philadelphia are much less likely to have a credit or debit card (McNeil et al., 2017), thus presenting a potential barrier for this "unbanked" population (Howland et al., 2017; Kodransky & Lewenstein, 2014; Kretman Stewart et al., 2013). This issue was raised as a potential barrier by community and nonprofit leaders in Milwaukee; however, most residents who attended meetings stated that they had a credit or debit card (Ketchman, 2015). Likewise, the majority of low-income residents in Boston have credit and debit cards (Freedman, 2015). Estimates for the entire unbanked population vary from 7.7% to 22%, but African-Americans and Hispanics are overrepresented in these statistics (Carney, 2012).

3.2.2.4 *Children and Cargo*

Lower-income people of color are more likely to have children at home—58% compared to 35% of higher-income people of color and 22% of higher-income white residents—which indicates that child transport options are a barrier (McNeil et al., 2017). A study in Minneapolis highlighted the inability of bike share programs to support bringing children along or hauling cargo (Kretman Stewart et al., 2013), and nearly half of survey participants in Portland were interested in riding with their children (Community Cycling Center, 2012). In Milwaukee, questions concerning families with children were brought up at most meetings with community stakeholders, with some residents recommending trailer bikes or bike trailers for young children (Ketchman, 2015). Several participants in a Philadelphia study expressed similar concerns about the system not being family friendly including a lack of available bikes for children (Hoe, 2014).

3.2.2.5 *Cost*

Bike sharing base annual membership rates cost about the same as a monthly transit pass in most cities (Ketchman, 2015), which is an important threshold identified in equity studies (Hoe, 2014; Kretman Stewart et al., 2013). Thirty-two percent of intercept survey

respondents in Bedford Stuyvesant stated they would purchase an annual Citi Bike membership if it were less expensive (Fillen-Yeh & Chaney, 2017). A similar percentage of bike share operators (15 of 44 respondents) stated that cost to use the system was a key barrier (Howland et al., 2017). High membership costs and concerns about bike liability were barriers for nearly half (48% and 52%, respectively) of lower-income residents of color in Philadelphia, Chicago, and Brooklyn (McNeil et al., 2017).

4. Supply of Bike Share Infrastructure: Equity Gap Analysis

Utilization of accessibility measures and the equity of accessibility have not been fully integrated in transportation planning and project prioritization in Baltimore. This study's equity gap analysis attempts to effectively establish a method to assess the equity of bike share infrastructure using population density. Additionally, this study provides a GIS-based methodology for planning bike share using equity and level of traffic stress. A comparison between traditional equity gap metrics and our adapted density-based metric is also provided, along with recommendations for future expansion of bike share in the City of Baltimore.

4.1 Scope of Analysis and Study Area

This study measures safety as the percentage of bikeable roads within census blocks, with infrastructure categorized based on a level of traffic stress rating. The LTS rating provides a quantitative measure of comfort and connectivity and was originally developed by the Mineta Transportation Institute. Kittleson and Associates (2017) adopted it for the Baltimore Department of Transportation in 2017, and this LTS network was used as a reference for the present study. The LTS assigns each road segment into one of four levels, ranging from LTS 1 (lowest stress) to LTS 4 (highest stress) based on lanes, speed limit, parking availability, presence of a centerline, intersections, and the type and width of bicycle lanes where they exist (Furth, Mekuria, & Nixon, 2016).

Figure 3 illustrates the study area that aligns with the LTS network developed for Baltimore by Kittleson and Associates (2017). The study area, which is defined by the extent of Kittleson's LTS work for the City, is 35 square miles and includes 39 operational Baltimore Bike Share stations with 20 more stations expected to open during the current expansion phase.

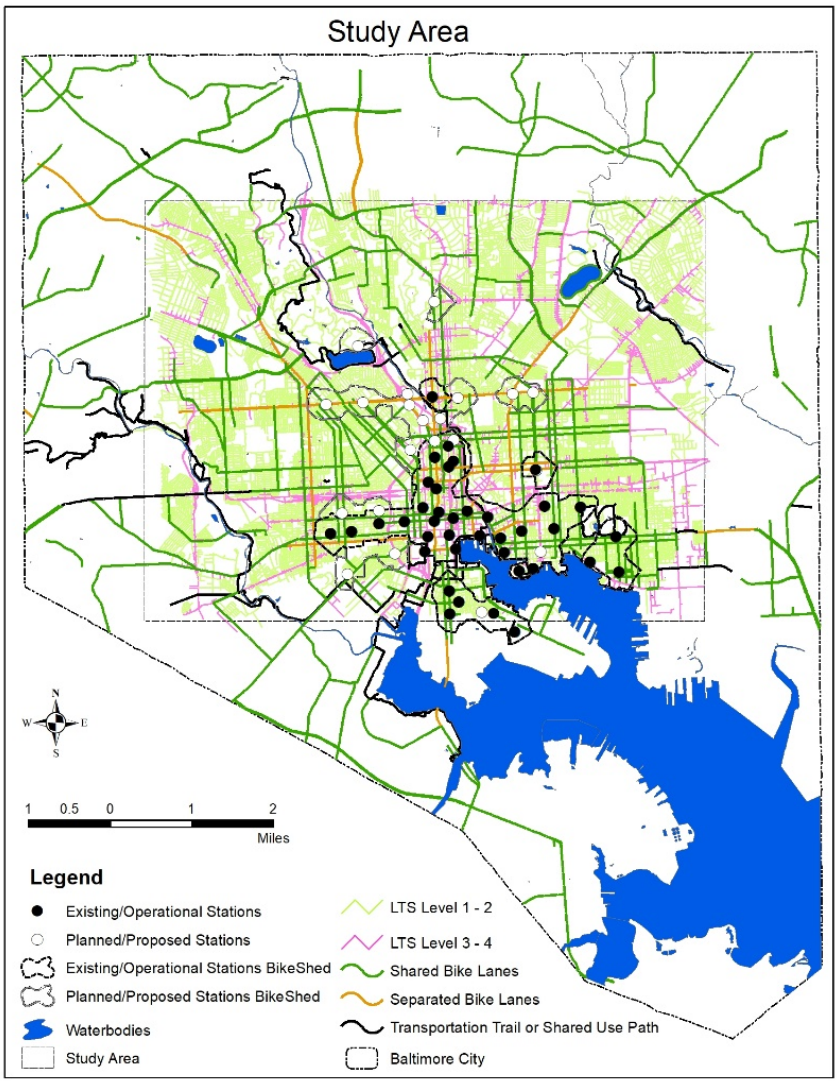


Figure 3 – Map of Baltimore bicycle infrastructure and study site

4.2 Data Sources

The socioeconomic data needed for the analysis was obtained using Census data provided by American Community Survey (ACS). The ACS provides detailed information relating to demography, socioeconomic, housing, and travel characteristics for defined boundaries within the United States. ACS five-year estimates (2010-2015) were used to acquire the most recent data available at the largest geographic resolution, the census block group.

4.3 Bike Equity Index Development

The Bike Equity Index (BEI) used in this study is a composite measure of the US Census data from five demographic groups—people younger than 18 (Youth) and older than 65 years old (Elderly), non-white, non-Hispanic minorities (Minority), households below the poverty line (Poverty), and Zero-Car Households. These indicators can be categorized into two groups: (1)

transit dependent indicators that represent Youth, Elderly, and Zero-Car Households groups and (2) environmental justice indicators that represent Minority and Poverty groups.

The ACS tables used to obtain data for these equity indicators are as follows:

- ACS: B01001 Sex by Age
- ACS: B25044 Tenure by Vehicles Available
- ACS: B03002 Hispanic or Latino Origin by Race
- ACS: C17002 Ratio of Income to Poverty Level in the Past 12 Months

The BEI used in this study is adopted from the methodology developed by Rachel Prelog (2015) in a report for the League of American Bicyclists. To combine the indicators into a single BEI measurement, values for each indicator are standardized using the Z-score statistic. The Z-score statistic represents how many standard deviations from the mean the value is for a region; see (1).

$$Z = \frac{x - \mu}{\sigma} \tag{1}$$

where, x is the percentage of the indicator, μ is the mean, and σ is the standard deviation.

To calculate the Z-score for each block group *i*, the mean and standard deviation for all block groups in the study area, must be found. Then the Z-scores from all five indicators are added together to create the BEI. However, only positive Z-scores are used in the index construction, and negative scores are converted to zero. This eliminates indicators with negative Z-scores (below average values) from diminishing the effect of other indicators. If a negative Z-score is used in the index construction, it would decrease the overall BEI value, making it appear less disadvantaged. Furthermore, all indicators are given equal weight, meaning that no one indicator was thought to be more important to determining equity than another. The minimum BEI is, therefore zero, and the lower the BEI, the greater the equity.

The initial BEI developed by Prelog considered the percentage of each indicator per block group. Our adapted BEI considers the population (or household) per square mile. Considering population density in developing the equity index is useful for the planning of bike share stations. This study thus proposes a new equity index that is expressed by the following equation:

$$BEI_i = E_i + Y_i + C_i + M_i + L_i \tag{2}$$

where

E_i = max{0, Z-score of elderly population per square mi}

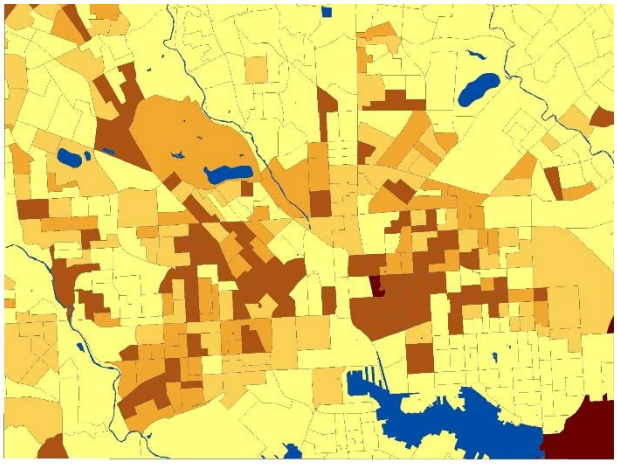
Y_i = max{0, Z-score of youth population per square mi}

C_i = max{0, Z-score of zero-car households per square mi}

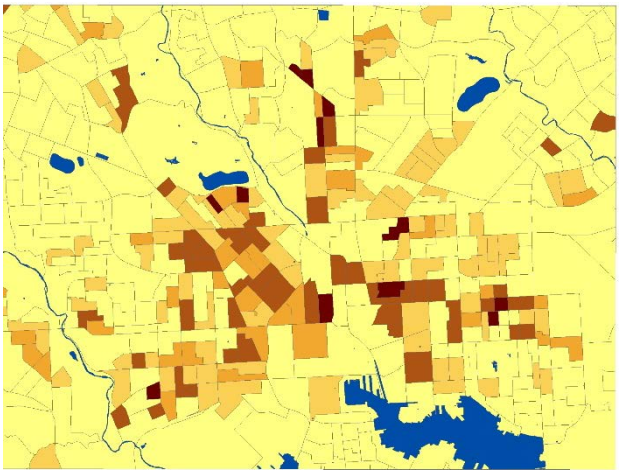
M_i = max{0, Z-score of minority (non-white) population per square mi}

L_i = max{0, Z-score of low-income population per square mi}.

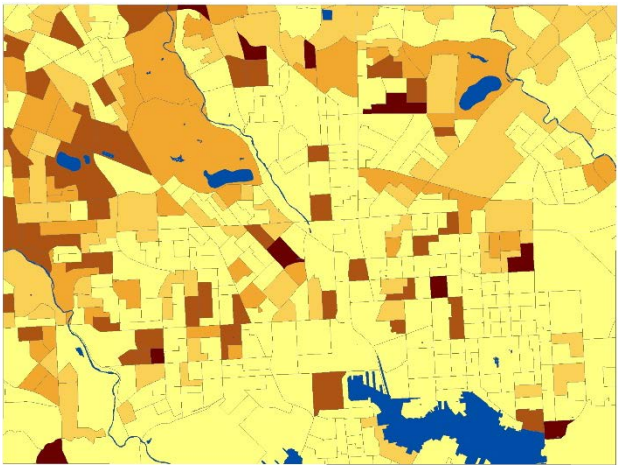
Using density for normalization provides better scenarios for planning purposes. Density assumes uniform distribution of indicators throughout the census block group and accounts for population and size of census blocks. Figure 4 shows the Z-scores of the transit dependent indicators, Figure 5 shows Z-scores for the equity indicators, and Figure 6 provides a comparison of the BEI using the two methods.



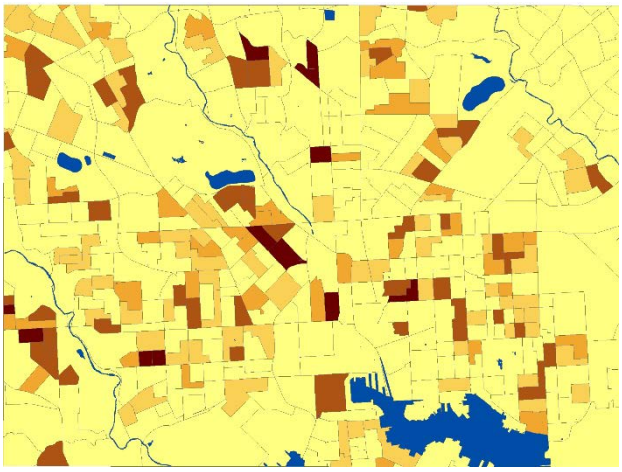
Zero-Car Households (%)



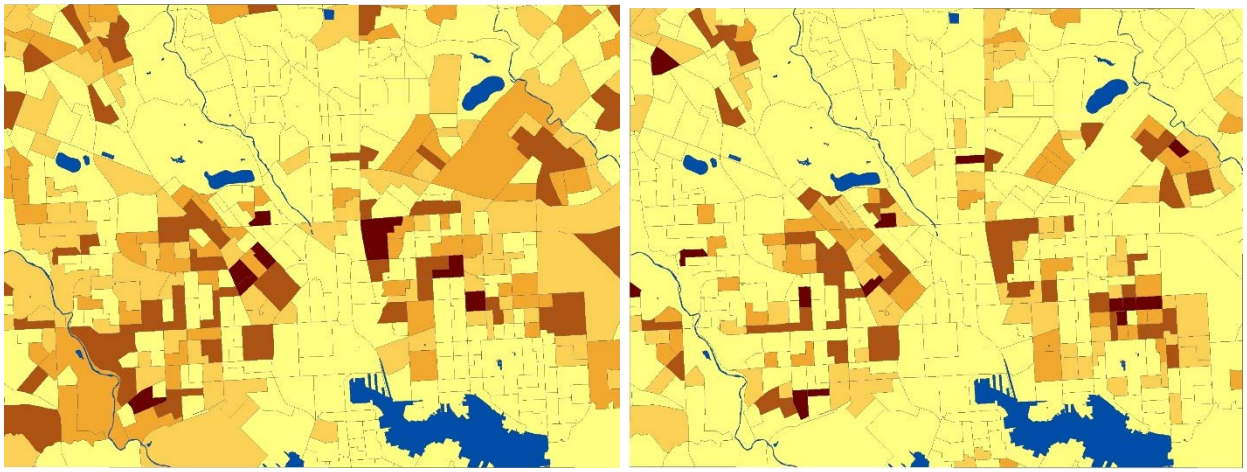
Zero-Car Households (density)



Elderly (%)



Elderly (density)



Youth (%) Youth (density)

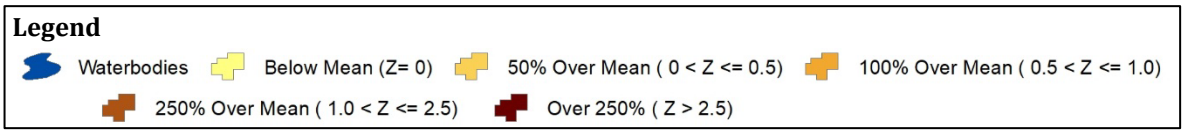
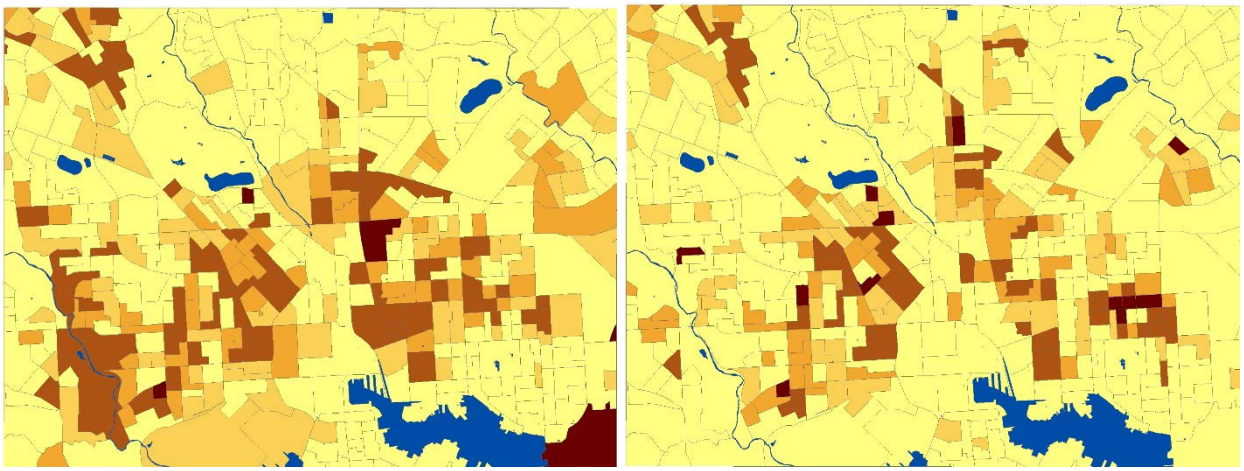
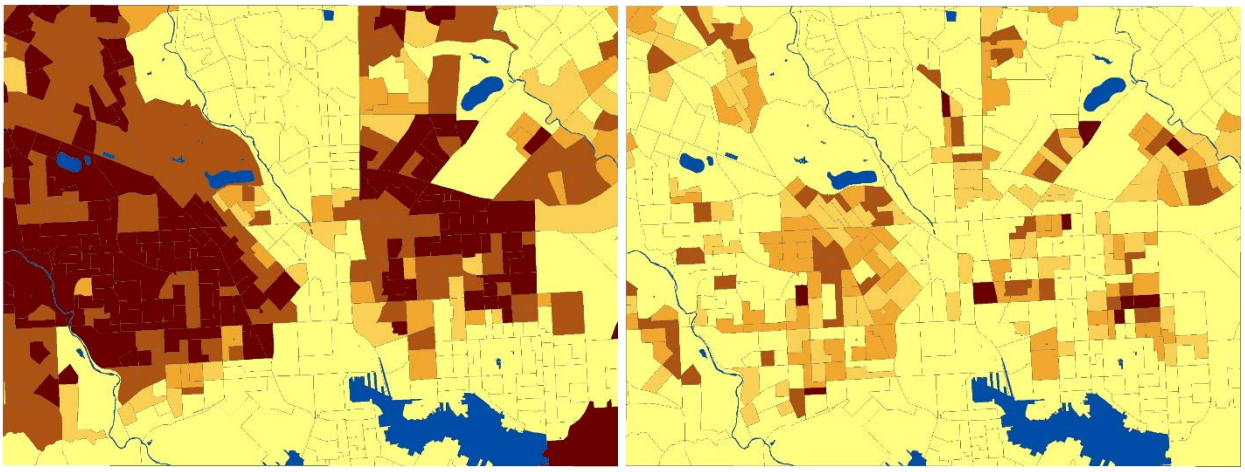


