

Citi Bike: The First Two Years



Sarah M. Kaufman, Lily Gordon-Koven,
Nolan Levenson and Mitchell L. Moss



June 2015

CITI BIKE

The First Two Years

Introduction 5

Citi Bike in Context 6

History of Bicycling in New York City 6

Urban Change 7

Global Context 7

Planning Citi Bike 7

Citi Bike Launch 8

Citi Bike's Success 8

Comparative Connection to Transit 11

Activity Hubs 12

Looking Forward 13

Diversity 13

Rebalancing & Repair 16

Future Plans 17

Appendix A: Research Methodology and Framework 18

Endnotes 19

Cover Image: Sean Davis, Flickr/seandavis

ABOUT THE RUDIN CENTER FOR TRANSPORTATION

The Rudin Center for Transportation Policy and Management at NYU's Wagner school explores challenges in transportation and infrastructure. The Center draws upon faculty and graduate students to conduct research on cities and mobility, information technology in transportation and access to mass transit.

We have built a Mobility Factbook exploring the 27 modes of transportation in New York City, and issue reports on social media in transit, the future of taxis and the Citi Bike system.

The Rudin Center was named in recognition of a gift from Lewis Rudin and receives support from leading firms in transportation, finance, and communications.

The director of the Center is Mitchell L. Moss, Henry Hart Rice Professor of Urban Policy and Planning.

Rudin Center for Transportation

Robert F. Wagner School of Public Service, New York University

295 Lafayette Street, Second Floor, New York, NY 10012

www.NYURudinCenter.com

ABSTRACT

New York City launched Citi Bike, the largest bike share program in the United States, in May 2013. This study examines the first two years of Citi Bike and its role in New York City mobility. Citi Bike's station connection to public transportation hubs and station density are major factors in the system's high ridership and use. Seventy-four percent of Citi Bike stations are within a five-minute walk of a subway station entrance, providing a "last mile" solution for transit commuters. The system's greatest challenges are expanding and diversifying its customer base while also rebalancing the number of bicycles available at high-demand stations. Citi Bike has become an integral part of New York's transportation culture, even though it serves a limited geographic area. This report addresses those challenges and recommends strategies for the future.

Acknowledgements

Thanks to Justin Tyndall and Sean Lewin of the NYU Rudin Center; Justin Ginsburgh with Motivate; and Stephanie Levinsky with the Trust for Governors Island and formerly of NYC Department of Transportation.

Public bike sharing allows users to ride rented bicycles from one bike station to another. The number of bike share programs in the United States has increased in the last four years: by late 2014, more than 20 bike share programs were operating in cities across the U.S. This report explores how New York City's bike share program, Citi Bike, relates to the existing travel modes, and the characteristics of its users.

Urban bike share systems in Washington, DC, Boston, Chicago, San Francisco, Denver, Miami, and New York City provide access to downtown business districts, residential neighborhoods, and

commercial retail hubs by bicycle for daily commuters and casual users. Citi Bike is the largest bike share program in the United States, and in its first two years has become a key element in the city's transportation network, providing a last-mile solution.

By early February 2015, Citi Bike riders had taken more than 13.6 million trips, and more than 120,000 riders spent \$95 to become annual members.¹ Unlike other American bike share programs, Citi Bike operates at a dense, concentrated core that intertwines with transit. When mass transit is facing serious constraints, Citi Bike complements and supplements existing transit in New York City.



Image: Instagram/citibike

CITI BIKE IN CONTEXT

History of Bicycling in New York City

Cycling in New York City is not a new phenomenon: before the advent of the automobile, bicycles were a common mode of transportation. During the early 1900's, the bicycle empowered the women's rights movement by enabling women to travel independently, wear pants instead of petticoats, and engage in public life.² Delivery persons and messengers have been using bicycles to quickly transverse the City's streets for decades.³

Mayor Edward Koch supported bicycling infrastructure in New York City during the 1970's and witnessed peaks in bicycling during the gas crisis of the late 1970's and the 1980 transit strike.⁴ He implemented the first protected bike lanes in Midtown in 1980, but the city removed the lanes following political and media pressure the same year.⁵ Expansion of the City's limited bicycle facilities remained stagnant for nearly two decades.

During the past decade, however, the bicycle network has flourished. Led by Mayor Michael M. Bloomberg, New York City added more than 350 miles of bike facilities, contributing to more than 700 miles of bike facilities from 2007 to 2013.⁶ Bicycling reached one percent modeshare⁷ in New York City in 2013 and Mayor Bill de Blasio announced a goal to reach six percent mode share by 2020.⁸ In September 2014, Bicycling Magazine named New York City the country's best bicycling city.⁹

The focus on bicycle safety from police and lawmakers continues to grow, particularly with Mayor Bill De Blasio's Vision Zero program, which aims to end traffic fatalities in New York City.¹⁰

Attention from other industries surges as more New Yorkers choose to bicycle. For example, luxury hotels are lending bicycles to guests.¹¹ Meanwhile, application developers are using data from the DOT to build smartphone apps and websites that make biking in New York City easier, helping riders to find bike stations, routes and shops. In addition to traditional tourism bicycle rental companies, the company Spinlister introduced a peer-to-peer rental model for short-term bicycling rentals.¹²

Bicycle commuting in New York City doubled between 2007 and 2011. Likewise, screenline counts of riders at bridge crossings nearly tripled from 12,756 in 2000 to 36,434 in 2013.¹³ The bike lane expansion has received criticism from some local residents and media; however, a 2012 New York Times poll showed that 66% of New Yorkers think bike lanes are a good idea.¹⁴ The Prospect Park West in Brooklyn bicycle lane created large public debate and a lawsuit, despite evidence showing improved traffic safety.¹⁵ Massive improvements in the city's bicycle networks, coupled with popular support, created a political and infrastructure foundation that made Citi Bike possible.