Figure 4 – Comparison of transit dependent indicators Z-scores



Poverty (%) Poverty (density)



Minority (%) Minority (density)

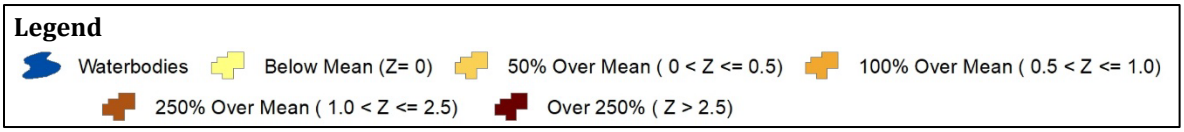
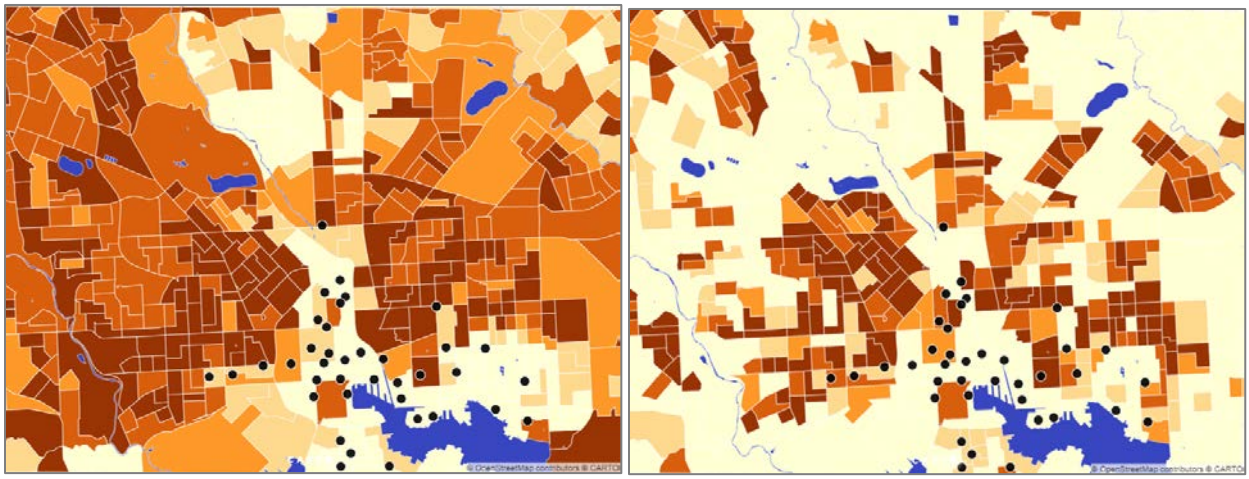


Figure 5 – Comparison of equity indicators Z-scores



BEI (%) BEI (density)

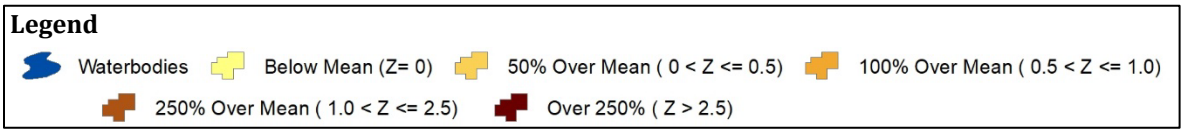


Figure 6 – Bike Equity Index comparison

4.4 Results and Discussion

The City of Baltimore is relatively new to the bike share program, having launched in 2016. Though the City is trying to revamp its public transportation and promote alternative and

active modes of transportation, Baltimore lacks accessibility and infrastructure related to biking. Only 15.36% of roads in the City of Baltimore have dedicated bike lanes. The bike share program stations are concentrated around the downtown Inner Harbor area and tourist attractions where bike lanes are adequate, too; see Figure 2. In much of the city, stations and bike lanes are scarce. Indeed, out of 653 census block groups, 16 (2.45%) do not even have one bike lane.

The bikeshed area (catchment of quarter-mile bike share station distance) intersecting multiple block groups are proportionally attributed to each block group and then compared to the total area of each region yielding a percent of bike share coverage metric for each block group. Table 1 categorizes bike share coverage into three categories: no coverage (None), partial coverage (Part), full coverage (Full). The bike equity index is divided into three categories as well: Low Need (BEI=0), Medium Need (0<BEI ≤2.5), and High Need (BEI>2.5). Table 1 shows the percent of the population (in bold) and percent of census block groups (in italics) that fall into each category.

Currently, there are 39 bike share stations. Eighty-one percent of all census blocks in the study area do not have access to bike share due to the small system. Most of the bike share coverage is concentrated in Medium Need areas when measuring BEI by density and percent; see Table 1A and Table 1B. Figure 7 presents the categories in Table 1 graphically. Vertical equity ensures a redistribution of resources to address disparities. An equitable system would ensure that areas with a High Need (i.e., a high BEI) have the most access to bike share (i.e., the entire census block has access to a bike share station within a quarter of a mile from home). Red indicates block groups that have an oversupply of station access based on need; purple represents an undersupply of station access based on need; and gray represents a well-balanced block group. The percent BEI shows most of the city unbalanced, whereas the density BEI shows much of the outlying areas of the city as balanced as the population density in those areas do not warrant a bike share location. BEI-density is more representative of the bike share planning process.

Table 1 – Comparison of Bike Equity Indices and bike share station coverage by percent of population (bold) and percent of census block (italics)

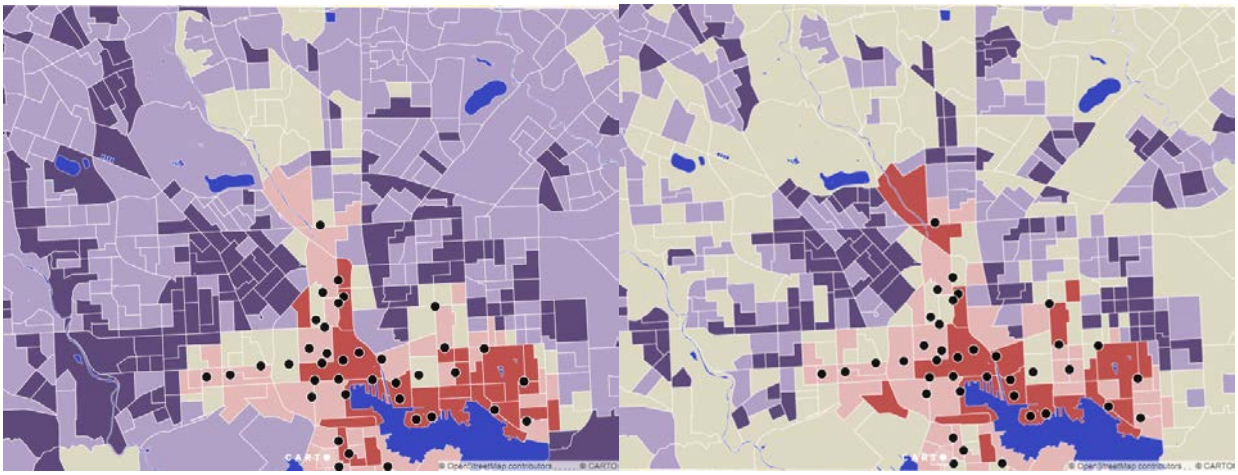
A		**Bike Share Coverage 39 Stations**				***B***		**Bike Share Coverage 39 Stations**			
		None	**Part**	**Full**	***Total***			**None**	**Part**	**Full**	***Total***
BEI-%	**Low Need**	**6.4%** *5.7%*	**3.8%** *3.3%*	**6.6%** *5.5%*	**16.7%** *14.4%*	**BEI-den**	**Low Need**	**25.4%** *27.4%*	**2.6%** *2.2%*	**4.6%** *4.2%*	**32.6%** *33.7%*
	Med Need	**47.7%** *47.5%*	**2.0%** *0.9%*	**7.1%** *5.7%*	**56.8%** *54.0%*		**Med Need**	**25.5%** *29.1%*	**2.4%** *2.4%*	**7.9%** *6.8%*	**35.9%** *38.3%*

	High Need	**23.4%** *28.0%*	**0.4%** *0.7%*	**2.6%** *2.8%*	**26.4%** *31.5%*		**High Need**	**26.6%** *24.7%*	**1.2%** *0.2%*	**3.7%** *3.1%*	**31.5%** *28.0%*
	Total	**77.5%** *81.2%*	**6.2%** *4.8%*	**16.3%** *14.0%*	**100%** *100%*		***Total***	**77.5%** *81.2%*	**6.2%** *4.8%*	**16.3%** *14.0%*	**100%** *100%*
C		**Bike Share Coverage 59 Stations**				***D***		**Bike Share Coverage 59 Stations**			
		None	**Part**	**Full**	***Total***			**None**	**Part**	**Full**	***Total***
BEI-%	**Low Need**	**5.5%** *5.0%*	**3.6%** *3.1%*	**7.6%** *6.3%*	**16.7%** *14.4%*	**BEI-%**	**Low Need**	**23.0%** *24.9%*	**3.1%** *2.8%*	**6.5%** *5.9%*	**32.6%** *33.7%*
	Med Need	**41.9%** *41.4%*	**4.7%** *3.1%*	**10.2%** *9.6%*	**56.8%** *54.0%*		**Med Need**	**22.8%** *25.6%*	**3.3%** *3.3%*	**9.8%** *9.4%*	**35.9%** *38.3%*
	High Need	**19.5%** *23.9%*	**2.0%** *2.2%*	**4.9%** *5.5%*	**26.4%** *31.5%*		**High Need**	**21.1%** *19.7%*	**3.9%** *2.2%*	**6.5%** *6.1%*	**31.5%** *28.0%*
	Total	**66.9%** *70.2%*	**10.3%** *8.3%*	**22.8%** *21.4%*	**100%** *100%*		***Total***	**66.9%** *70.2%*	**10.3%** *8.3%*	**22.8%** *21.4%*	**100%** *100%*

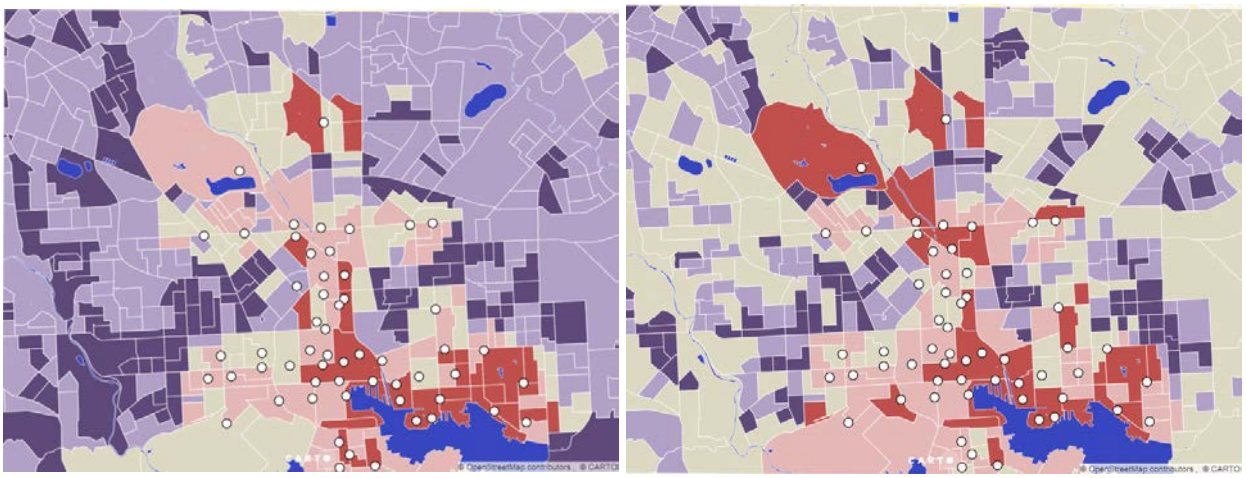
BEI vs. Stations: Red indicates oversupply of stations, Purple indicates undersupply of stations

BEI Categories: Low: BEI $= 0$, Medium: $0 <$ BEI ≤ 2.5, High: BEI > 2.5

Station Categories: None = No stations within ¼ mile, Part = Some of block group has access within ¼ mile of station, Full = All of block group has access to a station within ¼ mile



(a) BEI (%) vs. 39 Bike Share Coverage (b) BEI (density) vs. 39 Bike Share Coverage



(c) BEI (%) vs. 59 Bike Share Coverage (d) BEI (density) vs. 59 Bike Share Coverage

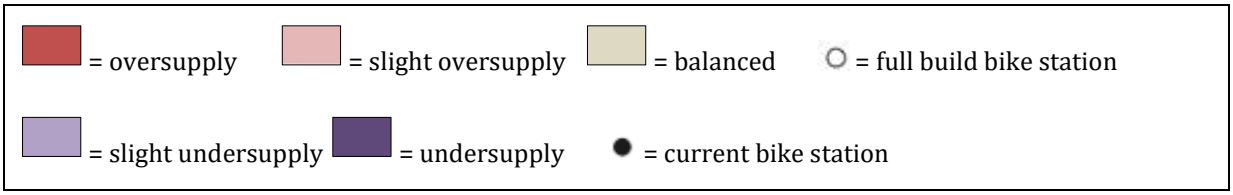


Figure 7 – Bike Equity Index and bike share coverage

To ensure safety and ridership, bike share stations are often installed along corridors with cycling infrastructure on high-volume streets. For the level of traffic stress, the total length of stressful roads (LTS 3 & 4) were compared with total road length within each block group. Then the percentage of unsafe road lengths ((LTS 3 & 4) / (total road length)) were standardized by Z-score. For consistency, negative LTS Z-scores are rounded up to zero. Table 2 compares the BEI-density and LTS index for the current bike share system and the proposed full build by populations with and without bike share access. The average BEI and LTS index across the study site is 2.08 and 0.40, respectively. Currently, the BEI for populations with bike share access is below the study site average, indicating populations with less equity indicators have more access to bike share. This improves slightly with the proposed full build with a BEI of 1.96, which is just below the study average. However, to address disparity, those with access to bike share should be above the site average. Safety does not explain the lack of equity in the system given the level of traffic stress is higher for populations with access to bike share than those without access in both scenarios. This is a result of the concentration of bike share facilities along the congested central business district corridor.

Table 2 – Average BEI-density and LTS score for the entire study site and individuals with and without access to bike share

		Population	BEI	LTS
Current System (39 Stations)	With Bike Share Access	83,889	1.44	0.54
	Without Bike Share Access	322,316	2.25	0.37
Proposed Full Build (59 stations)	With Bike Share Access	125,498	1.96	0.47
	Without Bike Share Access	280,707	2.13	0.38
Entire Study Site		***406,205***	***2.08***	***0.40***

The authors strongly believe that research in equity should consider a population-density-based BEI for bike share systems. As shown in Figure 6, the consideration of density provides planners with a targeted geographic area for bike share infrastructure. This is critically important for smaller systems as station density is an important determinant of ridership.

5. Demand for Bike Share: User and Barrier Analyses

The introduction to this report presented evidence that bike share access and benefits accrue to particular constituencies and community members, raising questions of bike share equity in Baltimore. Who is using Baltimore Bike Share and, conversely, who is *not* using Baltimore Bike Share and why are they not using it? Those general questions informed the design and execution of the following user and barrier analysis. Armed with answers to the research questions, policies and programs can be designed to improve bike share equity by fostering better recruitment, engagement, and retention of non-users (see Section 6).

5.1 Data Collection

Data collection targeted two populations: (1) existing Baltimore Bike Share users, and (2) Baltimore residents, employees, and frequent visitors who are non-users. The research team was scheduled to survey these populations in late summer and early fall of 2017 when system usage is normally high, but the theft and maintenance challenges that led to the September to October shutdown forced a significant delay. Rather than survey users and non-users during this abnormal period, the research team decided to wait through the 2017–2018 winter months and collect data when the weather improved and ridership numbers picked back up in spring 2018.

5.1.1 User Data Collection

The research team collaborated with the City of Baltimore and Bewegen Technologies to develop and distribute a survey to Baltimore Bike Share users. The survey was designed to

elicit information that would be useful for the research effort as well as information useful to the City of Baltimore and Bewegen Technologies (user satisfaction, relationship to other transit modes, recommendations for new docking station locations, etc.). Survey questions were inputted into Qualtrics online survey software and on April 16, 2018, Bewegen Technologies sent an email solicitation to members of the Baltimore Bike Share program who had an email on file (N=3105). A follow-up reminder was sent on April 23, and the survey closed the next day. Respondents with partial answers and single-trip tourist users were removed from the dataset, leaving a total of 245 usable survey responses (approximately 8% response rate). Incentives were not offered to boost the response rate. A copy of the user survey is in Appendix A, and summary statistics are presented in Appendix B. One concern with this survey approach is non-response bias against individuals who lack regular email access and those who are non-native English speakers (Anderson, 2017; Perrin, 2017).

5.1.2 Non-User Data Collection

The research team utilized two methods to collect data from the non-user population: intercept surveys and focus groups. With both groups, the research team sought to understand the barriers to entry into bike share and explore possible policy or programmatic options that would overcome such barriers.

The research was originally designed to be a two-step data collection process whereby bike share user data could inform the subsequent data collection from non-users. Specifically, the user data would identify the Baltimore communities that are underrepresented in bike share usage and consequently a target of the non-user population. Unfortunately, the delay in user data collection (see Section 5.1 above) and the looming final report deadline did not allow the research team enough time to identify the demographic characteristics of Baltimore Bike Share's underrepresented equity communities before non-user data collection. The research team therefore made an assumption that Baltimore Bike Share's equity communities are consistent with other bike share program's equity communities, specifically lower-income communities, communities of color, less-educated, and female (Buck et al., 2013; Goodman & Cheshire, 2014; Shaheen et al., 2014; Smith et al., 2015; Ursaki & Aultman-Hall, 2015).

5.1.2.1 Intercept Surveys

Intercept surveys were used to collect data from the non-user population. The research team developed a survey instrument and protocol (Appendix C) designed to understand barriers that individuals may encounter to Baltimore Bike Share usage. Students from Morgan State University were recruited to administer the survey. To achieve a diverse sample, survey administrators spent three hours near eight docking stations with a variety of land uses on six separate weekdays and five separate weekend days in April and May of 2018. Passersby were solicited to take the five-minute survey. Survey administrators were asked to solicit responses from diverse race, gender, and age characteristics. Participants were required to be Baltimore residents, be over 18 years old, know how to ride a bike, and have heard of though never used the Baltimore Bike Share system.

5.1.2.2 *Focus Groups*

Two focus groups were held in Baltimore on November 17, 2017. The research team partnered with the Southeast Community Development Corporation, a local nonprofit in Baltimore, to recruit participants and use space for the focus groups. The team also partnered with Equitable Cities LLC, a mid-Atlantic research consultancy with experience facilitating bicycling-related focus groups. Both partners were also chosen because they have Spanish language competencies. Incentives to participate in the focus groups included food, beverages, and a $25 pre-paid debit card. Participants were required to be Baltimore residents, be over 18 years old, and have never used Baltimore Bike Share. Participants were asked questions regarding their knowledge, awareness, opinions, and perceptions of biking and Baltimore Bike Share, as well as which changes would make them more likely to use the system.

Figure 8 – Flyer for the Spanish language focus group

The first focus group was conducted in Spanish, and all 12 participants were women. The second focus group was conducted in English and included a mixture of four men and five women. Equitable Cities LLC facilitated both focus groups, recorded the audio, and produced a follow-up summary report (see Appendix D).

5.2 Analytic Approach

The three data collection approaches identified above—user survey, non-user intercept survey, and focus groups—all played different but complementary roles in the analysis.

The user survey was designed for multiple purposes, with most questions designed for the City of Baltimore and Bewegen Technologies so they could develop and implement system improvements (customer support services, connections with other transportation options, etc.). The research team was primarily interested in utilizing the user survey to identify the presence of equity communities, if any, by evaluating the demographic data against ACS population averages for the bike share service area. Demographic variables included gender, age, education attainment, employment status, household income, race/ethnicity, and Hispanic origin (survey questions 31 through 37). The bike share service area, conceptualized as a "bikeshed," was defined by an area located within a one-quarter mile walk from each docking station in the Baltimore Bike Share system.[3] Data from census block groups that

[3] Over half of survey respondents noted that they live within ¼ mile of a docking station. Not all user survey respondents live within the bike share service area, and some live outside Baltimore completely, but the ¼ mile

intersect the service area were aggregated to represent the broader population of possible users for comparison against the user population.

The intercept survey data were used by the research team to perform additional analyses aimed at understanding the relationship between the underrepresented equity communities and barriers to using Baltimore Bike Share. Following the analysis of the intercept survey and identification of barriers for Baltimore's equity communities, a policy and program review of bike share equity best practices was conducted. The review helped to inform and develop recommendations for the City of Baltimore to enhance bike share equity.

The focus group data were not used to draw inferences or conclusions about equity communities because there were only two groups with a total of 21 participants. Rather, the focus groups were held to gather additional insights that could offer qualitative support or caveats to the research team's conclusions and proposed policy recommendations.

5.3 User Analysis

The characteristics of the user survey data were compared to those of residents living in the bikeshed area. Tests were performed for race/ethnicity, Hispanic origin, education attainment, gender, income, and employment status. Table 3 below presents the results of the analysis of the user survey dataset (values may not sum to 100% due to rounding).

Table 3 – User survey analysis[4]

	User Survey %	Bikeshed %	Significance
Race/Ethnicity (n=236)			
White	90.2	60.6	***
Black or African American	4.7	27.4	
Asian	2.5	5.9	
Other	2.5	5.1	
Hispanic Origin (n=235)			
Non-Hispanic	96.2	92.6	*
Hispanic	3.8	7.4	
Education Attainment (n=239)			
Master's or Higher	51.2	27.8	***
Bachelor's	40.6	29.7	
Associate's, Vocational, Certificate	1.3	3.4	
Some College, No Degree	5.4	11.8	
H.S. Diploma, GED, or Below	0.8	27.3	
Gender (n=236)			
Male	68.6	50.0	***
Female	31.4	50.0	
Income (n=232)			
Less than $10,000	1.3	11.3	

buffer was determined to be a reasonable geographic area for comparison and for identification of equity communities.

[4] Chi-squared goodness of fit tests

$10,000–$14,999	0.4	6.0	***
$15,000–$24,999	2.6	8.3	
$25,000–$34,999	3.9	8.2	
$35,000–$49,999	6.5	9.8	
$50,000–$74,999	21.1	16.7	
$75,000 –$99,999	16.0	11.4	
$100,000–$149,999	24.1	14.9	
$150,000–$199,999	9.1	6.5	
More than $200,000	15.1	6.9	
Employment Status (n=234)			
Full or Part-Time Employed	97.9	92.8	**
Unemployed	2.1	7.2	
* p<0.05, ** p<0.01, *** p < 0.001			

The user analysis indicates that Baltimore Bike Share users are predominately white, non-Hispanic, highly educated, male, high-income earners, and employed. Conversely, the equity communities with Baltimore Bike Share are non-white, Hispanic, less-educated, female, low-income earners, and unemployed. This is consistent with previous research on bike share user demographics (Buck et al., 2013; Goodman & Cheshire, 2014; Shaheen et al., 2014; Smith et al., 2015; Ursaki & Aultman-Hall, 2015). The results also confirm the research team's prior expectations about Baltimore Bike Share's equity communities (see Section 5.1.2).

5.4 Barrier Analysis

An intercept survey of non-users was designed and administered to understand the equity community's impediments to using the Baltimore Bike Share. Survey questions were adapted from the National Association of City Transportation Official's (2016) Bike Share Intercept Survey Toolkit and are included in Appendix C. Using a three-point scale, respondents were asked about the extent to which they agreed with 17 conditions, each representing a potential barrier. Nine conditions related to the act of riding a bicycle, while the remaining eight addressed access and use of Baltimore Bike Share.

5.4.1 Intercept Survey Descriptive Statistics

Population descriptive statistics include race, Hispanic identity, age, income level, gender, employment status, education attainment, and the last time the respondent rode a bike. These demographic data of the sample (n = 109) are summarized in Table 4.

Table 4 – Sample characteristics of intercept survey respondents

Independent Variables	Sample Statistic
Race (percent)	
Caucasian/White	61.47
Black or African American	25.69
Asian	4.59
American Indian or Alaska Native	0.92
Middle Eastern or North African	0.00
Native Hawaiian or Other Pacific Islander	0.00
Other	0.00
Mixed (constructed variable)	2.75
Did Not Answer	4.59
Hispanic (percent)	
Yes	5.50
No	88.99
Did Not Answer	5.50
Age, Years (mean, standard deviation, range)	36.4 (12.8) (19-73)
Annual Household Income (percent)	
Less than $10,000	1.83
$10,000–$14,999	3.67
$15,000–$24,999	8.26
$25,000–$34,999	8.26
$35,000–$49,999	16.51
$50,000–$74,999	19.27
$75,000–$99,999	8.26
$100,000–$124,999	3.67
$125,000–$149,999	3.67
$150,000–$199,999	0.92
More than $200,000	4.59
Did Not Answer	21.10
Gender (percent)	
Female	50.46
Male	46.79
Other	0.00
Did Not Answer	2.75
Employment Level (percent)	

Employed Full-Time	65.14
Employed Part-Time	11.93
Retired	8.26
Not Currently Employed	6.42
Did Not Answer	8.26
Education Attainment (percent)	
No H.S. Diploma	3.67
H.S. Diploma/Equivalent (GED)	11.93
Some College, But No Degree	13.76
Associate's Degree, Vocational School, or Certificate Program	2.75
Bachelor's Degree	33.94
Master's Degree	20.18
Professional/Doctoral Degree (MD, JD, PhD, etc.)	7.34
Did Not Answer	6.42
Last Time Rode a Bike (percent)	
Less Than One Month Ago	23.85
1–6 Months Ago	11.93
6–12 Months Ago	17.43
1–2 Years Ago	19.27
2–5 Years Ago	14.68
5–10 Years Ago	7.34
Greater Than 10 Years Ago	3.67
Did Not Answer	1.83

5.4.2 Regression Analysis

A regression analysis was conducted to explore possible relationships between barriers to using the Baltimore Bike Share and equity communities. To simplify the analysis, the intercept survey demographic and barrier data were converted into two sets of dichotomous categorical variables. Using the demographic data, respondents were placed into an equity community, as identified in Section 5.3, or otherwise. As shown in Table 5, the largest equity group captured by the intercept survey were females, while Hispanics and the unemployed were least represented. The small number of observations associated with these two equity populations limits the extent to which inferences can be drawn from the analysis.

Table 5 – Equity communities represented in intercept survey

Equity Community	Definition of Equity Community	Percent of Respondents in Equity Community (n=number of respondents)
Non-White	All Races Except White	36% (104)
Hispanic	Hispanic	6% (103)
Less-Educated	Having a High School Diploma or Less	34% (102)
Female	Female	52% (106)
Low-Income Earners	Having a Family Income Less Than $50,000	49% (86)
Unemployed	Excludes Full- and Part-Time Workers and Retirees	7% (100)

The responses to potential barriers were collapsed into dichotomous variables having values of "agree that the condition is true" or otherwise (as represented by any of "neither agree or disagree," "disagree," or N/A). Table 6 provides the frequency at which respondents agreed to statements regarding potential barriers to using the Baltimore Bike Share. Approximately half of all respondents agreed that they would not use Baltimore Bike Share without a helmet and that Baltimore's streets and sidewalks feel unsafe to ride on. Respondents also expressed concern about being held responsible financially if anything happens to a Baltimore Bike Share bike (44%) and have a preference to use their own bike instead of a bike share bike (40%). Less than 10% of respondents agreed that they do not have access to the internet to register, do not have a credit or debit card to use for registration, and are embarrassed to be seen riding a bike.

Table 6 – Frequency of bike share barriers

Potential Barrier Statement	Variable Name	Percent of Total Respondents Agreeing with Barrier Statement (n=109)
I have concerns about knowing how to use the Baltimore Bike Share system.	USE	24
I am concerned that station locations are not near where I would want to go.	LOCATIONS	34
I don't want to enter my credit or debit card information on the internet in order to register.	NOREGISTER	25
I don't have a credit card or debit card to use for registration.	NOCARDREGISTER	7
I don't have access to the internet to register.	NOACCESS	6
I'm worried about the cost of joining or using the Baltimore Bike Share.	COST	17
I am worried that it will be difficult to check out or return Baltimore Bike Share bikes.	BIKESECURE	25
I would not ride a Baltimore Bike Share bike without a helmet.	HELMET	50
I'm worried about being held responsible financially if anything happens to the bike.	RESPONSIBLE	44
I am concerned that I cannot ride a Baltimore Bike Share bike with my child(ren) or easily carry things I need.	CARGO	28

I'm not comfortable enough riding a bike to use a Baltimore Bike Share bike.	COMFORT	17
I am embarrassed to be seen riding a bike.	EMBARRASS	7
I would be too concerned about the potential to be a victim of crime or harassment while riding a bike.	VICTIM	21
Baltimore's streets and sidewalks feel unsafe to ride on (traffic, safe routes).	UNSAFE	52
I would be concerned about getting sweaty or getting my clothes or hair messed up while riding.	HYGIENE	19
I prefer to use my own bike instead of a Baltimore Bike Share bike.	OWNBIKE	40
I am not interested in riding a bike in Baltimore.	NOTINTERESTED	18

The regression study included both bivariate and multivariate data analysis. Bivariate regressions were run for each of the barriers against three types of independent variables to develop preliminary insight into the data set. The independent variables consisted of the six equity communities, age of respondent, and last time the respondent rode a bike.[5] Multivariate regression explored the extent to which the perception of certain barriers to using the Baltimore Bike Share could be better explained by considering multiple independent variables and their separate impacts. Consequently, for each barrier, a theoretically grounded model relating it to the independent variables was developed based on a conceptual understanding of dependent and independent variable behavior. Taken together, the results of the regression analyses can help explain conditions under which the 17 statements were perceived as barriers to using Baltimore Bike Share.

Because of the binary nature of the dependent variables, the regression approach applied a linear probability model using Ordinary Least Squares with robust standard errors. A linear approach was utilized instead of a logit model for clarity of results and easy-to-interpret

[5] RECENT is a dichotomous nominal variable constructed from the ordinal variable "last time rode a bike" from Table 4 representing bicycle usage in the past two years or not.

coefficients.[6] Table 7 presents conceptually logical and statistically significant results of the regression analysis. Bivariate analysis results are included in Appendix E.

Table 7 – Significant results of multiple regression analysis[7]

Equity Group	Barrier	Regression Model			
		Dependent Variable(s)	n	Coefficient (standard error)	t statistic
Female					
	USE	female	106	0.210 (0.078)	2.67**
	HELMET		82		
		female		0.236 (0.107)	2.21*
		age		0.009 (0.004)	2.28*
	COMFORT	female	106	0.215 (0.065)	3.30**
	EMBARRASS	female	106	0.145 (0.048)	3.03**
	VICTIM		98		
		female		0.234 (0.077)	3.02**

[6] Linear models with small sample sizes are unlikely to yield different answers than logit (Beck, 2015).
[7] Goodness of fit was calculated using a pseudo coefficient of determination recommended by Studenmund (2016) for binary choice models. Values ranged between 0.50-0.67.

		unemployed		-0.205 (0.060)	-3.43**
	HYGIENE	female	106	0.212 (0.073)	2.93**
	NOTINTERESTED		104		
		female		0.223 (0.068)	-2.57*
		recent		-0.245 (0.096)	-2.57*
Hispanic					
	RESPONSIBLE	Hispanic	103	0.421 (0.162)	2.60*
* p<0.05, ** p<0.01, *** p < 0.001					

The only equity group with logically sound and statistically significant relationships was female. The associated five barriers were: (1) being concerned about knowing how to use the Baltimore Bike Share system (USE); (2) not being comfortable enough riding a bike to use a Baltimore Bike Share bike (COMFORT); (3) having concern about getting sweaty or getting clothes or hair messed up while riding (HYGEINE); (4) not willing to ride a Baltimore Bike Share bike without a helmet (HELMET) (in combination with the independent variable, Age), and (5) not being interested in riding a bike in Baltimore (NOTINTERESTED) (in combination with the independent variable, Recent).

Three additional relationships were identified from the analysis. Specifically, (1) expressing concern about being held responsible financially if anything happens to a bike share bike (RESPONSIBLE) was associated with whether or not a respondent is Hispanic; (2) being concerned about the potential to be a victim of crime or harassment while riding a bike (VICTIM) was associated with two equity groups: female (positive association) and unemployed (negative association); and (3) being embarrassed (EMBARRASS) to be seen

riding a bike was associated with being female. However, as noted earlier, the low variation within the data for the variables involved in these relationships, Hispanic (6%), Unemployed (7%), and EMBARASS (7%), suggest that these findings be applied with considerable caution.

No logically sound and statistically significant relationships were found for three of the six equity groups (non-white, low-income, and less-education) and eight of the 17 barriers (LOCATIONS, NOCARDREGISTER, NOREGISTER, NOACCESS, COST, BIKESECURE, CARGO, and UNSAFE). While statistically significant bivariate relationships were observed for NOCARDREGISTER and NOACCESS, they are deemed unreliable due to the lack of data variability in both dependent and independent variables. The statistically significant bivariate relationships between CARGO and non-white and between BIKESECURE and being Hispanic were determined to have unsound logical underpinnings and were, therefore, deemed spurious. Finally, bivariate relationships between age and LOCATIONS, BIKESECURE, and HELMET, while statistically significant, were negligible based on the magnitude of the coefficients and not theoretically strong in some cases.

Also of interest are logically sound and statistically significant relationships identified from analysis of the variable RECENT. Having ridden a bike within the past two years was examined as both an independent variable to explain barriers and as a dependent variable to be explained by equity group. Table 8 shows the results of these regressions. Having ridden a bike within the past two years was found to be positively associated with whether individuals prefer to use their own bikes over a Baltimore Bike Share bike and with being in the white equity group. It was negatively associated with being interested in riding a bike in Baltimore. That is, respondents who last rode a bike more than two years ago were less likely to be interested in riding a bike in Baltimore than those who had ridden more recently.

Table 8 – Statistically significant results from bivariate analysis of RECENT

Dependent Variable	Independent Variable	Coefficient (standard error)	t statistic
OWNBIKE	RECENT	0.254 (0.097)	2.63*
NOTINTERESTED	RECENT	-0.231 (0.099)	-2.33*
RECENT	NOTWHITE	-0.263 (0.096)	-2.72**
* p<0.05, ** p<0.01, *** p < 0.001			

5.5 Discussion

The intercept survey reveals several noteworthy observations regarding community perceptions about biking and Baltimore Bike Share. Foremost, there is a great deal of interest in the Baltimore community in bicycle transportation, evidenced by less than 20% of respondents reporting a lack of interest in riding a bike in the city. Related findings supporting this conclusion are that less than 20% of the community are embarrassed to ride a bike, are not comfortable knowing how to ride a bike share bike, or are concerned with personal hygiene/appearance.

Concomitant with this interest in bicycling, however, respondents reported a significant degree of concern for riding on Baltimore streets. Half of all respondents expressed a preference for wearing a helmet and reservations about feeling safe using Baltimore's bicycling infrastructure. These results are consistent with studies that indicate a majority of people fall into an "interested but concerned" category about bicycling (Dill & McNeil, 2016; Geller, 2009).