Urban Change

Bike share came to New York City during the rise of the “sharing economy,” and an economic recovery after the 2008 recession. In 2013, the year Citi Bike launched, New York City’s population passed 8.4 million residents for the first time.¹⁶ More than two dozen car sharing companies in the United States offer use of vehicles on a temporary, as-needed basis. These companies, plus sharing-economy successes like Uber and Lyft, remove the long-term costs of owning and maintaining a vehicle, which can be prohibitive for urbanites who may benefit from use of a vehicle occasionally.¹⁷ Meanwhile, companies like Airbnb facilitate peer-to-peer exchanges of space and goods, and co-working spaces and food co-ops dot the New York City landscape.¹⁸

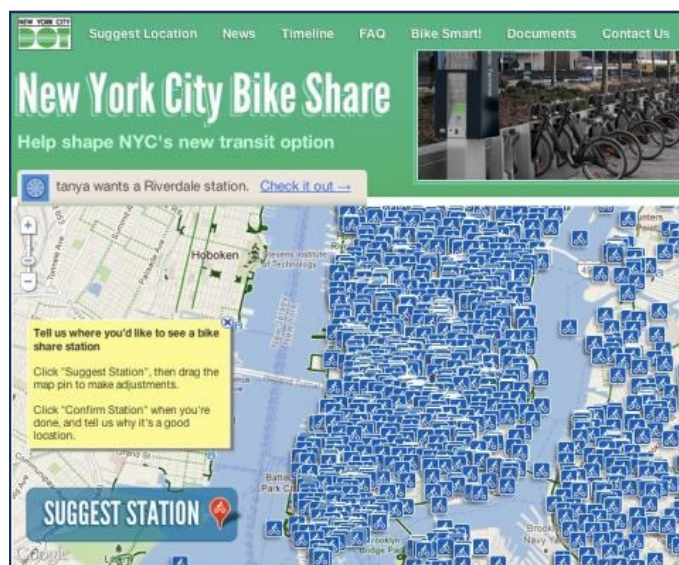
Global Context

Compared to cities in Latin America, Asia, and Europe, New York and other American cities were relatively slow to implement bike sharing. Early forms of bike share began in Dutch and Danish cities in the 1960’s and 1990’s, and Paris pioneered the first public computerized bike share program in 1998. By 2013, nearly 400 bike share programs were established or growing in cities across Europe and Latin America. The largest known bike share program is in the Chinese city of Wuhan, which has approximately 90,000 bicycles for a population of 9 million residents. Seventy-nine Chinese cities hosted bike share programs when Citi Bike launched in 2013.¹⁹ Bike share implementation in New York City marks an important moment in the city’s transportation history and reflects growing trends in modal integration and innovation.

Planning Citi Bike

The New York City Department of City Planning conducted a bike share feasibility study in 2009.²⁰ The City issued a request for proposals in November 2010 and ultimately selected NYC Bike Share, a newly formed subsidiary of Alta Bicycle Share,²¹ in September 2011. Funding was provided by Citigroup and underwritten by Goldman Sachs Urban Investment Group.

DOT staff conducted 159 multilingual outreach meetings and more than 200 additional stakeholder meetings to engage residents and community groups in the planning process. Using a new online tool called “Shareabouts,” the city solicited more than 10,000 station location suggestions and 60,000 comments from the public. DOT staff then identified feasible station locations from public input to create the network of more than 300 initial stations.²²



Shareabouts allowed New Yorkers to vote on Citi Bike station locations.

Citi Bike Launch

After several delays, including one related to equipment damage caused by Superstorm Sandy, Citi Bike launched in May 2013 with 330 stations and 5,000 bikes in the lower half of Manhattan and pockets of northwest Brooklyn, including Williamsburg and downtown Brooklyn.²³ By launch day, 16,000 people had signed up as annual members.²⁴

Annual Citi Bike memberships cost \$149 (\$99 at launch)²⁵ and provide members with an unlimited number of 45-minute rides. Rides longer than 45 minutes result in overage charges ranging from \$2.50 for an additional 25 minutes to more than \$9.00 for additional time. Seven-day passes are available for \$25 and 24-hour passes are available for \$9.95, both with similar trip time constraints. New York City Housing Authority residents and credit union members qualify for discounted \$60 annual memberships.²⁶ Prior to launch day, DOT and NYC Bike Share staff hosted events to introduce New Yorkers to the system.²⁷

Naturally, some New Yorkers criticized Citi Bike. Residents in Fort Greene, Brooklyn, for example, expressed concerns over the loss of on-street parking and the effect on historic aesthetics. Residents in other cases defaced stations with large stickers.²⁸ Other neighborhood groups objected to the locations of bike share stations, and some were relocated.

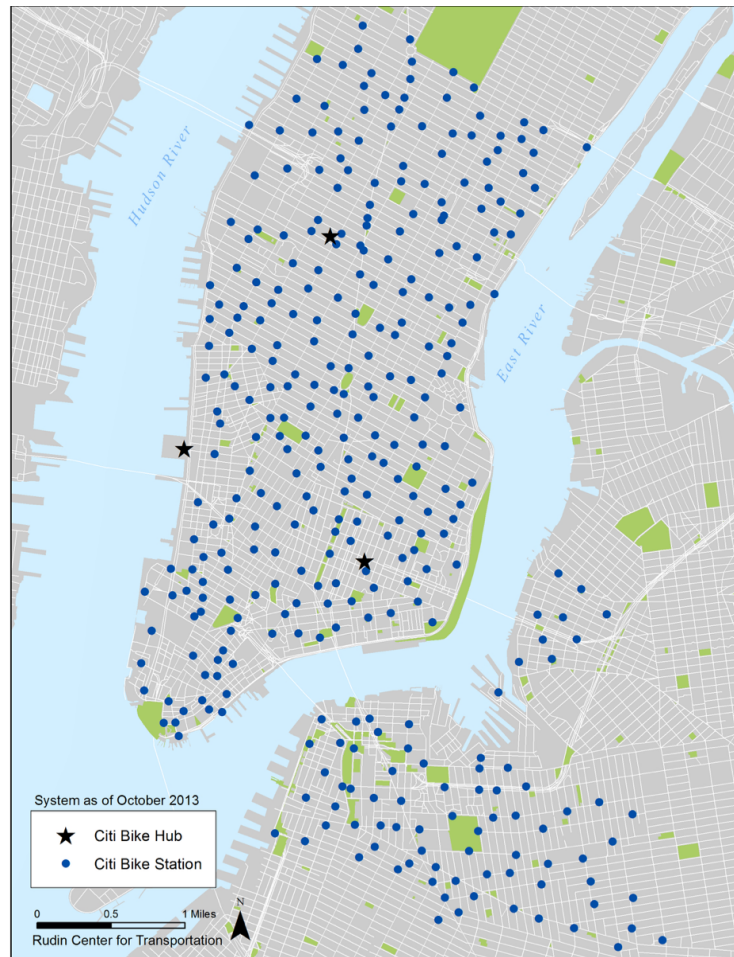
Geographically, the system covers the city's major commercial business districts and several residential areas, allowing riders to travel short distances from work to home or between meetings. Users take an average of 34,000 Citi Bike trips daily,²⁹ comparable to the ridership of the busiest local New York City Transit bus routes.³⁰ Over 90% of those rides are taken by annual members, rather than casual users.