Encouragingly, of the eight barriers related to the Baltimore Bike Share system specifically, most respondents (66% or more) did not report concerns about the seven conditions that addressed accessing and participating in the program, including registration, cost, physically handling the bikes, and convenience of station locations. Indeed, survey results suggest that the primary concern (44%) perceived by the community about the Baltimore Bike Share program is being held financially responsible if anything happens to the bike. This finding may reflect widely reported challenges the bike share program faced over the past year, including stories of stolen and damaged bikes.

Turning to findings on the relationship between equity groups and barriers to biking and bike share, the regression analysis found statistically and theoretically significant relationships for women only. Being female was found to be associated with a 21- to 24-point increase in the probability of being concerned about four conditions: knowing how to use the bike share bikes; being comfortable enough riding a bike to use a bike share bike; personal hygiene; and riding without a helmet. While concerns about riding without a helmet were also more broadly shared with the general intercept survey population (50%), more than 76% of the general population disagreed with having concerns about the other three conditions. Given this, it is not surprising that women were also more likely to express no interest in riding a bike in Baltimore and only make up 30% of bike share members. Taken together, these results support the need for policies and programs directed at helping women become more comfortable with how to use bicycles for transportation and recreational purposes and more easily access the bike share program.

Of the remaining five equity communities examined, two populations (Hispanic and the unemployed) were not represented sufficiently in the intercept survey data to draw substantively significant conclusions. No significant relationships within the sample were found for the low-income and less-education equity communities.

Lastly, while no barriers to biking and bike share were found for the non-white equity group, it is notable that this population was associated with not having ridden a bike within the past two years. Not surprisingly, not having ridden recently was found to be associated with not being interested in riding a bike in Baltimore. These findings suggest that strategies that offer opportunities for individuals to try cycling in supported environments may be effective in reducing barriers to biking and bike share.

6. Equity Best Practices

Baltimore Bike Share is not unique in its demographic mismatch between bike share users and the general population. Nearly all bike share systems experience a similar challenge, and many cities are attempting to ameliorate these conditions. This section reviews strategies that other cities implemented to address inequities in their own locations. It also summarizes the evaluations conducted after program implementation to determine whether the interventions were effective and successful at enhancing bike share equity.

6.1.1 Equity Program Summaries

A variety of actions to redress bike equity concerns were explored in cities across the United States. Eight of these efforts are reviewed below and include bike share systems in New York City, Philadelphia, Minneapolis, Milwaukee, Chicago, Boston, Washington, D.C., and Portland.

All eight bike shares offered either free or discounted bike share memberships to address cost concerns (Andersen, 2016; Capital Bikeshare, 2017; Fillen-Yeh & Chaney, 2017; Greenfield, 2015; Kodransky & Lewenstein, 2014; Musser, 2016; Schwarz, 2016; Wade, 2015; Whitten, 2015). Boston addressed payment logistic concerns by making monthly payment installment options available and removing debit card holds (Murphy, 2014). Boston and Washington, D.C. offer unlimited 60-minute rides in recognition of the spatial disconnect that often exists in equity communities (Bluebikes, 2018; Capital Bikeshare, 2017). Unbanked residents were helped in Philadelphia, Chicago, Washington, D.C., and Portland with in-person enrollment options (BIKETOWN, 2017; Greenfield, 2015); cash payment options (Bike Arlington, 2015; BIKETOWN, 2017; Greenfield, 2015; Hamilton, 2015); free checking accounts (Kodransky & Lewenstein, 2014); and simplified single-ride pricing schemes (Ketchman, 2015) to remove structural barriers to signing up for the program. Outside of the eight cases reviewed, Pittsburgh became the first city in the United States to offer free 15-minute bike share rides to anyone holding a public transit card (Cox, 2017b).

The eight bike share systems depicted a wide array of awareness raising strategies. In addition to creating and leveraging local networks, some bike share programs (Brooklyn, Chicago, Milwaukee, Washington, D.C., and Boston) placed particular attention on the creation of culturally sensitive communications materials relative to language and imagery that reflected the target audience (Corbin, 2015; Fillen-Yeh & Chaney, 2017; Ketchman, 2015). Creative marketing approaches used in Philadelphia, Chicago, and Brooklyn included use of art murals and other art-related programs (Corbin, 2015; Hamilton, 2015), social media

campaigns (Fillen-Yeh & Chaney, 2017; Hamilton, 2015) and virtual "games" (Smalls, 2016). Bike ambassador programs, which use locally hired bike share advocates to work directly within equity communities, were set up in Brooklyn, Philadelphia, Milwaukee, and Chicago to assist with awareness-raising efforts and to help integrate biking and bike share into local communities (Chicago Complete Streets, 2017; City of Philadelphia, 2015; Fillen-Yeh & Chaney, 2017; Schwarz, 2016). In Brooklyn and Philadelphia, mini grants were made available to bike ambassadors to support these efforts (Better Bike Share Partnership, 2018; Fillen-Yeh & Chaney, 2017).

Some bike share programs fostered outreach efforts by hosting events that provided bike education and engaged residents with opportunities to gain comfort with riding in their communities. Typical events involved community rides to farmers markets and around neighborhoods (Better Bike Share Partnership, 2016; Fillen-Yeh & Chaney, 2017; Greenfield, 2015; Kodransky & Lewenstein, 2014). Brooklyn offers an example of a multi-faceted programing effort in its Bed-Stuy Bikes! series. Its August 2016 Bed-Stuy Bikes! Back to School Edition featured free backpacks and school supplies, a helmet give-away, learn-to-ride classes on Citi Bikes, free flu shots and health screenings, bike safety classes, organized rides, food, kid-friendly community programing like cooking and exercise classes, face painting and arts & crafts, and a DJ (Fillen-Yeh & Chaney, 2017).

Learn-to-ride classes and/or bike safety and education classes were provided at no charge in Philadelphia, Chicago, Portland, Washington, D.C., and Brooklyn (City of Philadelphia, 2017; Fillen-Yeh & Chaney, 2017; Greenfield, 2017; Kodransky & Lewenstein, 2014; Musser, 2016). Free bicycle helmets were distributed in Portland, Washington, D.C., Brooklyn, and Milwaukee (BIKETOWN, 2017; Capital Bikeshare, 2017; Fillen-Yeh & Chaney, 2017; Wade, 2015). Philadelphia developed a program to create meaningful engagement between bike share systems and young people. This effort resulted in the creation of the Better Bike Share Partnership's (2016) youth engagement toolkit. In Minneapolis, Nice Ride Neighborhood recruited participants for a three-year structured pilot program to promote a culture of biking (Martin & Haynes, 2014).

Some municipalities made efforts to embed equity considerations within the framework of their bike share contracts. Working in partnership with nonprofit organizations Verde and the Coalition of Communities of Color and bike share operator Motivate, Portland's Bureau of Transportation (PBOT) adopted equity measures in the PBOT-Motivate bike share contract, known as the "High Road Standards" (Musser, 2016). This equity plan is founded on three principles: to offer affordable pricing; to train and hire Portlanders from underserved populations for bike share operations and pay a family wage; and to expand the service area to more low-income areas in the city. In Boston, equity performance goals were incorporated into a 2016 Request for Proposal (RFP) for an operator for the metro-Boston bike share program (Edelman & Azemati, 2017).

The table below summarizes the research on barriers to both bicycling and bike share usage. It lists identified barriers as well as strategies implemented in the eight bike share programs that were designed to overcome the barriers.

Table 9 – Strategies to address bike share barriers

Barriers	Strategies
Barriers Related to Biking	
Infrastructure	None specified
Experience	Education and encouragement events/programs Youth engagement program
Perceptions	Education and encouragement events/programs More and improved communications material (targeted language and imagery) Ambassador program Mini grant program Youth engagement program Free helmets
Law Enforcement, Personal Safety	None specified
Barriers Related to Bike Share Systems	
Docking Stations	Increased number of stations in equity neighborhoods
Awareness	More and improved communications material (targeted language and imagery) Marketing through the arts Use of social media Creation and use of networks Mini grant program Ambassador program

	Youth engagement program
Registration and Payment Method	Cash payment option Simplified pricing scheme (single-ride pricing) In-person enrollment option Availability of monthly payment installment option Free checking account
Children and Cargo	None specified
Cost	Free and discounted memberships Unlimited 60-minute rides Removal of debit card holds for casual users

6.1.2 Effectiveness of Equity Programs

While many efforts are underway to enhance bike share equity, few independent studies have assessed effectiveness of these efforts to increase ridership among equity communities. This section summarizes available data for the few studies that have evaluated program outcomes.

6.1.2.1 New York City (Brooklyn)

The success reported by the Bedford Stuyvesant neighborhood of Brooklyn was the result of efforts to improve the image of biking and a commitment to building strong relationships with the community and among partners (Fillen-Yeh & Chaney, 2017). Perceptions of biking improved by rallying local figures to lead rides and use bikes. In addition, framing Citi Bikes as integral to meeting community needs and addressing concerns of low-income people in the neighborhood helped to normalize biking. The value of Citi Bikes was showcased through engagement efforts, such as hosting community rides to farmers markets and making Citi Bikes available to workforce development participants. Over the course of the effort, three high-profile Bed-Stuy Bikes! community events were held, along with five stakeholder events and trainings (engaging almost 200 participants in 2016) and 84 community-led group rides (involving over 445 participants in 2016). In total, programming reached over 2,500 participants in 2015 and 2016.

The importance of trust between the community and partnering lead organizations was highlighted as an important factor contributing to success in Bedford Stuyvesant. The construction of 26 new stations in Bedford Stuyvesant and expanded program area helped to demonstrate the commitment of the city to bike share in equity neighborhoods. The

community partner selected to implement the program had a long history of advocacy in Bedford Stuyvesant and was viewed with credibility. Data sharing and effective communications were used to build a foundation of trust. Collaborators used a data dashboard that allowed all partners to understand the impact of interventions of each partner organization as well as collect membership and ridership information. Data were used to develop new outreach strategies and programs.

Lastly, adequate resourcing was identified as an important factor in the Bedford Stuyvesant outcomes. Funding allowed for a full-time staff member dedicated to the expansion at Restoration and mini-grants to involve smaller community organizations. In addition, funding was used to create jobs in the form of New York City Housing Authority ambassadors and teens to support Citi Bike for Youth. These programs helped to further support for bike share and foster new generations of people motivated to promote healthy communities, and included, as an indirect benefit, the opportunity for professional development. Finally, monetary resources allowed for the compensation of actual participants in programming, based on an understanding that financial incentives can improve equitable outcomes, especially in low-income areas.

6.1.2.2 Philadelphia

Like Bedford Stuyvesant, Philadelphia developed and implemented several strategies for building a more diverse population of bike share users. While there is no rigorous evaluation of the impact of particular strategies on bike share use in equity communities, the Better Bike Share Partnership identified three key success factors based on interviews with community-based partners implementing Philadelphia's efforts: (1) cultivating relationships, (2) learning about the target community, and (3) building employment opportunities (Cox, 2017a). Community outreach is critical to building bike share programs that include representation of the equity populations. Understanding the target community enables the design and implementation of programs that will meet its needs, whether it is as simple as teaching safe bicycling practices or as complicated as creating opportunities to access financial opportunities. The City of Philadelphia (2017) reports some success with its equity efforts with the percentage of African American users more than doubling from 2015 to 2016.

6.1.2.3 Minneapolis

There was no success reported in Minneapolis after more stations were added and Nice Ride distributed free or discounted memberships in underserved communities (Kretman Stewart et al., 2013). The program then shifted focus to individuals who are likely to use Nice Ride, but have difficulty accessing bike share without support (Nice Ride Minnesota, 2015). A number of resources were invested in these individuals including an orientation ride, an introduction to the Nice Ride system, tips on how to ride in traffic, and a free helmet. At the end of each orientation, riders were given free year-long memberships and access to a computer to create a Nice Ride account.

Nice Ride Minnesota also developed an alternative approach to expanding general bicycle usage in equity communities not currently near Nice Ride stations (Martin & Haynes, 2014). In the pilot, residents were offered a free bicycle, structured learning experiences and a community of riders over a four-month period, which led to improved perceptions of bicycling and a reported increase in bicycling for transportation purposes. Residents who completed the program received $200 vouchers that they intended to redeem for bicycles, bicycle accessories, and bicycle repairs.

As a result of this work, Nice Ride Minnesota concludes that reaching underserved populations means creating supportive, educational programs that give new riders the tools they need to be successful (Nice Ride Minnesota, 2015). These tools should encourage active transportation rather than attempting to make urban bike share work in low-density areas.

7. Recommendations for Improving Baltimore Bike Share Equity

The results of the preceding analyses indicate that Baltimore Bike Share infrastructure is not equitably distributed to areas of the city, and it is not accessed by several traditionally underserved populations, including women, people of color, the unemployed, and persons represented by low levels of academic achievement. In addition, the analyses suggest that there are various barriers to both biking and Baltimore Bike Share faced by equity and non-equity groups to varying degrees. Baltimore does have some initiatives in place to lower barriers to equity communities, such as reduced membership costs ($3/month) for individuals enrolled in the state's Supplemental Nutrition Assistance Program. However, additional programmatic interventions can be strategically designed and implemented to address the unique challenges of the City. The following recommendations are put forth.

7.1 Targeted Baltimore Bike Share System Expansion

Equity should be an important determinant during the planning process and not simply used as a post-implementation metric. A GIS-based methodology is recommended to plan the expansion of Baltimore's bike share facilities using the density-based bike equity and level of traffic stress indices presented earlier. The three categories for the LTS index are as follows: low stress ($Z=0$), medium stress ($0<Z\leq1$), and high stress ($Z>1$).

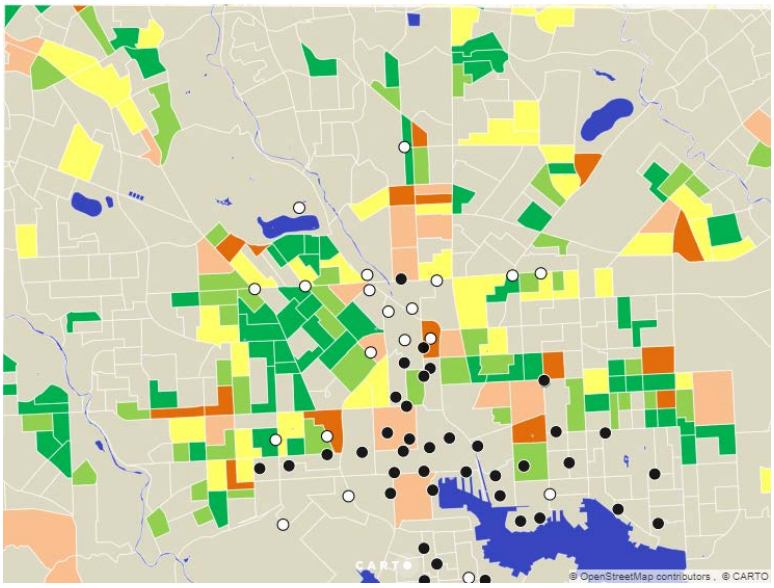
Table 10 shows the breakdown by BEI-density and LTS index; the percent of the population in each category is in bold and the percent of census block groups in italics. Block groups with high need and low stress (shown in green) are prime for bike share investment. Conversely, block groups with high need and high stress require bike infrastructure (e.g., bike lanes) or traffic calming before implementing bike share (shown in orange). Currently, 15% of the population reside in block groups with high need and low stress; see Table 10a.

Table 10 – Planning matrix: BEI-density vs LTS index

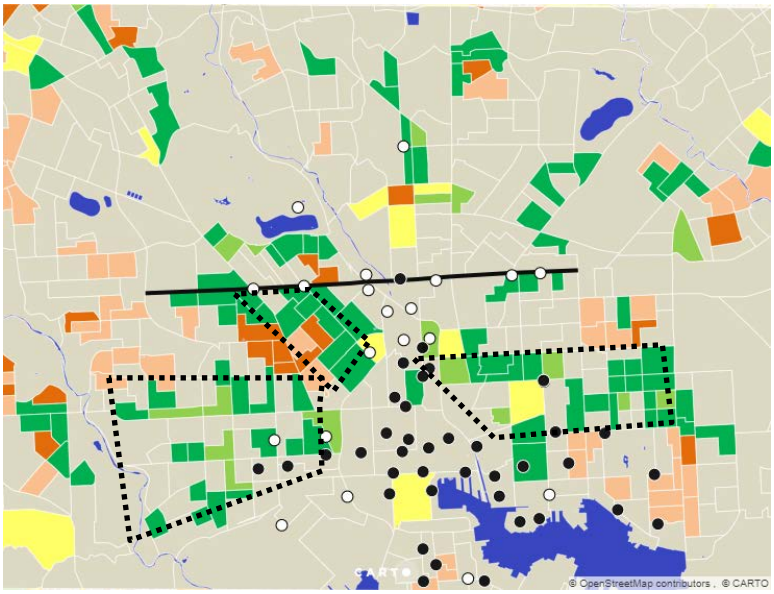
A	**LTS (current)**	***B***	**LTS (North Ave)**

		High Stress	Med Stress	Low Stress	Total			High Stress	Med Stress	Low Stress	Total
BEI-den	Low Need	7.2% *7.7%*	11.2% *10.5%*	14.2% *15.5%*	32.6% *33.7%*	BEI-den	Low Need	6.3% *7.9%*	5.6% *5.7%*	20.7% *20.1%*	32.6% *33.7%*
	Med Need	5.3% *4.6%*	7.4% *8.8%*	23.2% *24.9%*	35.9% *38.3%*		Med Need	10.2% *11.2%*	2.8% *2.6%*	22.9% *24.5%*	35.9% *38.3%*
	High Need	4.2% *3.5%*	12.4% *10.1%*	14.9% *14.4%*	31.5% *28.0%*		High Need	5.3% *4.8%*	4.9% *3.7%*	21.4% *19.5%*	31.5% *28.0%*
	Total	16.7% *15.8%*	31.0% *29.3%*	52.3% *54.9%*	100% *100%*		Total	21.8% *23.9%*	13.3% *12.0%*	64.9% *64.1%*	100% *100%*

Orange = infrastructure or traffic calming priority area, green = bike share ready area, yellow = secondary priority area



(a) Planning prioritization with current infrastructure



(b) Planning Prioritization after North Avenue Rising Project

Figure 9 – Infrastructure prioritization schematic

Table 11 – BEI and LTS index before and after infrastructure improvement

		Population	**BEI**	**LTS**
Proposed Full Build (59 stations)	With Bike Share Access	125,498	1.96	0.47
	Without Bike Share Access	280,707	2.13	0.38
	Entire Study Site	*406,205*	*2.08*	*0.40*
Full Build with North Avenue Bike Lane	With Bike Share Access	125,498	1.96	0.29
	Without Bike Share Access	289,707	2.13	0.44
	Entire Study Site	*406,205*	*2.08*	*0.39*

Several of the planned bike share stations are located along North Avenue (denoted by a black line in Figure 9b). The North Ave Rising multimodal roadway is a good example of how additional infrastructure can improve bikeability and safety within a region. The project is funded in part through the TIGER grant program and transportation improvements include dedicated bus lanes, streetscaping, dedicated bus-bike lanes, and bike share stations. Table 10b shows the LTS Index breakdown by BEI. With the addition of the bike lane along North Avenue, 21% of the population now live in high-need, low-stress zones. Though this lane did not greatly change the overall LTS index for the study site, the addition of the bike infrastructure lowers the level of traffic stress in the full design from 0.47 to 0.29 for those with bike share access under a fully built Phase 1B scenario; see Table 11.

Under this full build-out scenario, equity is slightly improved a BEI of 1.96 compared to the current BEI of 1.44. Despite this improvement, the City of Baltimore could benefit from more equitable placement of bike stations. Station installation within the high-need and low-stress zones marked by black dashed lines in Figure 9b would improve the equity for the system and should be considered for future phases. To enhance the equity of the system, the research team recommends that the City of Baltimore prioritize bike share system expansion into the neighborhoods east (Franklin Square, Lexington) and west (Washington Hill, Butcher's Hill, Highlandtown) of the downtown corridor.

7.2 Capitalize on Visibility of Baltimore Bike Share Physical Assets

The user and intercept survey results highlight the importance of docking stations and bikes in helping to inform and attract users to the system. Nearly half of intercept survey respondents (45%) and one quarter of system users (23%) first learned of Baltimore Bike Share by seeing the physical bike share infrastructure. Indeed, the most important factor cited by surveyed members for deciding to join Baltimore Bike Share was noticing a bike share station near their homes or workplaces (73%). Baltimore Bike Share stations and bikes are therefore effective marketing tools available for the City and Bewegen Technologies. Thoughtful and intentional use of these structures for advertising and instructional purposes may offer critical opportunities to attract equity communities.

To market bike share to the Hispanic equity community, for example, participants in the Spanish language focus group (see Appendix D) recommended that images of Hispanics riding bike share and instructions in Spanish would be well received. These marketing and instructional materials could be incorporated into the docking stations, which currently only provide instructions in English. The stations also could be used to target equity groups through marketing materials that advertise the electric assist bicycles. Becoming disheveled or sweaty while using Baltimore Bike Share was a barrier for women, but the electric assist bikes require less physical exertion and, therefore, can overcome this obstacle. Further, given that 40% of surveyed non-users said they prefer to use their own bikes instead of a bike share bike, a third example is to use kiosks to advertise benefits of Baltimore Bike Share in a manner that targets the population that already owns a bike. Residents who own bikes may dismiss out of hand bike share service thinking that the program does not apply to them. However, bike share can be a useful alternative to using one's own bike primarily because it allows for one-way travel options, creating flexibility in travel planning, especially when a variety of mobility options exist (e.g., public transit, ridesharing, taxis). These are just a few ways in which the highly visible bike share structures can be harnessed to promote equitable system use.

7.3 Develop and Implement a Robust Community Outreach Plan

Another key recommendation is for the City of Baltimore and Bewegen Technologies to build a strong program of citizen bike and bike share education and engagement, with particular focus on equity communities. Drawing from the results of this study and review of bike share

best practices, actions that might be particularly appropriate for Baltimore are discussed below in the form of a two-pronged equity strategy.

To begin, ambassador programs are reported to be effective when they are implemented, so the first prong is to identify a corps of individuals to work within equity communities to market, support, explain, and demonstrate the benefits of biking and utility of Baltimore Bike Share (City of Philadelphia, 2017; Fillen-Yeh & Chaney, 2017). Ambassadors could be local residents, members of partner organizations, or participants of work training or youth development programs. The New York City and Philadelphia systems should be contacted, as well as the Better Bike Share Partnership, to learn about their ambassador initiatives, find out what worked and what did not, and examine how Baltimore's unique regional characteristics might shape the design of a program (City of Philadelphia, 2015).

Ambassadors can subsequently support the implementation of the second prong of the equity strategy: event planning. Community events provide opportunities to effectively engage with local residents to convey bike education and bike share information. Organized community rides, for example, can allow non-users to trial bike share bikes and gain familiarity with the system's operation. The group aspect of community rides increases individuals' comfort and enjoyment level and helps to build a culture of cycling (Fillen-Yeh & Chaney, 2017). Indeed, 50% of users said that using a bike share bike from another system was important to their decision to join Baltimore Bike Share, thus supporting efforts that provide individuals an opportunity to test bike share bikes. The non-user analysis showed that individuals who had not ridden a bicycle in the last two years were less likely to want to cycle in Baltimore, so the community ride mitigates against this condition as well. All focus group participants, without exception, indicated they would welcome and participate in a community ride. It is important to offer helmets to participants in group-riding activities, since personal safety was identified as a major concern for non-users (nearly half of intercept survey respondents would not ride without a helmet and the overwhelming majority of focus group participants stated that helmet use would promote bike share usage).

In addition to group rides, other strategies that can be deployed by ambassadors include pop-up and planned demonstration events at or near docking stations, promotion of bike-to-school and bike-to-work days in equity communities, and bike education and skills development classes. The regression analysis found statistically significant barriers to biking and bike share for women around issues related to safety, comfort, and bike and bike share operation. Offering courses designed to address the concerns of women may help reduce these and other barriers. In addition, given that 60% of respondents to the members survey stated that they have a friend or family member who is a Baltimore Bike Share member. Creating "bring a friend" or "refer a friend" benefits in the outreach program might be useful in reducing impediments to participation.

A community outreach program could be administered directly by the City or coordinated with a local third-party organization(s) (e.g., area non-profit, community development corporation, etc.), many of which exist that are supportive of promoting bike share benefits.

Leveraging extant community resources can reduce the fiscal burden to the City and, importantly, build trust within Baltimore neighborhoods. A positive relationship between equity communities and a community partner was viewed as essential to the success of the Bedford Stuyvesant initiative, for example. Thus, any intervention by the City should be implemented through a partner organization that already retains the trust of equity communities and has the technical and human resource capacity to deliver an equity initiative.

Like all cities, financial and human resources are limited in Baltimore, so funding equity enhancement programs may require applications to grant-giving and/or philanthropic organizations. The Better Bike Share Partnership, which offers annual grants to cities aiming to implement bike share equity strategies, is one potential source of funding.

7.4 Transportation Equity Planning

A final recommendation is for the City of Baltimore to ensure that equity concerns and goals are emphasized in the City's transportation plan. While review of the transportation plan was outside the scope of this project, our examination of bike share equity best practices, as discussed above, highlighted the need for trust with equity communities to address mobility barriers. As private shared mobility services, such as dockless bikes and electric scooters, are introduced into municipal transportation systems, inclusion of equitable transportation policies is increasingly important. Transportation equity encompasses both distributive and procedural justice dimensions, which are further discussed in Section 8.3 below.

8. Future Research

8.1 Refinement and Expansion of Bike Equity Index

Other cities may adopt the BEI-density methodology and study approach and modify them according to their specifications. After developing indexes for several cities, a comprehensive BEI can be established that can serve for most of the cities across the country. The following refinements and to BEI-density may can be considered in future research:

1. New bikeshed area calculation for access based on population density, facilities, origin-destination trips, etc.
2. Consideration of the elevation of the road and land use patterns to evaluate the comfort in ridership.
3. Assigning weight to the indicators to help identify priority areas for investments.
4. Redistribution of bike stations to improve connectivity to destination locations.

This work presents a GIS-based methodology for the evaluation and planning of bike share infrastructure by taking into account equity indicators and level of traffic stress. The methodology developed can be applied to other systems and modes. A comprehensive BEI should be considered as a requirement before any substantial investments because it will help

to reduce social disparities. An equitable geographic and socio-economic distribution of bicycle infrastructure will serve all the residents and develop a comprehensive, connected network throughout the city.

8.2 Assessing Impacts/Evaluating Outcomes

There is a sizable knowledge gap around the outcomes of various interventions designed to enhance bike share equity. Very few independent assessments exist that analyze the impact of equity strategies and evaluate program effectiveness (Kretman Stewart et al., 2013). The effectiveness of equity programs for Baltimore Bike Share could be evaluated by administering another user survey after program implementation and assessing the survey results against the survey data collected for this research. An objective measure of success would be whether the user demographics become more representative of the bikeshed area after program implementation. Researchers could also take an interpretivist methodological stance to assess outcomes and conduct interviews to examine the perspectives, experiences, and expectations of Baltimore Bike Share equity communities and determine the extent to which Baltimore Bike Share's programs meet the needs of and serve these communities (Potter, 2008). Given that 34% of intercept survey non-users expressed concern about stations being located where they want to go, an origin-destination analysis for equity groups could be added to this assessment to quantitatively examine the extent to which Baltimore Bike Share meets their transportation needs.

8.3 Procedural Equity Analysis

Assessments of bike share equity, including the evaluation performed here, focus on questions of distributive equity, particularly around who accesses the system after it is implemented. This narrow definition of equity overlooks the equally important question of procedural justice in the conceptualization, design, planning, public outreach and engagement, and implementation of bike share systems. A procedural equity analysis could be conducted for Baltimore Bike Share to evaluate the early stages of the program (conceptualization, design, planning, public outreach and engagement, implementation) and ask question of fairness throughout. However, this task is complicated by the fact that an ex post facto evaluation would necessarily rely on individuals' memories and notes rather than firsthand experiences and empirical observation by the researcher(s). Therefore, it would be more straightforward and credible to conduct a procedural equity analysis during and parallel to the process under examination.

Many scholars have defined indicators for procedural equity, and a research team would need to select one or a combination that is appropriate for bike share research design (Blader & Tyler, 2003; Colquitt & Rodell, 2015; Leventhal, 1980; Tsuchiya, Miguel, Edlin, Wailoo, & Dolan, 2005; Tyler, 1988). The research team used the "down time" during the winter months of 2017–2018 to explore procedural equity criteria and research methodologies and developed a skeleton framework that could be used ex post facto to judge procedural justice in bike share system implementation. Any researcher or program evaluator interested in

receiving these materials should not hesitate to reach out to the University of Delaware–affiliated authors of this report.

9. Conclusion

Baltimore Bike Share is new by comparison to other cities' systems. In its short life, it has experienced a number of challenges, from missing bikes to staff turnover. Yet the system shows promise, and there is a clearly a demand for bike share trips in the City. Baltimore Bike Share is an integral component of the City's transportation and sustainability goals, but those ambitions must be paired with attention to the communities that benefit—or don't benefit—from public policy and infrastructure investment. Sustainable transportation is not achievable unless it delivers just outcomes and does not further marginalize the already-marginalized population.

This study employed a two-part assessment of equity in Baltimore's new bike share program. The first developed and employed a novel density-based Bike Equity Index and used GIS methods to highlight neighborhoods that are undersupplied with bicycle infrastructure. The second approach utilized survey and focus group methods to identify and evaluate the demographic groups that are underrepresented in the bike share system, and it attempted to identify unique barriers that are preventing entry and sustained usage.

Research results demonstrate strengths and weaknesses of Baltimore Bike Share, and they highlight the system's promise. The planned future docking stations and bicycle infrastructure along North Avenue is a positive development from an equity perspective because this area is a high-need community. Baltimore Bike Share will enhance the transit equity for individuals living along the corridor. On the other hand, not all of Baltimore's diverse communities are benefiting equally from bike share. People of color, Hispanics, women, low-income residents, and those with less education are disproportionately underrepresented in the system.

Equity is not an outcome that is passively achieved; it requires near-constant proactive effort and dedication to improvement. Readers of this report should be encouraged by the research that shows relatively straightforward interventions can mitigate against inequitable outcomes. At a minimum, a sustained and targeted community engagement strategy with organized group rides and give-away helmets—implemented by a trusted partner—will be effective to recruit equity communities. The critical message is that once individuals get on a bike share bicycle, experience the system, and feel safe doing so, they will be much more inclined to continue their participation. Baltimore Bike Share has value and utility for the diverse residents and visitors of the city, and equity is achievable.

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11. Appendices

11.1 Appendix A

Q1 Welcome to the Baltimore Bike Share Survey!

The City of Baltimore, in conjunction with Morgan State University and the University of Delaware, is conducting a survey of Baltimore Bike Share members. Your feedback will help us understand how we can improve Baltimore Bike Share services. This research can only be a success with the generous help of people like you. We hope you will enjoy answering our questions and we look forward to receiving your responses.

The survey should take approximately 15 to 20 minutes and you must be 18 or older to participate. You do not have to participate, and you can skip any questions you do not want to answer. Your responses will be anonymous and we will not collect personally identifiable information. If you have any questions or concerns about your involvement in this research project, please contact Philip Barnes at the University of Delaware at pbarnes@udel.edu or (302) 831-7010. This research is sponsored by the Mid-Atlantic Transportation Sustainability University Transportation Center and is approved by the Institutional Review Board at the University of Delaware.

By selecting "Yes" to the question below, you are indicating that you are at least 18 years of age and are giving your consent to participate in this research effort. Thank you for your help in improving the Baltimore Bike Share system!

Q2 Will you please take the Baltimore Bike Share survey?

- O Yes
- O No

Q3 Which of the following best reflects your current Baltimore Bike Share membership level?

- O Founding Member
- O Monthly Pass Holder
- O Go Pass Holder
- O Single-Trip User, local to Baltimore area
- O Single Trip User, visitor/tourist to Baltimore area
- O Downtown Partnership Access Pass Holder
- O Business Plan
- O Former member, but not currently a member

Q4 Why are you no longer a member of Baltimore Bike Share? (Select only one answer)

- O Baltimore Bike Share was too physically strenuous
- O Bikes were not available at docking stations when I needed them
- O Cost was too high
- O Didn't use enough
- O Bike Share stations were too far away from my home/destination
- O Prefer to use a personal bike instead of Baltimore Bike Share
- O Moved/moving out of the area
- O Dissatisfied with customer service
- O Unsafe/lack of bicycle infrastructure
- O Other (please specify) _____

Q5 How many of your family and friends have Baltimore Bike Share memberships?

- O 0 / zero
- O 1
- O 2-3
- O 4 or more
- O Not sure

Q6 When did you first join Baltimore Bike Share (mm/dd/yyyy)? (Enter best estimate.)

_____

Q7 How did you first learn about the Baltimore Bike Share system?
(Select only one answer)

- O Employer/information at work or school
- O Community center/faith-based organization/local non-profit
- O Friend/family/coworker
- O Social media (Facebook, Twitter, Instagram etc.)
- O Television/radio
- O Ad on a bus/bus shelter/train/water taxi
- O Newspaper/magazine
- O Seeing the stations/kiosks
- O Community event
- O Internet search
- O Other: _____

Q8 For each of the situations related to Baltimore Bike Share (BBS) below, please indicate its importance to your decision to become a BBS bike share member.

	Not important	Important	Does Not Apply/I did not experience this situation.
Noticed a BBS station/kiosk near your home or work	O	O	O
Rode a BBS bike that you paid to use or that someone else checked out for you or at an event	O	O	O
Had friends or family that used BBS	O	O	O
Followed BBS on social media	O	O	O
Attended a special event related to BBS	O	O	O
Found out you qualified for a discounted membership or pass	O	O	O
Talked to someone who worked for the BBS	O	O	O
Used a bike share bike from another system (not the Baltimore Bike Share)	O	O	O

Q9 What was your primary motivation(s) to join Baltimore Bike Share? (Select up to three answers.)

- ☐ Save money on transportation
- ☐ Get around more easily, faster
- ☐ Like to bike, fun way to travel
- ☐ Exercise, fitness
- ☐ Access to a pedal electric-assist bike
- ☐ Concern for the environment, carbon emissions
- ☐ Access to a bike/backup bike
- ☐ Access to another mode of transportation
- ☐ One-way travel option
- ☐ Employer benefit
- ☐ Discounted or free membership
- ☐ My friends/family encouraged me
- ☐ Other (please specify) _____

Q10 Of your selections from the previous question, please choose your most important reason for joining the Baltimore Bike Share. If you typed an answer for "Other" and it is your most important reason, please type the answer again.

- O Save money on transportation
- O Get around more easily, faster
- O Like to bike, fun way to travel
- O Exercise, fitness
- O Access to a pedal electric-assist bike
- O Concern for the environment, carbon emissions
- O Access to a bike/backup bike
- O Access to another mode of transportation
- O One-way travel option
- O Employer benefit
- O Discounted or free membership
- O My friends/family encouraged me
- O Other (please specify) _____

Q11 Did you join the Baltimore Bike Share for any of the following reasons?

	Yes	No	Not sure/Does not apply
I do not have my own bike or related gear (lock, lights).	O	O	O
I do not want to have to maintain a bike.	O	O	O
I don't have a safe place to store a personally owned bike at home.	O	O	O
There is often not a safe place to leave a personally owned bike at the places I go.	O	O	O
I need a pedal electric-assist bike to ride comfortably in my area.	O	O	O

Q12 Thinking about **the first time** you used the Baltimore Bike Share system, please rate the following statements.

	Agree	Neither agree nor disagree	Disagree	Not sure/Does not apply
Someone helped me use the Baltimore Bike Share system.	O	O	O	O
Registering for a Baltimore Bike Share membership was straight forward.	O	O	O	O
It was easy to remove and dock a bike from the station.	O	O	O	O
I did not have trouble navigating from one station to another.	O	O	O	O
The Baltimore Bike Share app was easy to use.	O	O	O	O
Overall, I was satisfied with my first experience using Baltimore Bike Share.	O	O	O	O

Q13 What is your home zip code?

_____

Q14 How far is it from your home to the nearest Baltimore Bike Share station?

O up to 4 blocks (about 1/4 mile)

O 5 to 8 blocks (about 1/2 mile)

O 9 to 12 blocks (about 3/4 mile)

O 13 to 15 blocks (about 1 mile)

O More than 1 mile

O Not sure

Q15 What is your zip code at work?

O ZIP: _____

O Not currently employed

Q16 How far is it from your work to the nearest bike share station?

- O up to 4 blocks (about 1/4 mile)
- O 5 to 8 blocks (about 1/2 mile)
- O 9 to 12 blocks (about 3/4 mile)
- O 13 to 15 blocks (about 1 mile)
- O More than 1 mile
- O I work from home
- O Not sure

Q17 For what purposes do you most often use the Baltimore Bike Share? (Select up to three answers.)