Citi Bike's Success

Why does Citi Bike work? New York City, dense and walkable, lends itself well to a tightly knit web of bike share stations. The density of bike share stations, illustrated in the map below, makes it convenient for riders to find and return bikes, is the main element in the system's success.

For a fuller understanding of the system's success, we looked at the geographic relationship to New York City's subways. Serving 5.5 million riders every weekday with more than 700 miles of track,³¹ the subway extends far beyond Citi Bike's geographic reach. However, Citi Bike helps users cut down on travel time by biking, rather than walking or taking a bus or taxi, for the "last mile" to their destination. In analyzing the busiest stations, we found a strong connection between existing transit infrastructure and Citi Bike's use.

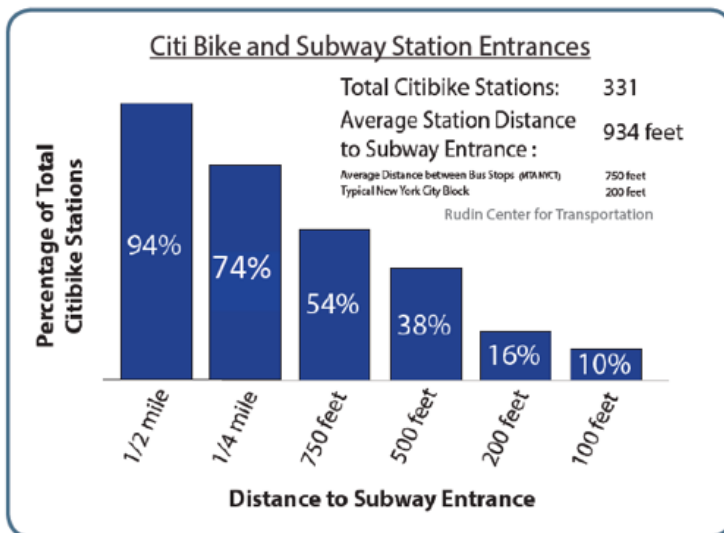
Citi Bike Stations and Hubs



Subway lines primarily run North-South along the center of Manhattan on Lexington Avenue, Broadway, 6th Avenue, 7th Avenue, and 8th Avenues, leaving the far east and west sides without immediate subway access and slow crosstown bus access. The layout of Citi Bike stations, blanketing the southern half of the island from east to west and 59th Street to Battery Park, enables multidirectional travel; for crosstown travellers, Citi Bike presents a quick and relatively inexpensive alternative to walking, taking a cab, or a crosstown bus. New York City's buses are among the slowest in the nation; a mile-

long bus trip across 34th Street could take more than 20 minutes but a Citi Bike cuts the same trip down to 10 minutes or less, depending on the rider.³²

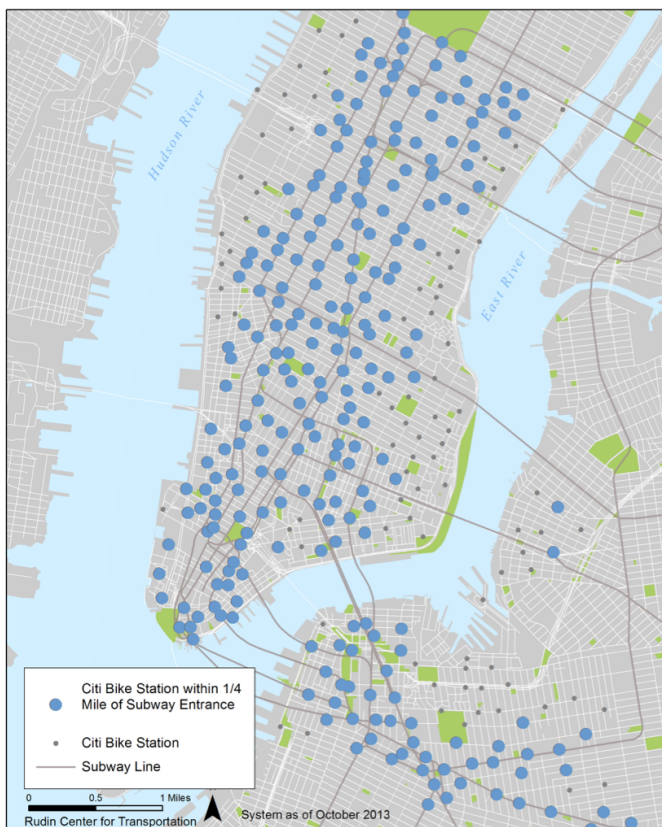
This solution to the last mile problem is made possible by the ease of transfer between bike and public transit. Seventy-four percent all Citi Bike stations, 243 of 330, are within a quarter-mile of a subway station entrance; thirty-eight percent are within 500 feet; sixteen percent are within 200 feet; and ten percent are within 100 feet. The following pages illustrate the system's connection to transit.



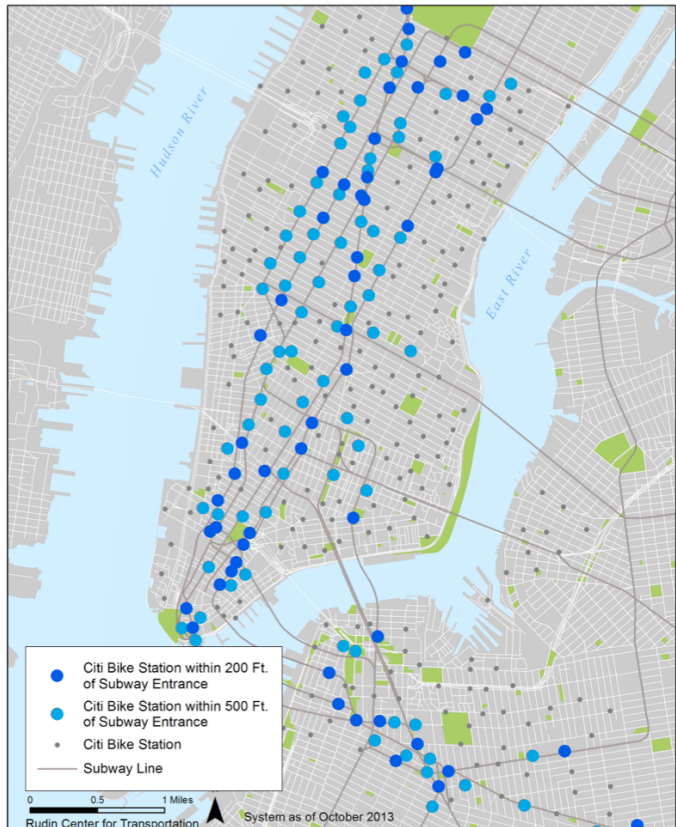
Within the geographic extent³³ of Citi Bike stations, there are 158 subway stations, roughly 2.1 Citi Bike stations for every subway station. The proximity of Citi Bike stations to subway entrances encourages short trips and enables multimodal trips without the hassle of securing a private bicycle, time spent walking, the cost of a taxi or car service, and with the added benefit of providing exercise. According to a new study from the National Association of City Transportation Officials, walkable

station spacing is essential to convenience of use and equity for users in bike share systems.³⁴ To that extent, New York's bike share system far exceeds the usefulness of any North American system, providing a dense system interwoven with transit.