- ☐ Go to or from work or a work-related meeting/appointment
- ☐ Go to or from school
- ☐ Go to or from a personal appointment
- ☐ Visiting/hanging out with friends
- ☐ Restaurant/meal
- ☐ Entertainment
- ☐ Tourism
- ☐ Exercise, recreation
- ☐ Shopping, errands
- ☐ Other (please specify) _____

Q18 Of your selections from the previous question, please choose your primary use of the Baltimore Bike Share. If you typed an answer for "Other" and it is your primary use, please type the answer again.

- O Go to or from work or a work-related meeting/appointment
- O Go to or from school
- O Go to or from a personal appointment
- O Visiting/hanging out with friends
- O Restaurant/meal
- O Entertainment
- O Tourism
- O Exercise, recreation
- O Shopping, errands
- O Other (please specify) _____

Q19 As a result of your use of Baltimore Bike Share, do you use each of the following types of travel options less often, more often, or about the same as before you joined Baltimore Bike Share? (Select one for each row)

	Less often	About the same	More often	Not sure/Does not apply
Walk	O	O	O	O
MTA Bus	O	O	O	O
Charm City Circulator	O	O	O	O
Harbor Connector/Water Taxi	O	O	O	O
Metro Subway/Light Rail	O	O	O	O
MARC	O	O	O	O
Drive car	O	O	O	O
Taxi	O	O	O	O
Uber/Lyft	O	O	O	O
Carpool	O	O	O	O

Q20 How do you rate each of the following features of Baltimore Bike Share?

	Excellent	Good	Average	Poor	Terrible	Not Sure/Not applicable
Availability of bikes	O	O	O	O	O	O
Availability of docks	O	O	O	O	O	O
Condition of bikes	O	O	O	O	O	O
Condition of stations	O	O	O	O	O	O
Appearance of bikes	O	O	O	O	O	O
Bike Share app	O	O	O	O	O	O
Directions/Instructions at Stations	O	O	O	O	O	O
Online station map	O	O	O	O	O	O
Map at station	O	O	O	O	O	O
Ease of Docking/Releasing a bike	O	O	O	O	O	O
Pedal electric-assist bikes	O	O	O	O	O	O

Q21 How do you rate each of the following features of Baltimore Bike Share registration and customer support?

	Excellent	Good	Average	Poor	Terrible	Not Sure/Not Applicable
Online registration	O	O	O	O	O	O
Obtaining your membership pass	O	O	O	O	O	O
Pass activation	O	O	O	O	O	O
Call center wait time	O	O	O	O	O	O
Call center's ability to solve issues	O	O	O	O	O	O
Personal profile and usage statistics	O	O	O	O	O	O

Q22 Have you experienced mechanical issues with a bike share bike?

O Yes

O No

Q23 Please explain the type of mechanical issue(s) you experienced with a bike share bike.

_____

Q24 Have you experienced technical issues while utilizing the bike share app?

O Yes

O No

Q25 Please explain the type of technical issue(s) you experienced with the bike share app.

_____

Q26 Have you experienced technical or mechanical issues while utilizing a bike share kiosk?

O Yes

O No

Q27 Please explain the type of technical or mechanical issue(s) you experienced while utilizing a bike share kiosk.

_____

Q28 What change(s) to the Baltimore Bike Share program would most encourage you to use the service more often? (Select up to three answers.)

- [ ] More docks/bikes at existing stations
- [ ] More stations in the existing service area
- [ ] Expand to areas where bike share doesn't operate now (greater coverage)
- [ ] Help finding safe routes to get places
- [ ] Better bike infrastructure (e.g., bike lanes or paths) that connect to Baltimore Bike Share stations
- [ ] More pedal electric-assist bikes
- [ ] Fewer pedal electric-assist bikes
- [ ] A dockless option (being able to deposit your Baltimore Bike Share bike at any bike rack)
- [ ] Longer free use period or lower fees for keeping a bike out too long
- [ ] Combine your Charm Card or Commuter Bus Pass with your Baltimore Bike Share pass
- [ ] If more of my friends or family used the system
- [ ] Greater carrying capacity for cargo
- [ ] Ability to carry or ride with children
- [ ] None of these changes would encourage me to use the service more often
- [ ] Other (please specify) _____

Q29 Of your selections from the previous question, please choose which change is most important to you. If you typed an answer for "Other and it is your most important change, please type the answer again.

O More docks/bikes at existing stations

O More stations in the existing service area

O Expand to areas where bike share doesn't operate now (greater coverage)

O Help finding safe routes to get places

O Better bike infrastructure (e.g., bike lanes or paths) that connect to Baltimore Bike Share stations

O More pedal electric-assist bikes

O Fewer pedal electric-assist bikes

O A dockless option (being able to deposit your Baltimore Bike Share bike at any bike rack)

O Longer free use period or lower fees for keeping a bike out too long

O Combine your Charm Card or Commuter Bus Pass with your Baltimore Bike Share pass

O If more of my friends or family used the system

O Greater carrying capacity for cargo

O Ability to carry or ride with children

O None of these changes would encourage me to use the service more often

O Other (please specify) _____

Q30 Where would you like to see a new bike share station or stations constructed, if any?

_____

Q31 With which gender identity do you most identify?

O Man

O Woman

O Other (please specify) _____

Q32 What is your age in years?

_____

Q33 What is the highest level of education you've received?

O No H.S. diploma

O H.S. diploma/equivalent (GED)

O Some college, but no degree

O Associate's degree, vocational school, or certificate program

O Bachelor's degree

O Master's degree

O Professional school degree (MD, DDC, JD, etc.) or doctorate degree (PhD, EdD, etc.)

Q34 Are you currently employed, either full-time or part-time?

- O Employed full-time (35 hours or more per week)
- O Employed part-time (up to 34 hours per week)
- O Retired
- O Not currently employed

Q35 Approximately what was your total household income last year? (If you live with roommates or other persons who are unrelated to you, please report your individual income).

- O less than $10,000
- O $10,000 - $14,999
- O $15,000 - $24,999
- O $25,000 - $34,999
- O $35,000 - $49,999
- O $50,000 - $74,999
- O $75,000 - $99,999
- O $100,000 - $124,999
- O $125,000 - $149,999
- O $150,000 - $199,999
- O more than $200,000

Q36 Which category best describes your race/ethnicity? (You may select multiple options)

- O Caucasian or White
- O Black or African American
- O Asian
- O American Indian or Alaska Native
- O Middle Eastern or North African
- O Native Hawaiian or other Pacific Islander
- O Other (please specify) _____

Q37 Are you of Hispanic origin?

- O Yes
- O No

Q38 Do you have any suggestions or recommendations to improve Baltimore Bike Share?

_____

_____

11.2 Appendix B

Q3 - Which of the following best reflects your current Baltimore Bike Share membership level?

#	Answer	%	Count
1	Founding Member	44.14%	113
2	Monthly Pass Holder	8.59%	22
3	Go Pass Holder	25.00%	64
4	Single-Trip User, local to Baltimore area	13.28%	34
8	Downtown Partnership Access Pass Holder	0.00%	0
5	Business Plan	0.00%	0
6	Former member, but not currently a member	8.98%	23
	Total	100%	256

Q4 - Why are you no longer a member of Baltimore Bike Share? (Select only one answer)

#	Answer	%	Count
1	Baltimore Bike Share was too physically strenuous	0.00%	0
2	Bikes were not available at docking stations when I needed them	30.43%	7
3	Cost was too high	0.00%	0
4	Didn’t use enough	8.70%	2
5	Bike Share stations were too far away from my home/destination	8.70%	2
6	Prefer to use a personal bike instead of Baltimore Bike Share	8.70%	2
7	Moved/moving out of the area	13.04%	3
8	Dissatisfied with customer service	8.70%	2
9	Unsafe/lack of bicycle infrastructure	0.00%	0
10	Other (please specify)	21.74%	5
	Total	100%	23

Q5 - How many of your family and friends have Baltimore Bike Share memberships?

#	Answer	%	Count
1	0 / zero	27.84%	71
2	1	22.35%	57
3	2-3	25.88%	66
4	4 or more	12.94%	33
5	Not sure	10.98%	28
	Total	100%	255

Q7 - How did you first learn about the Baltimore Bike Share system?(Select only one answer)

#	Answer	%	Count
1	Employer/information at work or school	5.51%	14
2	Community center/faith-based organization/local non-profit	1.57%	4
3	Friend/family/coworker	14.96%	38
4	Social media (Facebook, Twitter, Instagram etc.)	28.35%	72
5	Television/radio	1.18%	3
6	Ad on a bus/bus shelter/train/water taxi	0.39%	1
7	Newspaper/magazine	12.60%	32
8	Seeing the stations/kiosks	21.65%	55
9	Community event	7.09%	18
10	Internet search	2.76%	7
11	Other:	3.94%	10
	Total	100%	254

Q8 - For each of the situations related to Baltimore Bike Share (BBS) below, please indicate its importance to your decision to become a BBS bike share member.

#	Question	Not important		Important		Does Not Apply/I did not experience this situation.		Total
1	Noticed a BBS station/kiosk near your home or work	7.84%	20	73.33%	187	18.82%	48	255
2	Rode a BBS bike that you paid to use or that someone else checked out for you or at an event	24.21%	61	21.83%	55	53.97%	136	252
3	Had friends or family that used BBS	32.14%	81	22.62%	57	45.24%	114	252
4	Followed BBS on social media	37.70%	95	23.41%	59	38.89%	98	252
5	Attended a special event related to BBS	28.46%	72	12.65%	32	58.89%	149	253
6	Found out you qualified for a discounted membership or pass	24.02%	61	22.44%	57	53.54%	136	254
7	Talked to someone who worked for the BBS	31.20%	78	11.20%	28	57.60%	144	250
8	Used a bike share bike from another system (not the Baltimore Bike Share)	15.35%	39	48.43%	123	36.22%	92	254

Q9 - What was your primary motivation(s) to join Baltimore Bike Share? (Select up to three answers.)

#	Answer	%	Count
1	Save money on transportation	4.52%	29
2	Get around more easily, faster	16.85%	108
3	Like to bike, fun way to travel	13.73%	88
4	Exercise, fitness	5.30%	34
5	Access to a pedal electric-assist bike	9.20%	59
6	Concern for the environment, carbon emissions	8.27%	53
7	Access to a bike/backup bike	12.48%	80
8	Access to another mode of transportation	10.76%	69
9	One-way travel option	13.88%	89
10	Employer benefit	0.00%	0
11	Discounted or free membership	1.72%	11
12	My friends/family encouraged me	1.09%	7
13	Other (please specify)	2.18%	14
	Total	100%	641

Q11 - Did you join the Baltimore Bike Share for any of the following reasons?

#	Question	Yes		No		Not sure/Does not apply		Total
1	I do not have my own bike or related gear (lock, lights).	27.05%	66	67.62%	165	5.33%	13	244
2	I do not want to have to maintain a bike.	25.82%	63	66.80%	163	7.38%	18	244
3	I don't have a safe place to store a personally owned bike at home.	21.22%	52	71.02%	174	7.76%	19	245
4	There is often not a safe place to leave a personally owned bike at the places I go.	48.16%	118	42.45%	104	9.39%	23	245
5	I need a pedal electric-assist bike to ride comfortably in my area.	22.86%	56	66.12%	162	11.02%	27	245

Q12 - Thinking about the first time you used the Baltimore Bike Share system, please rate the following statements.

#	Question	Agree		Neither agree nor disagree		Disagree		Not sure/Does not apply		Total
1	Someone helped me use the Baltimore Bike Share system.	13.52%	33	8.61%	21	63.52%	155	14.34%	35	244
2	Registering for a Baltimore Bike Share membership was straight forward.	73.66%	179	11.11%	27	10.70%	26	4.53%	11	243
3	It was easy to remove and dock a bike from the station.	59.67%	145	15.64%	38	19.75%	48	4.94%	12	243
4	I did not have trouble navigating from one station to another.	70.37%	171	13.99%	34	9.47%	23	6.17%	15	243
5	The Baltimore Bike Share app was easy to use.	46.72%	114	24.59%	60	21.31%	52	7.38%	18	244
6	Overall, I was satisfied with my first experience using Baltimore Bike Share.	64.46%	156	15.70%	38	15.29%	37	4.55%	11	242

Q14 - How far is it from your home to the nearest Baltimore Bike Share station?

#	Answer	%	Count
1	up to 4 blocks (about 1/4 mile)	53.28%	130
2	5 to 8 blocks (about 1/2 mile)	14.34%	35
3	9 to 12 blocks (about 3/4 mile)	6.15%	15
4	13 to 15 blocks (about 1 mile)	6.56%	16
5	More than 1 mile	18.44%	45
6	Not sure	1.23%	3
	Total	100%	244

Q16 - How far is it from your work to the nearest bikeshare station?

#	Answer	%	Count
1	up to 4 blocks (about 1/4 mile)	59.57%	137
2	5 to 8 blocks (about 1/2 mile)	5.65%	13
3	9 to 12 blocks (about 3/4 mile)	0.87%	2
4	13 to 15 blocks (about 1 mile)	3.04%	7
5	More than 1 mile	24.35%	56
6	I work from home	1.74%	4
7	Not sure	4.78%	11
	Total	100%	230

Q17 - For what purposes do you most often use the Baltimore Bike Share? (Select up to three answers.)

#	Answer	%	Count
1	Go to or from work or a work-related meeting/appointment	18.33%	92
2	Go to or from school	0.80%	4
3	Go to or from a personal appointment	12.55%	63
4	Visiting/hanging out with friends	13.35%	67
5	Restaurant/meal	8.76%	44
6	Entertainment	11.35%	57
7	Tourism	5.18%	26
8	Exercise, recreation	13.15%	66
9	Shopping, errands	12.55%	63
10	Other (please specify)	3.98%	20
	Total	100%	502

Q19 - As a result of your use of Baltimore Bike Share, do you use each of the following types of travel options less often, more often, or about the same as before you joined Baltimore Bike Share? (Select one for each row)

#	Question	Less often		About the same		More often		Not sure/Does not apply		Total
1	Walk	22.50%	54	54.58%	131	18.75%	45	4.17%	10	240
2	MTA Bus	21.01%	50	36.55%	87	7.14%	17	35.29%	84	238
3	Charm City Circulator	23.75%	57	48.75%	117	7.92%	19	19.58%	47	240
4	Harbor Connector/Water Taxi	13.87%	33	38.24%	91	4.20%	10	43.70%	104	238
5	Metro Subway/Light Rail	13.75%	33	44.58%	107	5.42%	13	36.25%	87	240
6	MARC	8.44%	20	48.52%	115	3.38%	8	39.66%	94	237
7	Drive car	34.73%	83	45.19%	108	5.86%	14	14.23%	34	239
8	Taxi	25.42%	60	26.69%	63	1.69%	4	46.19%	109	236
9	Uber/Lyft	30.38%	72	45.57%	108	13.50%	32	10.55%	25	237
10	Carpool	12.71%	30	30.08%	71	2.97%	7	54.24%	128	236

Q22 - Have you experienced mechanical issues with a bike share bike?

#	Answer	%	Count
1	Yes	60.83%	146
2	No	39.17%	94
	Total	100%	240

Q24 - Have you experienced technical issues while utilizing the bike share app?

#	Answer	%	Count
1	Yes	44.12%	105
2	No	55.88%	133
	Total	100%	238

Q26 - Have you experienced technical or mechanical issues while utilizing a bike share kiosk?

#	Answer	%	Count
1	Yes	43.10%	103
2	No	56.90%	136
	Total	100%	239

Q28 - What change(s) to the Baltimore Bike Share program would most encourage you to use the service more often? (Select up to three answers.)

#	Answer	%	Count
1	More docks/bikes at existing stations	11.42%	77
2	More stations in the existing service area	8.75%	59
3	Expand to areas where bikeshare doesn't operate now (greater coverage)	18.84%	127
4	Help finding safe routes to get places	3.86%	26
5	Better bike infrastructure (e.g., bike lanes or paths) that connect to Baltimore Bike Share stations	20.47%	138
6	More pedal electric-assist bikes	12.02%	81
7	Fewer pedal electric-assist bikes	0.30%	2
8	A dockless option (being able to deposit your Baltimore Bike Share bike at any bike rack)	6.38%	43
9	Longer free use period or lower fees for keeping a bike out too long	2.67%	18
10	Combine your Charm Card or Commuter Bus Pass with your Baltimore Bike Share pass	5.93%	40
11	If more of my friends or family used the system	0.74%	5
12	Greater carrying capacity for cargo	1.78%	12
13	Ability to carry or ride with children	1.93%	13
14	None of these changes would encourage me to use the service more often	0.89%	6
15	Other (please specify)	4.01%	27
	Total	100%	674

Q31 - With which gender identity do you most identify?

#	Answer	%	Count
1	Man	67.78%	162
2	Woman	30.96%	74
3	Other (please specify)	1.26%	3
	Total	100%	239

Q32 - What is your age in years?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your age in years?	24.00	73.00	37.50	10.49	109.94	236

Q33 - What is the highest level of education you've received?

#	Answer	%	Count
1	No H.S. diploma	0.00%	0
2	H.S. diploma/equivalent (GED)	0.84%	2
3	Some college, but no degree	5.44%	13
4	Associate's degree, vocational school, or certificate program	1.26%	3
5	Bachelor's degree	40.59%	97
6	Master's degree	33.89%	81
7	Professional school degree (MD, DDC, JD, etc.) or doctorate degree (PhD, EdD, etc.)	17.99%	43
	Total	100%	239

Q34 - Are you currently employed, either full-time or part-time?

#	Answer	%	Count
1	Employed full-time (35 hours or more per week)	89.58%	215
2	Employed part-time (up to 34 hours per week)	5.83%	14
3	Retired	2.50%	6
4	Not currently employed	2.08%	5
	Total	100%	240

Q35 - Approximately what was your total household income last year? (If you live with roommates or other persons who are unrelated to you, please report your individual income).

#	Answer	%	Count
1	less than $10,000	1.29%	3
2	$10,000 - $14,999	0.43%	1
3	$15,000 - $24,999	2.59%	6
4	$25,000 - $34,999	3.88%	9
5	$35,000 - $49,999	6.47%	15
6	$50,000 - $74,999	21.12%	49
7	$75,000 - $99,999	15.95%	37
8	$100,000 - $124,999	14.66%	34
9	$125,000 - $149,999	9.48%	22
10	$150,000 - $199,999	9.05%	21
11	more than $200,000	15.09%	35
	Total	100%	232

Q36 - Which category best describes your race/ethnicity? (You may select multiple options)

#	Answer	%	Count
1	Caucasian or White	90.25%	213
2	Black or African American	4.66%	11
3	Asian	2.54%	6
4	American Indian or Alaska Native	0.42%	1
5	Middle Eastern or North African	0.42%	1
6	Native Hawaiian or other Pacific Islander	0.00%	0
7	Other (please specify)	1.69%	4
	Total	100%	236

Q37 - Are you of Hispanic origin?