**Citi Bike Stations within
1/4 Mile of a Subway Entrance**




Citi Bike Stations within 200 and 500 Feet of a Subway Entrance



Comparative Connection to Transit

To put the system's density in context, we compared the density and relationship to transit of four other noteworthy bike share programs in the United States: Divvy in Chicago, Capital Bikeshare in Washington, DC, Hubway in Boston, and Nice Ride in Minneapolis/St. Paul.

This chart highlights both the comparative density of New York's system and the higher usage of the system overall. Due to its station density, New York has achieved a more usable and convenient system, particularly for connecting to the transit hubs included in its web of stations. The system was designed for residents, not visitors, resulting in heavier usage.

	New York City Citi Bike	Chicago Divvy	Boston Hubway	Washington, DC Capital Bikeshare	Minneapolis- St. Paul Nice Ride
Launch Year	2013	2013	2011	2010	2010
Bikes	6,000	3,000	1,300	3,000	1,550
Stations	330	300	140	350	170
Rides/Bike/Day	5.2	3.8	3.2	3.6	1.6
Stations/Sq. Mile	23	8	5	4	4
Scaled Comparison					

Activity Hubs

Citi Bike's density, cost, and integration with diverse modes of travel contribute to the system's adoption as a regular mode choice by New Yorkers for both leisure and commuting. This integration becomes evident through an analysis of the system's busiest stations. The table below shows the busiest stations for trip starts and ends each month between July 1, 2013 and February 28, 2015.

Top 10 Stations: Trip Starts (Monthly Average)			Top 10 Stations: Trip Ends (Monthly Average)	
Station	Trips		Station	Trips
8 Ave & W 31 St	7603		E 17 St & Broadway	6417
Lafayette St & E 8 St	6427		Lafayette St & E 8 St	6319
E 17 St & Broadway	5463		8 Ave & W 31 St	6140
W 21 St & 6 Ave	5449		E 42 St & Vanderbilt Ave	5973
Pershing Square North	5013		W 21 St & 6 Ave	5670
Broadway & E 14 St	4940		Pershing Square North	5027
West St & Chambers St	4748		University Pl & E 14 St	4899
Cleveland Pl & Spring St	4581		Broadway & E 14 St	4870
Broadway & E 22 St	4542		West St & Chambers St	4593
University Pl & E 14 St	4495		W 41 St & 8 Ave	4591

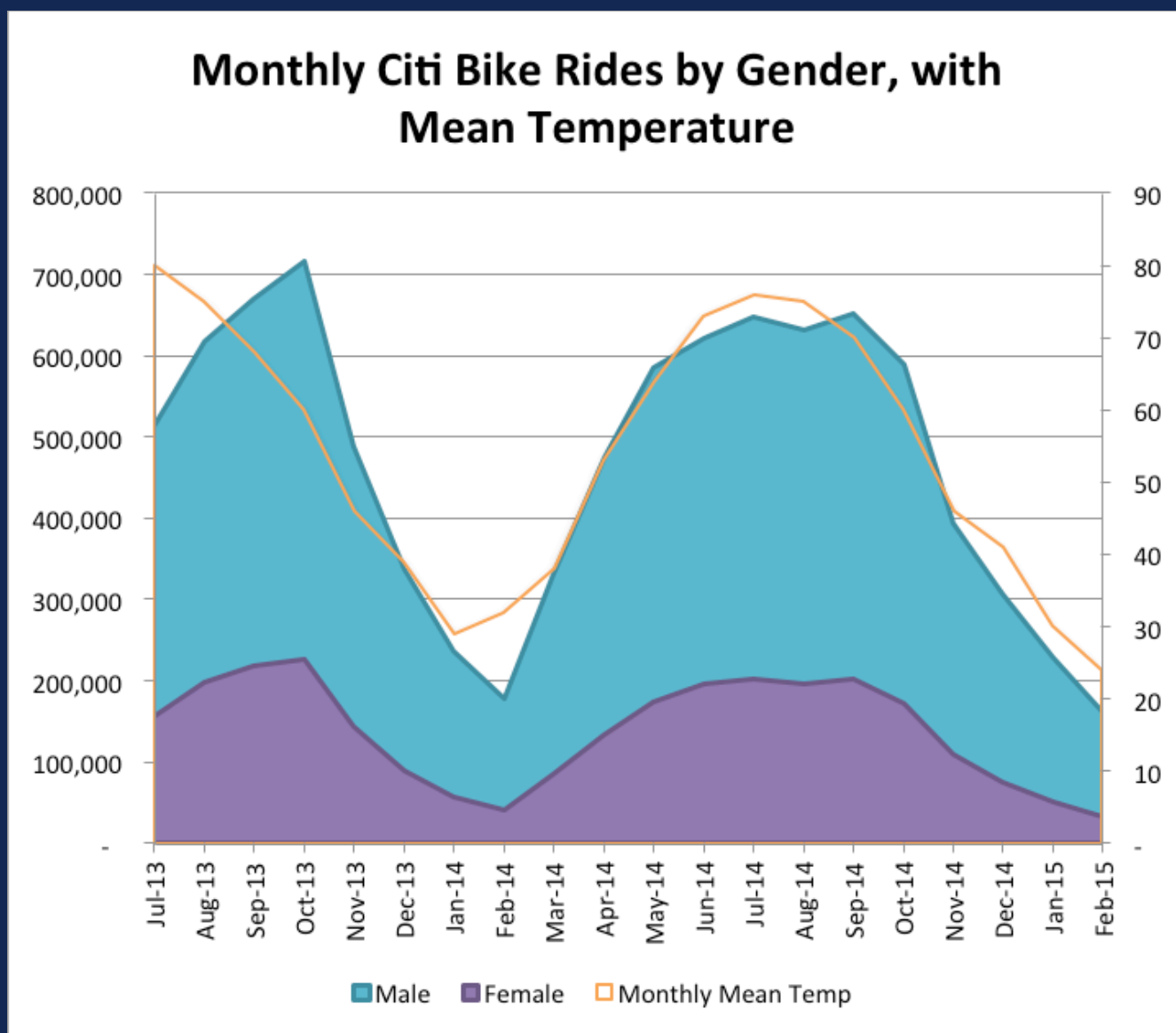
The busiest stations are adjacent to major transit hubs, including those surrounding Grand Central Terminal, Pennsylvania Station, and the Port Authority Bus Terminal. Together, these transit hubs carry more than a million passengers in and out of the city each day from the surrounding regions via New Jersey Transit Buses and Commuter Rail, Long Island Rail Road, Metro-North Railroad, and Amtrak. In Midtown, Union Square, Flatiron, SoHo, and Downtown, the busiest stations are linked not only to commuter rail lines but also to the city's subways.