#	Answer	%	Count
1	Yes	3.83%	9
2	No	96.17%	226
	Total	100%	235

11.3 Appendix C

Baltimore Bike Share Non-member Intercept Survey

1. ***How did you first learn about the Baltimore Bike Share program?***

- ☐ Employer/information at work or school
- ☐ Community center/faith-based organization/local non-profit
- ☐ Friend/family/coworker
- ☐ Social media (Facebook, Twitter, Instagram etc.)
- ☐ Television/radio
- ☐ Ad on a bus/bus shelter/train/water taxi
- ☐ Newspaper, magazine or radio/TV news
- ☐ Seeing the stations/kiosks or bike on the street
- ☐ Community event
- ☐ Internet search
- ☐ Other: _____

2: When was the last time you rode a bike?

- ☐ Less than one month ago
- ☐ 1-6 months ago
- ☐ 6-12 months ago
- ☐ 1-2 years ago
- ☐ 2-5 years ago
- ☐ 5-10 years ago
- ☐ Greater than 10 years ago

Read: "When considering whether you might try the Baltimore Bike Share, for each of the following statements, please indicate whether you Agree, Disagree, or Neither Agree nor Disagree. You may also choose Not Applicable."

	Agree	Neither Agree or Disagree	Disagree	N/A
3. I have concerns about knowing how to use the Baltimore Bike Share system.	☐	☐	☐	☐
4 I am concerned that station locations are not near where I would want to go.	☐	☐	☐	☐
5. I don't want to enter my credit or debit card information on the internet in order to register.	☐	☐	☐	☐
6. I don't have a credit card or debit card to use for registration.	☐	☐	☐	☐
7. I don't have access to the internet to register.	☐	☐	☐	☐
8. I'm worried about the cost of joining or using the Baltimore Bike Share.	☐	☐	☐	☐
9. I am worried that it will be difficult to check out or return BBS bikes.	☐	☐	☐	☐
10. I would not ride a Baltimore Bike Share bike without a helmet.	☐	☐	☐	☐
11. I'm worried about being held responsible financially if anything happens to the bike.	☐	☐	☐	☐
12. I am concerned that I cannot easily carry things I need or ride with my child(ren) when using the Baltimore Bike Share.	☐	☐	☐	☐
13. I'm not comfortable enough riding a bike to use a Baltimore Bike Share bike.	☐	☐	☐	☐
14. I am embarrassed to be seen riding a Baltimore Bike Share bike.	☐	☐	☐	☐
15. I would be too concerned about the potential to be a victim of crime or harassment while riding a bike.	☐	☐	☐	☐
16. Baltimore's streets and sidewalks feel unsafe to ride on (traffic, safe routes).	☐	☐	☐	☐
17. I would be concerned about getting sweaty or getting my clothes or hair messed up while riding.	☐	☐	☐	☐
18. I prefer to use my own bike instead of a Baltimore Bike Share bike.	☐	☐	☐	☐
19 I am not interested in riding a bike in Baltimore.	☐	☐	☐	☐

20: What is the primary reason why you have not tried the Baltimore Bike Share? (Surveyor: Circle respondent's answer on the previous question. If the response is not listed, please write on line below.)

_____

21: Do you have any other comments about the Baltimore Bike Share?

_____

22: With which gender identity do you most identify?

- ☐ Female
- ☐ Male
- ☐ Other (please specify)_____
- ☐ Refusal

23: What is your age in years? (Surveyor: Enter REFUSAL, if Respondent chooses not to answer.) _____

24: What is the current status of your employment situation?

- ☐ Employed full-time
- ☐ Employed part-time
- ☐ Retired
- ☐ Not currently employed
- ☐ Refusal

25: What is the highest level of education you've received?

- ☐ No H.S. diploma
- ☐ H.S. diploma/equivalent (GED)
- ☐ Some college, but no degree
- ☐ Associate degree, vocational school, or certificate program
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional/Doctoral degree (MD, JD, PhD, etc.)
- ☐ Refusal

26: Approximately what was your total household income last year? (If you live with roommates or other persons who are unrelated to you, please report your individual income).

- ☐ less than $10,000
- ☐ $10,000 - $14,999
- ☐ $15,000 - $24,999
- ☐ $25,000 - $34,999
- ☐ $35,000 - $49,999
- ☐ $50,000 - $74,999
- ☐ $75,000 - $99,999
- ☐ $100,000 - $124,999
- ☐ $125,000 - $149,999
- ☐ $150,000 - $199,999
- ☐ more than $200,000
- ☐ Refusal

27: Which category best describes your race/ethnicity? (You may select multiple options)

- ☐ Caucasian or White
- ☐ Black or African American
- ☐ Asian
- ☐ American Indian or Alaska Native
- ☐ Middle Eastern or North African
- ☐ Native Hawaiian or other Pacific Islander
- ☐ Other (please specify) _____
- ☐ Refusal

28: Are you of Hispanic origin?

- ☐ Yes
- ☐ No
- ☐ Refusal

11.4 Appendix D

Focus Group Summary Report: Baltimore Bike Share Equity Project

Charles T. Brown, MPA and Kaelin Conover

Introduction

The summary below highlights findings from two focus groups with Baltimore City residents as part of the Baltimore Bike Share Equity project with Morgan State University and the University of Delaware. The primary purpose of the focus groups was to understand factors preventing the use of Baltimore's Bike Share System, as well as the types of strategies and incentives that might improve individual and overall use and awareness of the system for transportation and recreational purposes. This report includes the following sections. Section I, this section, is the Introduction. Section II includes an overview of the focus groups as well as demographics of all focus group participants. Sections III and IV provide an overview of the morning and afternoon focus groups by highlighting key demographic characteristics and participants' responses to questions on household composition and responsibilities, travel modes, neighborhood perceptions, bicycling perceptions and experiences, bicycle theft, and awareness of and recommendations to improve their use of the Baltimore City Bike Share System. Section V is a discussion of the key findings and Section VI includes a number of policy and program considerations to improve access and use of the bike share system.

Overview of Focus Groups

The focus groups were held on Friday from 9:00 am to 11:00 am and 5:30 pm to 7:30 pm on November 17, 2017, at the office of the Southeast Community Development Corporation (SCDC).[8] Morgan State University, University of Delaware, and SCDC served as the official hosts for both focus groups, and led the recruitment and identification of focus group participants. In order to participate in the focus groups, each participant had to be 1) a resident of the city of Baltimore, 2) age 18 years or older, and 3) must not have used the Baltimore Bike Share System prior to participating in the focus groups. There were twenty-three (23) identical questions asked in each focus group; topics ranged from neighborhood perception to bicycling knowledge and experience to bicycle usage and attitudes to overall perceptions and awareness of the city's bike share system. All focus group participants received food, drinks, and a $25 VISA gift card. The morning focus group was conducted in Spanish and the evening focus group in English. The latter was also marketed as a "Happy Hour Focus Group" to attract participants to the Friday night focus group (*See Figure 1.*) The focus groups were facilitated by Charles T. Brown, MPA and Kaelin Conover, both of Equitable Cities, LLC.

[8] http://www.southeastcdc.org/who-we-are/mission/

Figure 10: Flyer used to attract focus group participants to the evening focus group, Baltimore, MD, 2017

Demographics of All Focus Group Participants

A total of twenty-one residents participated in the two focus groups. Of the twenty-one residents, twelve (12) participated in the morning focus group and nine (9) participated in the evening focus group. As shown in Figure 1, there was a predominance of female over male participants in the focus groups (81% versus 19%, respectively). The majority of participants identified as single (52%) and Hispanic/Latino (57%), with one in three participants (33%) between the ages of 35 to 44 years old. While a visible minority had obtained a four-year college degree or higher (19%), the overwhelming majority were less than high school or high school graduates (77% combined). The majority of participants (52%) also reported a median household income of less than $25,000, significantly lower than Baltimore's median household income of $42,241.[9] See Table 1.

Table 12: Demographics of all focus group participants, Baltimore, MD, 2017

Variable	***Category***	***Number of Participants***	***Percentage***
Age	18-25	3	14%
	25-34	3	14%
	35-44	7	33%

[9] https://www.census.gov/quickfacts/fact/table/baltimorecitymaryland,US/PST045216

	45-54	4	19%
	55 or older	4	19%
Gender	Male	4	19%
	Female	17	81%
Race/Ethnicity	Black	5	24%
	White	3	14%
	Hispanic/Latino	12	57%
	Mixed Race	1	5%
Education Level	Less than high school	10	48%
	High school graduate	6	29%
	Some college	1	5%
	Two-year college degree	0	0%
	Four-year college degree	1	5%
	Graduate degree	3	14%
Household Income	Less than $25,000	11	52%
	$25,000 - $49,999	7	33%
	$50,000-$74,999	2	10%
	$75,000-$99,999	1	5%
Marital Status	Single	11	52%
	Married	6	29%
	Living with partner	4	19%

Focus Group #1 – Spanish Speaking Only

This section of the report highlights findings from the first focus group, held from 9:00am to 11:00am on November 17, 2017 at the office of SCDC. The Hispanic/Latino only focus group had twelve (12) participants, all women, and was facilitated in Spanish and later translated and transcribed into English by Kaelin Conover of Equitable Cities, LLC. Andy Dahl of SCDC provided occasional translation support during the focus group.

Demographics of Focus Group #1 Participants

All twelve (12) of the participants in the first focus group identified as women of Hispanic and Latino origin. Men were also recruited and expected to attend; however, it is inferred that the timing of the focus group negatively impacted their availability. Of those in attendance, 50 percent identified as married and one-third (33%) reported living with a partner. An overwhelming majority of participants reported not earning a high school diploma (67%), with the remaining participants either high school or college graduates (25% and 8%, respectively). All of the participants reported a median household income of under $50,000, with the majority (67%) reporting a median household income of less than $25,000—significantly lower than Baltimore's median household income for 2015 *(See Table 2.).*

Household Composition, Responsibilities, Travel Mode, and Neighborhood Perceptions

Household Composition, Responsibilities, and Travel Mode

The participants were asked to explain their household composition, daily responsibilities inside and outside their homes, and their primary mode of transportation. All of the women reported having at least two children and living with their partners. The majority of their daily responsibilities include taking care of the home and their children. The majority of the participants stated that they rely heavily on public transportation and walking for their daily commute and activities. Of the women who rely on public transportation, a few said that bus stations were in close proximity to their homes, while others stated they have to walk a couple of blocks to the bus stop. Three of the women reported the use an automobile as their primary mode of transportation. Coincidentally, these same three women were also the only participants to have jobs outside the home (i.e., part-time jobs babysitting).

Neighborhood Perceptions

When asked to describe their overall perceptions of their neighborhoods in regards to safety, cleanliness, and built environment characteristics, most of the participants described their neighborhoods as safe. However, most of the participants highlighted the lack of cleanliness as an issue and placed a strong emphasis of the number of dirty streets "with lots of trash" in their neighborhoods. One of the participants explained how every Saturday, her neighbors clean their street in order to maintain cleanliness and overall attractiveness. One of the participants, who lives by a park, stated that there are a lot of bike lanes but also a lot of accidents. She perceived the combination of the car and bike lanes as negatively impacting the width of the street (i.e., narrowing the roadway) and therefore causes motorists to get confused and hit cyclists. She suggested, "The city widen roadway lanes in order to prevent such accidents."

Table 13: Demographics of focus group #1 participants, Baltimore, MD, 2017

Variable	***Category***	***Number***	***Percentage***
Age	18 years or older	0	0%
	25-34	3	25%
	35-44	6	50%
	45-54	3	25%
	55 or older	0	0%
Gender	Male	0	0%
	Female	12	100%
Race/Ethnicity	Hispanic/Latino	12	100%
Education Level	Less than high school	8	67%
	High school graduate	3	25%
	Some college	0	0%
	Two-year college degree	0	0%
	Four-year college degree	0	0%
	Graduate degree	1	8%
Household Income	Less than $25,000	8	67%
	$25,000 - $50,000	4	33%
	$50,000-$100,000	0	0%
Marital Status	Single	2	17%
	Married	6	50%
	Living with partner	4	33%

Bicycle Perceptions and Experiences

Participants were asked to state what word(s) come to mind when they hear the terms bicycle and bicycling. Their collective responses included words such as exercise, fun, stress reliever, mode of transportation, and "for sporting activities." Participants also shared their views and perceptions regarding cyclists in the city. They viewed many of those who ride bicycles in the city and in parks as either "American families or young adults commuting to work as medical professionals in the John Hopkins area or in places such as restaurants in Downtown Baltimore."

Bicycle Ability and Ownership

Only five of the twelve participants stated that they knew how to ride a bike. Three of the remaining seven participants shared stories of how they once attempted to learn to ride but after falling off of the bicycle, they were deterred from wanting to ride a bicycle again in fear of

falling and getting hurt. While the majority of the women stated that their children have bicycles, only two of the participants reported currently owning a bicycle. One participant stated, “I am afraid to buy a bike because of how many bikes get stolen either in my neighborhood.”

Bicycle Use

When asked about recent bicycle use, only three of the twelve participants reported having ridden a bike in the past year. One participant mentioned riding to the supermarket and two others stated that they ride for exercise. Although all the participants believe that a bike is less expensive than owning a car, neither had any clue as to the true cost of purchase and maintenance of a bicycle. All of the participants are in favor of their children riding bicycles; however, as expected, the safety of their children remains their top concern.

Perceptions Regarding Who Bicycles

Participants were asked whether they thought riding a bicycle to and from work paints a negative picture about one’s socio-economic status. None of the participants thought that biking for this purpose reflected negatively on one’s economic status. In fact, one participant stated, “bicycling to works does not mean an individual is poor; it may just simply mean that it is an easier form of transportation [for that individual.]” Other participants agreed, pointing out that individuals who choose to ride a bicycle to and from work may just be more environmentally and economically conscious, as “a bike is a lot less expensive than a car.” Another participant stated, “Given the fact that many of the women in the group do not have cars, bicycling would be a more practical mode of transportation if it were safer and if they lived closer to their jobs.” In comparing cycling in the United States to her former home in Mexico, one participant stated, “People have more respect for cyclists in the U.S. than in Mexico and the streets in Mexico are crowded and dangerous, with many people getting hurt or killed due to traffic accidents.”

Victims of Bicycle Theft

Participants were asked to raise their hands if they had been victims of bicycle theft. Seven of the twelve participants raised their hands and confirmed that they had been victims of bicycle theft. Participants were then asked if they had purchased a new bicycle after their first one was stolen, and only one participant reported doing so. That participant however purchased the new bicycle for her son instead of herself. Although the majority of the participants stated they had their bicycles stolen in the past, none mentioned calling the police at the time of the incident. Participants’ reasons varied for not contacting the police during the time of the incident. One of the participants explained how her bicycle was stolen from her yard with no way of identifying who took the bike. Another participant agreed and added that no one calls the police due to the lack of evidence left behind by bicycle thieves. One participant also pointed out that there are usually no designated areas to park bicycles outside of stores and how this discourages many people from cycling to run simple errands. She summed it up by stating, “There should be an area to park and/or lock bicycles outside a store.”

Comfortable Places to Ride Bicycles

Participants were asked questions regarding where they felt most comfortable bicycling. With a heavy emphasis placed on street safety, all of the participants agreed that weather and traffic conditions heavily influence whether, when, and where they and their children choose to ride their bicycles. The majority of the women stated that they would not feel safe bicycling in the street—even with the increasing number of bike lanes—due to the lack of respect shown for cyclists. One participant alluded to perceived differences between racial/ethnic groups and areas of the city regarding cycling. She stated, "When I drive my daughter to school, the American kids are more prepared with safety equipment such as helmets and knowledge of hand signals, which gives them more respect in the road and ultimately protects them more while riding. Within the area surrounding The John Hopkins Hospital, there are more professionals comfortable with bike riding which is why there are more cyclists in that area."

Participants mentioned not seeing this behavior reflected in their respective neighborhoods, thus creating an increasing amount of concern when biking there, especially when it involves their children. The perceived lack of adequate bicycle infrastructure, coupled with their increasing concern for their children when bicycling in their neighborhoods, also fed into their concern for their children crossing the streets as pedestrians. One participant stated, "Pedestrians do not always look both ways when crossing the road, which puts many lives at risk. Both pedestrians and motorists need to be more aware, especially the young and motorists. This is why as one participant stated, "We feel most comfortable cycling in the park, with and without our children."

Baltimore Bike Share System Awareness, Perceptions, and Recommendations

Baltimore Bike Share System Awareness and Perceptions

Participants were asked questions regarding their knowledge, awareness, opinions, and perceptions of the Baltimore Bike Share System, as well as which improvements would make them more likely to use the system. When it came to their knowledge and awareness of the existence of the system, only four of the twelve participants had basic knowledge regarding the system's existence. However, after the participants received an overview of the system by the focus group facilitators, all of the participants stated that they would be willing to utilize the system with more knowledge of how to access the stations. Participants stated that they would use the system for a healthier lifestyle, to be economically and environmentally friendly, and to be able to get around faster than walking.

Focus Group #1 Participant Recommendations

Participants offered a number of suggestions and recommendations that would improve their use of the Baltimore Bike Share System. Their recommendations included the following:

Install more bike share stations in our communities.

Provide instructions on how to use the bike share system in Spanish (e.g., “many Hispanics work close to their homes and would ride the bikes, but there are no instructions for them to understand how to use it.”).
Offer easier ways to pay with cash rather than a credit card (“many Latinos do not have credit cards for personal reasons.”).

Make it convenient for women with children to use the system. One participant jokingly added, “If it had a seat for my baby, I would use it”. Although presented as a joke, many of the participants agreed—considering the majority of them are mothers and the primary caretakers of their respective families.

Promote and advertise the program on social media, city buses, local news, flyers in schools, and in other places where people walk most often.

Advertise images of other Hispanics/Latino families using the Bike Share system as well as images of other minorities.

Sell bike share passes at supermarkets, at bike stations, and online. Participants unanimously favored $2 per hour rather than $2 for a 45-minute ride and $15 per month for unlimited rides.