The bike-mass transit commuting patterns are apparent when studying the busiest stations in the morning and evening rush hours. This clustering of trips shows that riders are often connecting from commuter rail or bus in the morning, and returning after work. This factor also brings to light one of the system's greatest challenges: rebalancing, or relocating bike supplies to meet demand at popular locations.

LOOKING FORWARD

Diversity

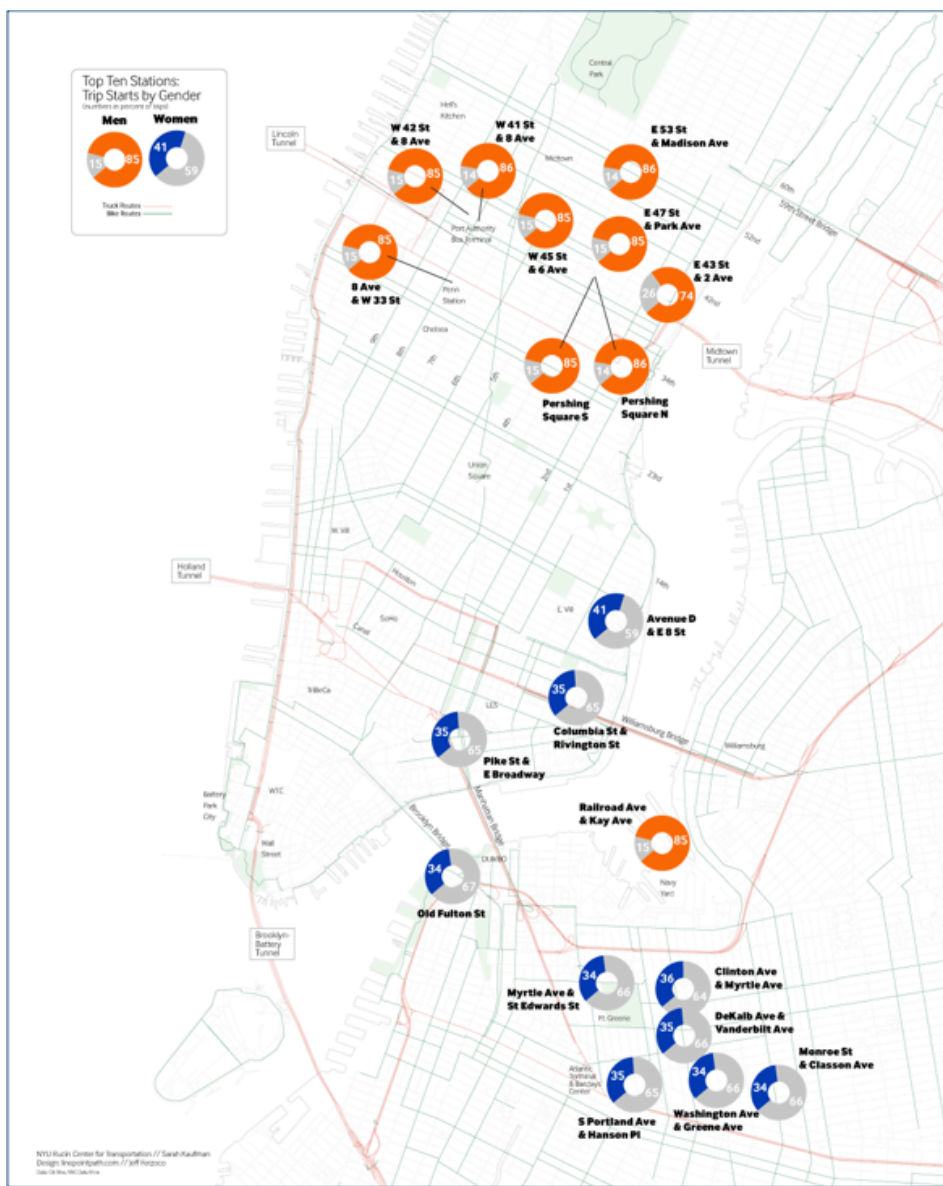
Despite Citi Bike's popularity, the vast majority of Citi Bike rides are taken by male riders: 77.7 percent of member rides were taken by a man.³⁶ The disparity between male and female usage grows to an 80:20 ratio, as women tend to ride Citi Bikes less in inclement weather. The chart below shows monthly Citi Bike rides by gender, with mean monthly temperature.



Safety

Women appear to prioritize safety in their Citi Bike riding. Most stations where the majority of Citi Bikes are picked up by men are in Midtown, Manhattan while stations preferred by women are in or close to Brooklyn. A map of the stations most preferred for each gender's trip starts, in total as of Spring 2014, is below. While the stations are all male-dominated, the female trip starts are markedly higher in Brooklyn.

These station characteristics tell a story of female riders opting for safety: 40 percent of women's top stations are adjacent to or have connections to a bike lane or protected greenway, compared to 30 percent for male-preferred stations. Women also choose stations on lower-traffic streets, with an average of two lanes of traffic, and highly restricted truck access; men's top station streets average 2.6 lanes of traffic and mostly unrestricted truck access. Finally, these stations vary in their recent safety records: between March 2013 and February of 2014, the stations preferred by women have a lower average number of cyclist injuries in recent memory: 0.8 for female-preferred locations versus 1.3 for male-preferred locations. The locational memory of safety conditions likely affects station and route choices.³⁷ In contrast, in European cities with separated bicycle infrastructure, women account for 50% of riders.³⁸ With the growth of protected bike lanes and the placement of additional Citi Bike stations near safe routes, more women will turn to biking as a safe and convenient travel mode.