Organize community bicycle rides and educate people on how they can easily gain access to the stations to get them where they need to go

Communicate with the public regarding the location and number of bike share robberies on platforms such as the Facebook group “Veins de Paterson Park” or “Neighbors of Paterson Park.” Participants were concerned however that the latter could negatively affect the amount of nearby available stations.

Strategies to Increase Use of Baltimore City Bike Share System

Participants were asked to respond to a list of eighteen (18) predetermined strategies that would make it more likely for them to use the Baltimore City Bike Share System. As shown in Table 3, the options ranged from discounted membership to organized rides for “people like me” to more fully manual bicycles and better outreach/marketing/advertising of the system. Participants unanimously agreed on 15 of the 18 strategies. While two strategies—more short-term membership or pass options and easier ways to pay with cash—didn’t receive unanimous agreement upon the participants, they were favored by 83% of the participants. Conversely, the strategy to increase the number of available pedal assist bicycles (E-Bikes) received no support.

Table 14: Predetermined list of 18 strategies to improve access and use of the Baltimore City Bike Share System, Baltimore, MD, 2017

Strategies:	Hispanic-Only Focus Group

a.	Discounted membership or use options	100%
b.	More short-term membership or pass options	83%
c.	Easier way to pay with cash	83%
d.	Option to sign up or buy passes at a store instead of online	100%
e.	Access to free or low-cost helmets and other gear	100%
f.	Organized rides for people like me (e.g. community organized rides)	100%
g.	If more of my friends or family could use the system with me	100%
h.	If the users of the system were more diverse	100%
i.	Help finding safe ways to get where I need to go	100%
j.	Free transfers between public transportation and the bike share stations	100%
k.	More bike share stations closer together	100%
l.	More Bike share stations where I want to go	100%
m.	More bike share stations closer to where I live	100%
n.	More bike lanes/bicycle infrastructure	100%
o.	Checkout time longer than 45 minutes	100%
p.	More Pedal Assist (e-Bikes) bicycles	0%
q.	More fully manual bicycles	100%
r.	Better outreach/marketing/advertising	100%

Focus Group #2 – English-Speaking Only

This section of the report highlights findings from the second focus group, held from 5:30 pm to 7:30 pm on November 17, 2017, at the office of SCDC. The English-only focus group had nine (9) participants and was facilitated by Charles T. Brown of Equitable Cities, LLC.

Demographics of Focus Group #2 Participants

The second focus group was very diverse in terms of age, gender, race/ethnicity, educational attainment, and household income. The majority of the participants were age 55 years or older, with one in three (33%) participants age 18-24 years old. Majority of the participants were female and a member of a racial/ethnic minority group. One in three participants (33%) identified as White. The educational attainment of the participants varied with the majority being less than or high school graduates (55% combined) and 33% college graduates. While 66% of participants reported a median household income of less than $50,000, one-third of the participants reported a median household income of $50,000 or higher. See Table 4.

Household Composition, Responsibilities, Travel Mode, and Neighborhood Perceptions

Household Composition, Responsibilities, and Travel Mode

Participants were asked to explain their household composition, daily responsibilities inside and outside their homes, and their primary mode of transportation. While all of the participants identified as single, in terms of marital status, only three of the participants (all female) reported living alone. Other participants reported living in households with as many as three

people sharing the home. The daily responsibilities of the male and female participants were similar. Both are the primary housekeepers, care for other family members/siblings inside the home, and use an automobile for most errands. Three of the participants rely on public transportation and one of the male participants, who is retired and disabled, relies on mobility assistance.

Neighborhood Perceptions

When asked to describe their overall perceptions of their neighborhoods in regard to safety, cleanliness, and built environment characteristics. For the most part, participants described their neighborhoods as being racially and ethnically diverse with adequate access to parks, public transportation, narrow streets, and neighbors who care about the condition of the community. In the same sentences, however, participants voiced concerned over the lack of cleanliness, traffic, occasional shootings, "corner boys", property crimes, and violent crimes against bus passengers, and other people living within the neighborhood. One female participant summed it by stating, "I just don't venture out at night."

Bicycle Perceptions and Experiences

Participants were asked to state what word(s) come to mind when they hear the terms bicycle and bicycling. The most repeated words mentioned by participants included: fun, exercise, joy, freedom of movement, and the ability to move quickly from one destination to the next. One male participant, who had had both of his legs amputated, stated that he missed "the childhood feeling of wind blowing in his face while riding a bicycle. While expressing words such as exercise, fun, sustainability, and cost savings come to mind, one female participant stated that other words such as feeling unsafe and possible accidents also come to mind." Another female participant agreed and shared that when she hears these terms they remind her of the "controversy over bicycle lanes being placed in certain parts of the city."

Table 15: Demographics of focus group #2 participants, Baltimore, MD, 2017

Variable	**Category**	**Number**	**Percentage**
Age	18 years or older	3	33%
	25-34	0	0%
	35-44	1	11%
	45-54	1	11%
	55 or older	4	44%
Gender	Male	4	44%
	Female	5	56%
Race/Ethnicity	Black	5	56%
	White	3	33%
	Hispanic/Latino	0	0%
	Mixed Race	1	11%

Education Level	Less than high school	2	22%
	High school graduate	3	33%
	Some college	1	11%
	Two-year college degree	0	0%
	Four-year college degree	1	11%
	Graduate degree	2	22%
Household Income	Less than $25,000	3	33%
	$25,000 - $49,999	3	33%
	$50,000-$74,999	2	22%
	$75,000-$99,999	1	11%
Marital Status	Single	9	100%
	Married	0	0%
	Living with partner	0	0%

Neighborhood Perceptions

Seven of the nine participants reported knowing how to ride a bicycle, and of the two participants that reported not knowing how to ride, both stated that they would be interested in learning. One of the two participants that reported not knowing how to ride a bicycle is the male participant that had his legs amputated. Prior to having his legs amputated he stated that he knew how to ride a bicycle. However, given his current condition, he stated he would need a new "special bicycle" and someone to teach him how to ride it. "If those things could happen, I'll be okay with riding a bicycle," the male participated stated.

Bicycle Use and Ownership

Participants were asked about bicycle ownership and recent bicycle use. Six of the nine participants stated that they own a bicycle but only four had bicycles that were fully operable. Of those with fully operable bicycles, only three of the participants had used the bicycle in the past year. Their reasons for using the bicycles included convenience and the desire to have fun, move fast, exercise, and "feel the adrenaline."

Perceptions Regarding Who Bicycles

Participants were asked about their family, friends and co-workers' views towards bicycling, as well as whether they thought biking for transportation purposes reflected negatively on one's socio-economic status. Participants were also asked if they felt a bicycle was too expensive to purchase and maintain. In regard to the views of family members, the majority of participants stated that family is and would be supported of them bicycling for transportation purposes. One young male participant stated that his family enjoys seeing him "pop a wheelie" on this bicycle. Another female participant stated that not only are her family members supportive of

her riding her bicycle “but many would also like to ride their bicycles if they knew how.” Conversely, one female participant added that her family members would be concerned about her safety “due to how unsafe it is to bicycle in the city.”

While participants’ responses to family members’ views on bicycling were consistent, their responses varied when asked about friends, coworkers, and their own perceptions regarding bicycling for transportation purposes and its perceived impact on one’s socio-economic status. One female participant, an elementary school teacher, stated that her friends and coworkers would “think I’m crazy if I bicycled to work given the distance from my home to my job and the amount of stuff I have to carry with me each day.” Another male participant added that his coworkers would think he’s “the coolest co-worker ever and would be impressed.” While another participant added that their friends and coworkers would say, “It looks like fun.”

Participants, for the most part, did not think that bicycling for transportation painted a negative picture of one’s socio-economic status. Instead, they mentioned that they would view that individual as someone who is concerned and wants to protect the environment. One female participant did add however if one is to be judged for bicycling for transportation reasons, assumptions would be made based on “the type of bicycle (whether its inexpensive or expensive) and the type of clothing the individual is wearing (i.e., office attire versus exercise gear). Only one participant, a female, felt that a bicycle is too expensive to purchase and no participant thought it was difficult to maintain the bicycle after purchasing it.

Victims of Bicycle Theft

Participants were asked to raise their hands if they had been victims of bicycle theft. Five of the nine participants raised their hands and confirmed that they had been victims of bicycle theft. One in three reported having their bicycle stolen more than once and another one-third reported having their bicycle stolen three times or more. Participants were then asked if they had purchased a new bicycle after their first one was stolen. Of the three participants that had their bicycles stolen, each reported getting a new bicycle but not immediately after it was stolen due to anger and a lack of resources. One male participant stated that his bicycle was stolen while he was attending an event at the baseball stadium. “I reported it to the police but never got a response,” he stated. “I was pissed. It took me a couple of months to get a new bicycle.” A female participant who was also a victim of bicycle theft stated that she had three bicycles stolen from her in less than a year. “When I reported it to the police, they asked if it had been locked.” While she was initially displeased and frustrated with the response she received from the police officers, she mentioned that they later followed up to see if a bicycle they had recovered belonged to her. “I was impressed,” she added. The youngest participant in the group, a young male who likes to “pop wheelies” on his bicycle in the streets of Baltimore, stated that he has had his bicycles stolen more than five times. However, it did not discourage him and nor did he report it to the police. “Because people around here know how much I love bicycling and popping wheelies, people just offer me used bicycles. I have so many bicycles at my house at any given time.”

Comfortable Places to Bicycle

Participants were asked if there are certain places throughout the cities that they feel comfortable bicycling. Participants overwhelming agreed that the most comfortable place to bicycle are local parks, followed by trails, boardwalks, and on sidewalks. One participant, a female, stated that the only place she feels comfortable bicycling is in "other cities and counties." Two of the male participants stated that they feel comfortable bicycling "almost everywhere in the city."

Participants were asked whether they worry about their or their children's safety while riding a bicycle in the city. Five of the nine participants stated that they are concerned about their safety while bicycling in the city. Their concerns varied according to the time of day, however. During the day, participants expressed concerns about pavement condition, rush hour traffic, roadway construction, disinvestments, bad/aggressive/disrespectful drivers, drunk drivers, and having to bicycle in lanes next to ongoing traffic. One female participant stated, "They would rather hit you than hit a pothole." When it came to bicycling at night, participants were concerned with drug dealers, harassment, assault, and robbery. One female participant stated, "I don't go out without my dogs or friends at night."

Baltimore Bike Share Awareness, Perceptions, and Recommendations

Baltimore Bike Share Awareness System and Perceptions

Participants were asked questions regarding their knowledge, awareness, opinions, and perceptions of the Baltimore Bike Share System, as well as which improvements would make them more likely to use the system. All nine of the participants were aware of the system's existence but their overall knowledge of the system was limited. Participants expressed a number of concerns with the system such as bicycles getting stolen, there not being enough stations available, and there never being bicycles available for use. One female participated stated, "I love the idea of it but the reality of it is that bikes are never available." After hearing more about the system from focus group facilitators, another female participant added, "I love the idea of the electric bikes. Those seem cool." Other participants agreed.

Focus Group #2 Participant Recommendations

When asked to share for what reasons they would use the system, participants stated that they would use the system to go to bars, go on dates, enjoy time with family, and to leverage the convenience of bicycling over driving. When asked in which ways should the system be advertised, and which locations in the city should bike share membership should be sold, participants offered the following suggestions and recommendations:

Link and coordinate the bike share system with bus service and at major bus stops.

Place more stations around the city.

Educate students and parents during open house events at local schools.

Develop “happy bike share commercials” like the MTA commercials. One female participant liked the idea of a commercial but felt it would not be long enough to educate everyone on the system.

Table during community and citywide festivals.

Make more bicycles available.

Advertise at bus shelter locations but use smiling and happy people in the advertisement. Conduct outreach to the general public but include safety lessons.

Lead with education and not “sales.”

Offer the ability to purchase bike share memberships at supermarkets, East Point Mall, transit stations, streets fairs and festivals, community centers, hospitals (for seniors), truck stops, and churches.

Offer senior discounts.

Most are willing to pay $3 for a 45-minute bicycle ride and $20 per month for unlimited 45-minute bike rides, with a few willing to pay $30 per month.

Strategies to Increase Use of Baltimore City Bike Share System

Participants in the evening focus group were asked to respond to the same list of eighteen (18) predetermined strategies as the morning focus group. The strategies considered what would make it more likely for them to use the Baltimore City Bike Share System. As shown in Table 5, the options ranged from discounted membership to organized rides for “people like me” to more fully manual bicycles and better outreach/marketing/advertising of the system. Of the 18 strategies listed, participants unanimously agreed on one strategy that would make it more likely for them to use the system (i.e., organized rides for people like me). The other top five strategies receiving the highest votes were: help finding safe ways to get where I need to go, more bike share stations where I want to go, more bike lanes/bicycle infrastructure, checkout time longer than 45 minutes, and more pedal assist bicycles (E-Bikes). Those receiving the least support from the participants included: the option to sign up or buy passes at a store instead of online, easier ways to pay with cash, more bike share stations closer to where I live, if the users of the system were more diverse, and more fully manual bicycles. Interestingly, the latter two received no support from the participants.

Table 16: Strategies to increase use and access of the Baltimore City Bike Share System, Baltimore, MD, 2017

Strategies:	Focus Group #2
a. Discounted membership or use options	78%
b. More short-term membership or pass options	67%

c. Easier way to pay with cash	33%
d. Option to sign up or buy passes at a store instead of online	56%
e. Access to free or low-cost helmets and other gear	78%
f. Organized rides for people like me (e.g. community organized rides)	100%
g. If more of my friends or family could use the system with me	78%
h. If the users of the system were more diverse	0%
i. Help finding safe ways to get where I need to go	89%
j. Free transfers between public transportation and the bike share stations	67%
k. More bike share stations closer together	78%
l. More Bike share stations where I want to go	89%
m. More bike share stations closer to where I live	11%
n. More bike lanes/bicycle infrastructure	89%
o. Checkout time longer than 45 minutes	89%
p. More Pedal Assist (e-Bikes) bicycles	89%
q. More fully manual bicycles	0%
r. Better outreach/marketing/advertising	67%

Discussion – Key Similarities and Differences between Focus Groups

There are a number of key similarities and differences between the morning, all Hispanic/Latino focus group and the evening, diverse focus group. The key differences included neighborhood perceptions, bicycle ability and use, co-workers' perceptions of cyclists, and their knowledge and awareness of the Baltimore Bike Share System. For example, participants in the evening focus group voiced greater concerns over personal safety issues (e.g., robberies, harassment, assaults), were more likely to own and have used their bicycle, and were more knowledgeable and aware of the Baltimore Bike Share System than their counterparts in the morning focus group. Key similarities among the focus group participants included perceptions regarding the overall lack of neighborhood cleanliness, views towards individuals cycling for transportation purposes, how often participants had been victims of bicycle theft, places participants were most comfortable bicycling, and the lack of bicycle-related infrastructure in participants' communities. Both focus group participants voiced their concern with safety while bicycling and stated that bicycling provided them with fun, joy, freedom, and the ability to exercise and be active.

Participants in the Hispanic/Latino focus group viewed the 18 strategies more favorably than the diverse focus group. For instance, the Hispanic/Latino focus group voted unanimously on 15 of the 18 strategies that would increase bicycle use, whereas the diverse focus group voted unanimously on only one of the strategies. Similarly, whereas four strategies (i.e., easier way to pay with cash; if the users of the system were more diverse; more bike share stations closer to where I live; and more fully manual bicycles) received less than 50% approval from the diverse focus group, only one strategies (i.e., more pedal assist bicycles/E-bikes) received the same

mark from the Hispanic/Latino focus group. The only strategy that received unanimous support from both groups is the desire to have more organized/community rides for people like themselves.

Policy and Program Recommendations

The policy and program recommendations listed below are gleaned from discussions with and recommendations provided by participants in both focus groups. The recommendations consider the importance and impact of three P's (i.e., people, place and power) in the context of increasing access and use of the Baltimore Bike Share System.

Bicycle Education and Trainings. Provide adult bicycle education and training in English and Spanish, with a strong emphasis on bicycle laws, techniques, helmet use, and ways to properly lock your bicycles.

Bicycle Storage/Docking Location. Install and position docking stations or other safe places to park and store bicycles outside of stores, bus stops, and other locations where cyclists frequent.

Build Trust. Develop ways to build trust among police officers and minority populations, particularly Black and Hispanic/Latino populations

Share the Road. Encourage "share the road" policies/legislation to promote decency and respect among all modes of transportation.

Infrastructure Investments. Encourage bicycle-related infrastructure investments in low-income and minority communities.

Bike Share and Transit Connections. Improve and provide better connections between bike share and transit. Position bike share stations within a minimum of a quarter of a mile of transit stops.

Complete Streets. Educate the public on the importance of complete streets and the narrowing of streets to improve the safety of all motorists.

Marketing and Advertisement. Increase the number of minorities and minority families in bike share marketing and advertisements. Market the bike share system in both English and Spanish.

Enforcement Priorities. Encourage the police department to respond to bicycle theft incidents in a timely fashion.

Bike Share ADA. Encourage the bike share provider to include bicycles for persons with disabilities (e.g., recumbent bicycles).

Bike Share for Families. Encourage the bike share provider to include bicycles for persons with children.

11.5 Appendix E

Equity Group **(independent variable) – SIGNIFICANT BARRIER (dependent variable)**	**Coefficient (standard error)**	**t statistic**
Non-white		
CARGO	0.21 (0.095)	2.23*
OWNBIKE	-0.234 (0.094)	-2.49*
Hispanic		
NOCARDREGISTER	-0.062 (0.025)	-2.50*
NOACCESS	-0.052 (0.023)	-2.27*
BIKESECURE	0.450 (0.199)	2.26*
RESPONSIBLE	0.421 (0.162)	2.60*
Less educated		
No significant findings		
Female		
USE	0.210 (0.078)	2.67**
COMFORT	0.215 (0.065)	3.30**

EMBARRASS	0.145 (0.048)	3.03**
VICTIM	0.267 (0.075)	3.56**
HYGIENE	0.212 (0.073)	2.93**
NOTINTERESTED	0.232 (0.070)	3.31**
Low-income earners		
No significant findings		
Unemployed		
NOCARDREGISTER	-0.075 (0.028)	-2.72**
NOACCESS	-0.054 (0.024)	-2.28*
EMBARRASS	-0.075 (0.028)	-2.72**
VICTIM	-0.226 (0.044)	-5.16***
NOTINTERESTED	-0.194 (0.041)	-4.68***
* p<0.05, ** p<0.01, *** p < 0.001		