Transporting Passengers

In addition to safety, women may be taking fewer Citi Bike rides due to household responsibilities. Women's trip purposes are often to "serve passengers," according to the National Household Travel Survey, indicating that they are transporting family members. For example, they are taking young children to school, or elderly relatives to appointments.³⁹ These activities are not conducive to bike-riding, and limit these users' ability to ride for part of all of their daily trips. While some parents bring young children to school on their own bike-mounted child seats, Citi Bike does not offer this option, completely eliminating bike share as a possibility for household trips.

Some cities are already addressing this challenge: the Paris Vélib' bike share program offers P'tit Vélib': children ages 2 to 8 can rent appropriately-sized bikes, with helmets, in protected bike areas.⁴⁰ Some bikes in Hangzhou, China, come with child

seats.⁴¹ Although a company in Washington, DC built a pop-on child seat for the Capital Bikeshare system, it was quickly sent a cease-and-desist letter by Alta for violating the terms of using the bicycles.⁴²

The need for child-friendly bike share uses is evident. If Citi Bike offered a similar program in areas with large numbers of children and protected bike lanes, more mothers could take advantage of the system.

System Expansion

An expansion of the Citi Bike system will likely increase the proportion of female riders. Because the new stations will be located in residential areas of Manhattan, Brooklyn and Queens, these bike routes will feature safety characteristics, like lower-traffic streets and fewer truck routes, preferred by female riders. By adding stations near schools, Citi Bike can assist parents dropping off and picking up children who may bike for the remainder of their commutes. This placement could attract more female riders who are mothers or caretakers for children at the school.

Partnerships

While Citi Bike offers partnership discounts on products, food and events, the system could help to attract more female riders by partnering with workplaces near Citi Bike stations. Although



Child-friendly bike share in Hangzhou. Image by Bradley Schroeder, ITDP.

women make up 48 percent of the Manhattan workforce below 59th Street,⁴³ they are taking fewer than 20 percent of Citi Bike trips in many locations. Citi Bike should partner with large companies to offer stations outside their buildings, ride partners, helmet loans for employees and training clinics for their workforces. Women workers, with these added safety measures, might be more inclined to opt for the convenience offered by bike share.

It is essential to increase women's use of Citi Bike, as women are early indicators of bike safety: when women use a biking program, it is considered successfully safe and convenient. Women have a long favorable history with biking. In the 1890s, women discovered the bicycle as the best means of personal mobility, providing exercise, freedom from reliance on men for transportation, and reform of requirements for wearing unwieldy undergarments. According to suffragist Susan B. Anthony, biking had "done more to emancipate women than anything else in the world."⁴⁴

It is possible to give women this advantage once more by making it simpler to bike: improving street safety, providing helmets through workplaces, developing child-friendly bike resources, and expanding to key locations in residential areas. Women have potential to enjoy Citi Bike as a productive part of their commutes as a result of implementing these recommendations.

Rebalancing & Repair

Citi Bike's popularity has created such a high demand that some stations regularly lack bikes or are completely full, making it hard to take or park a Citi Bike. Rebalancing is the process of redistributing bikes between 'attractive' and 'repulsive' stations. As commuters ride to work in the morning, 'repulsive' stations empty out and leave few to no bikes. Conversely, 'attractive' stations in busy neighborhoods fill up, leaving no place for riders to dock their bikes. Stations that are full or empty are considered to be an "outage."⁴⁵

Under contract with the city, NYC Bike Share faces financial penalties when adjacent station outages occur for more than one hour. To avoid outages, dozens of rebalancing teams shuttle bikes between full and empty stations using big box trucks, sprinter vehicles, and bicycle trailers.

New smartphone apps built by civic hackers mitigate these issues by helping Citi Bike riders find stations with open docks or available bikes. These apps include the official Citi Bike app as well as NYC Bikes, Availabike, and NYC Bike Share.

Despite the varied forms of rebalancing, Citi Bike still struggles to meet demand for riders. Although the main bike warehouse is in Sunset Park, Brooklyn, Citi Bike opened three hubs near Penn Station, Pier 40, and Delancey Street, where broken bikes can be repaired and working bikes can be staged for vehicle pickup. This proximity shortens the travel distances of rebalancing vehicles, avoiding the potentially hour-long trip from Sunset Park to Midtown, which could exceed the one-hour outage limit.

While surveyed users expressed frustration with bike distribution,⁴⁶ officials at the City's Department of Transportation have said that they believe commuters are tweaking their schedules and destinations to ensure easier access to bikes and docks during the morning and evening rush hours. In addition to rebalancing, Citi Bike has struggled to maintain its bikes and stations. A city audit in December 2014 found that New York City Bike Share failed to maintain equipment per its contract with the Department of Transportation.⁴⁷ Failures to perform station inspections and maintenance checks result in rider-generated signals where knowledgeable riders will turn the seat around on a broken bike to alert future riders.⁴⁸

Citi Bike is now upgrading the software and payment systems and docking equipment at all stations, which will likely produce an improvement in these issues.⁴⁹

Future Plans

In October 2014, the principals of the Related Companies and Equinox formed an investment company called Bikeshare Holdings that purchased Citi Bike's parent company, Alta Bicycle Share, renamed to Motivate. Plans were announced to double Citi Bike's users by 2017. Residents of Harlem, Long Island City, Greenpoint, Williamsburg, Bedford-Stuyvesant, Red Hook, Park Slope, Astoria, Prospect Heights, and Crown Heights will be among those to benefit from the increase from 330 to 700 stations and 6,000 to 12,000 bicycles.⁵⁰ This

expansion will likely be a boon for the outer boroughs, where the "last mile" from transit to home or work can be a much longer distance than in Manhattan. Expansion into these neighborhoods will likely enable more diverse Citi Bike ridership, reaching into middle-income communities, and areas where more women may feel comfortable biking.⁵¹

The change in ownership brought new leadership – former Metropolitan Transportation Authority CEO Jay Walder was named the new CEO of Motivate – and pricing: the price of annual Citi Bike memberships was raised to \$149.⁵² Though the Department of Transportation conducted initial outreach in some of the expansion neighborhoods, staff is revisiting communities to ensure station locations are publicly supported and technically feasible.⁵³

The integration of Citi Bike into New Yorkers' daily travel routines, and the commuting patterns that contribute to rebalancing woes, demonstrate the ability of transportation systems to reinforce one another. The addition of Citi Bike to the New York landscape means more choices - of mode, destination, and payment - for residents and visitors, and new efforts point to a positive future.



Appendix A: Research Methodology and Framework

Methodology and Data Sources

Using spatial data primarily from the United States Census⁵⁴ and New York City's Department of Information Technology & Telecommunications,⁵⁵ ridership and station activity data from New York City Department of Transportation and NYC Bike Share, LLC,⁵⁶ and station location data from NYC Bike Share, LLC, this study used ArcGIS software⁵⁷ to analyze and show connections between Citi Bike and public transit. Data from Divvy Bikes,⁵⁸ Chicago Open Data Portal,⁵⁹ Capital Bike Share,⁶⁰ the District Department of Transportation,⁶¹ Hubway,⁶² the Massachusetts Bay Transportation Authority,⁶³ Nice Ride,⁶⁴ and MetroGIS⁶⁵ allowed for comparisons in station coverage area and station density in New York City, Chicago, Washington, DC, and Minneapolis/St. Paul. Researchers conducted interviews with New York City Department of Transportation and NYC Bikeshare LLC staff.

Framework

We examine connections between New York City's bike share program, Citi Bike, and the previously existing transportation options in New York City. After observing the system's success in its first year of operation, this study analyzes connections between bike share stations and from stations to transit options. New York City's bike share system offers a solution to the "last mile"⁶⁶ problem, the problem of getting riders short distances, under a mile, to and from transit stations. A key component of this "last mile" analysis came through calculating the number of Citi Bike stations with 100, 200, 500, and 1320 feet⁶⁷ of subway station entrances and comparing the proximity and density of bike share stations in New York City, Washington, DC, Chicago, Boston, and Minneapolis/St. Paul.

Endnotes

1. System Data. (2014). Citi Bike. <http://www.citibikenyc.com/system-data>
2. Macy, Sue. (2011). *Wheels of Change: How Women Rode the Bicycle to Freedom (With a Few Flat Tires Along the Way)*. National Geographic Children's Books
3. Schwartz, Samuel I. (November 5, 2006). "Rolling Thunder" *The New York Times*. <http://www.nytimes.com/2006/11/05/opinion/05CI-Schwartz.html>
4. Cranor, David. (February 5, 2013). "Ed Koch, Force Behind Creation & Removal of First Green Lanes, Passes Away." *People for Bikes*. <http://www.peopleforbikes.org/blog/entry/ed-koch-force-behind-creation-and-removal-of-first-green-lanes-passes->
5. Ibid.
6. "Just the Facts: Our Works by the Numbers." (2014). Transportation Alternatives. <http://www.transalt.org/about/facts>
7. Miller, Stephen. (September 23, 2013). "Census: NYC Bike Commute Mode-Share Hits 1 Percent Threshold." *Streetsblog NYC* <http://www.streetsblog.org/2013/09/23/census-nyc-crosses-1-threshold-for-regular-bike-only-commuters/>
8. Miller, Stephen. (September, 17, 2014). "Trottenberg Talks About Expanding Cycling in the de Blasio Era." *Streetsblog NYC* <http://www.streetsblog.org/2014/09/17/at-town-hall-trottenberg-talks-about-expanding-cycling-in-the-de-blasio-era/>
9. Maslin Nir, Sarah. (September 4, 2014). "New York Is Named Best U.S. Bicycling City, Potholes and All" *The New York Times*. http://cityroom.blogs.nytimes.com/2014/09/04/new-york-is-named-best-u-s-bicycling-city-potholes-and-all/?_r=0
10. Vision Zero. <http://www.nyc.gov/html/visionzero/pages/home/home.shtml>
11. Zipkin, Amy. (December 8, 2014). "Hotels Let Guests Borrow Items or Leave Them." *The New York Times*. <http://www.nytimes.com/2014/12/09/business/hotels-let-guests-borrow-items-or-leave-them.html>
12. Spinlister. <https://www.spinlister.com/>
13. NYC Department of Transportation Bicycle Program. "NYC Commuter Cycling Indicator." <http://www.nyc.gov/html/dot/downloads/pdf/>
14. Grynbaum, Michael M. & Marjorie Connelly. (August 21, 2012). "Bicycle Lanes Draw Wide Support Among New Yorkers, Survey Finds." *The New York Times*. <http://www.nytimes.com/2012/08/22/nyregion/most-new-yorkers-say-bike-lanes-are-a-good-idea.htm>

15. Kazis, Noah. (June 16, 2011). "City's Response to PPW Lawsuit Matter-of-Factly Dismantles NBBL Claims." *Streetsblog NYC*. <http://www.streetsblog.org/2011/06/16/citys-response-to-ppw-lawsuit-matter-of-factly-dismantles-nbbl-claims/>
16. Roberts, Sam. (March 27, 2014). "Population Growth in New York City is Reversing Decades-Old Trend, Estimates Show" *The New York Times*. <http://www.nytimes.com/2014/03/27/nyregion/population-growth-in-new-york-city-is-reversing-decades-old-trend-estimates-show.html>
17. Steinberg, Stephanie & Bill Vlasic. (January 25, 2013). "Car-Sharing Services Grow, and Expand Options." *The New York Times* <http://www.nytimes.com/2013/01/26/business/car-sharing-services-grow-and-expand-options.html>
18. (March 9, 2013). "The rise of the sharing economy." *The Economist*. <http://www.economist.com/news/leaders/21573104-internet-everything-hire-rise-sharing-economy>
19. Larsen, Janet. (April 25, 2013). "Bike-Sharing Programs Hit the Streets in Over 500 Cities Worldwide" *Plan B Updates: Earth Policy Institute*. http://www.earth-policy.org/plan_b_updates/2013/update112
20. NYC Department of City Planning. (2009). Bike-Share Opportunities for New York City. http://www.nyc.gov/html/dcp/pdf/transportation/bike_share_complete.pdf
21. Plagued by management and financial difficulties, Alta Bicycle Share was purchased REQX Ventures in October 2014.
22. NYC Department of Transportation. (2013). NYC Bike Share: Designed by New Yorkers. <http://www.nyc.gov/html/dot/downloads/pdf/bike-share-outreach-report.pdf>
23. Hinds, Kate. (August, 13, 2013). "Timeline: NYC's Uncertain Bike Share Expansion." *WNYC Transportation Nation*. <http://www.wnyc.org/story/311498-citi-bike-share-expansion-timeline/>
24. Berman, Mark. (May, 28, 2013). "Bike sharing finally comes to New York City." *The Washington Post*. <http://www.washingtonpost.com/blogs/dr-gridlock/wp/2013/05/28/bike-sharing-finally-comes-to-new-york-city/>
25. Annual memberships cost \$95 until November 2014, when ownership and management changes resulted in the increase in annual memberships.
26. "Pricing Citi Bike." Citi Bike. <http://www.citibikenyc.com/pricing>
27. "Community Outreach and Helmet Fittings." (July 3, 2013). Citi Bike. <https://www.citibikenyc.com/blog/2013/07/03/community-outreach-and-helmet-fittings->
28. Abruzzese, Robert & Mary Frost. (April 18, 2013). "Citi Bike stations raise both praise and opposition in NYC." *The Brooklyn Eagle*. <http://www.brooklyneagle.com/articles/citi-bike-stations-raise-both-praise-and-opposition-nyc-2013-04-17-232400>

29. System Data. (2014).
30. "Average Weekday MTA Bus Ridership." (2013). Metropolitan Transportation Authority http://web.mta.info/nyct/facts/ridership/ridership_busMTA.htm
31. "Subway and Bus Ridership." (2013). Metropolitan Transportation Authority. <http://web.mta.info/nyct/facts/ridership/>
32. Travel times for walking, bicycling, and transit were estimated using Google Maps.
33. Geographic extent defined as a dissolved ½ mile around each Citi Bike station, excluding water.
34. "Walkable Station Spacing is Key to Successful, Equitable Bike Share," National Association of City Transportation Officials. April 2015. http://nacto.org/wp-content/uploads/2015/04/NACTO_Walkable-Station-Spacing-Is-Key-For-Bike-Share.pdf
35. NACTO figures for Rides/Bike/Day and Stations/Sq. Mile; remaining numbers from official bike share websites.
36. System Data. (2015).
37. Citi Bike System Data.
38. Camp, Allison. "Closing the Bicycling Gender Gap: The Relationship Between Gender and Bicycling Infrastructure in the Nation's Largest Cities," University of Oregon. June 2013. https://scholarbank.uoregon.edu/xmlui/bitstream/handle/1794/12935/Camp_Terminal_Project_CRP_4%202026.pdf?sequence=1
39. Rosenbloom, Sandra. "Understanding Women's and Men's Travel Patterns: The Research Challenge," in "Research on Women's Issues in Transportation: Conference Proceedings." Transportation Research Board, November 2004.
40. P'tit Velib. <http://blog.velib.paris.fr/en/ptit-velib/>
41. "Hangzhou Public Bike Share Scheme: 66,000 Bikes And Still Counting," Worldwide Cycling Atlas, December 2014. <http://www.worldwidecyclingatlas.com/journal/hangzhou-public-bicycle-bike-share-scheme/>
42. Snyder, Tanya. "Finally! A Kid's Seat for Bike-Share." Streetsblog, May 30, 2014. <http://usa.streetsblog.org/2014/05/30/finally-a-kids-seat-for-bike-share/>
43. American Factfinder. US Census. <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>
44. Zheutlin, Peter. "Women on Wheels: The Bicycle and the Women's Movement of the 1890s." <http://www.annielondonderry.com/womenWheels.html>

45. Jaffe, Eric. (August 27, 2014). "Balancing Bike-Share Stations Has Become a Serious Scientific Endeavor." *City Lab*. <http://www.citylab.com/commute/2014/08/balancing-bike-share-stations-has-become-a-serious-scientific-endeavor/379188/>
46. Bernstein, Andrea. (October 17, 2013). "Survey: 64% of CitiBike Users Unhappy About Full or Empty Docks." *WNYC Transportation Nation*. <http://www.wnyc.org/story/survey-64-citibike-users-unhappy-about-full-and-empty-docks/>
47. City of New York Office of Comptroller. (December 11, 2014). Audit Report on the Maintenance of Bike Share Equipment by new York City Bike Share, LLC, in Compliance with its Contract with the Department of Transportation. http://comptroller.nyc.gov/reports/audit/?r=12-11-14_MJ14-076A
48. Bonnington, Christina. (June 19, 2013). "Courteous Citi Bike Riders Are Alerting Others to Broken Rides." *Wired*. <http://www.wired.com/2013/06/citi-bike/>
49. Hawkins, Andrew J. "Citi Bike turnaround: so much promise, so many problems," *Crain's New York Business*. April 26, 2015. <http://www.crainsnewyork.com/article/20150426/TRANSPORTATION/150429891/citi-bike-turnaround-so-much-promise-so-many-problems>
50. NYC Department of Transportation. (October 28, 2014). NYC DOT, Alta, and Citi Announce Agreement to Expand Citi Bike Program in New York City. [Press Release] Retrieved from: <http://a841-tfpweb.nyc.gov/dotpress/2014/10/citi-bike-program-in-new-york-city/#more-339>
51. Perlmutter, David. (January 28, 2014). "How Citi Bike Could Expand to Serve Low-Income New Yorkers." *Untapped Cities*. <http://untappedcities.com/2014/01/28/how-citi-bike-could-expand-to-serve-low-income-new-yorkers/>
52. Ibid.
53. Miller, Stephen. (October, 28, 2014). "Citi Bike 2.0: New Owners Hire Jay Walder and Promise Major Expansion." *Streetsblog NYC*. <http://www.streetsblog.org/2014/10/28/citi-bike-2-0-new-owners-hire-jay-walder-promise-bike-share-expansion/>
54. American Factfinder. US Census. <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>
55. Department of Information Technology & Telecommunications. <http://www.nyc.gov/html/doitt/html/home/home.shtml>
56. System Data.
57. ArcGIS tool Network Analyst was not used for this study due to availability of software and existing the Manhattan street grid.
58. Divvy Bikes. <https://www.divvybikes.com/>
59. Chicago Open Data Portal. <https://data.cityofchicago.org/>
60. Capital Bike Share. <https://www.capitalbikeshare.com/>

61. District Department of Transportation. <http://ddot.dc.gov/>
62. Hubway. <http://www.thehubway.com/>
63. Massachusetts Bay Transportation Authority. <http://www.mbtta.com/>
64. Nice Ride. <https://www.niceridemn.org/>
65. MetroGIS. <http://metrogis.org/>
66. Before the launch of Citi Bike, a “last mile” analysis was conducted by Steven Romalewski on the Spatiality Blog (spatialityblog.com) on May 14, 2012, using the proposed station locations. That analysis can be found here:
http://spatialityblog.com/2012/05/14/citibikenyc_firstlastmile_quantified/
67. 1320 feet is equivalent to $\frac{1}{4}$ mile and approximately a five minute walking distance.

Citi Bike

The First Two Years

THE NYU RUDIN CENTER FOR TRANSPORTATION
295 LAFAYETTE STREET
2ND FLOOR
NEW YORK, NY 10012
WWW.NYURUDINCENTER.COM

JUNE 2015