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Bicycling for Transportation at Georgia State University: Findings and Recommendations for the Georgia State University Bike Plan

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Georgia State University

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ABSTRACT

BICYCLING FOR TRANSPORTATION AT GEORGIA STATE UNIVERSITY: FINDINGS AND RECOMMENDATIONS FOR THE GEORGIA STATE UNIVERSITY BIKE PLAN

By

SARAH BRAUNSTEIN MCCARTHA

April 24th, 2017

INTRODUCTION: Bicycling is a form of physical activity that can be used for transportation as a motor vehicle alternative. Bicycling has become a popular transportation method on university campuses.

AIM: The aim of this capstone is to illustrate student residential demographics and bike count trend data, evaluate the Georgia State University Touch the Earth Bike Share program, and generate recommendations for the Georgia State University Bicycle Plan. The overall goal is to increase bicycling at Georgia State University and improve the health of the Georgia State University population.

METHODS: Multiple methods were used in this capstone. Geographic Information Systems (GIS) found the geographic location of student respondents' residence. During the bike counts, data were collected on the age and gender of the bicyclists, and the total number of bikes at each intersection. The counts were conducted in two-hour increments on the same day during the morning and afternoon. Data was collected in the Fall 2009, Spring 2012, Spring 2014, Fall 2014, and Spring 2015 semesters. Lastly, during the Fall 2014 semester, an evaluation of the Touch the Earth Bike Share program was conducted using the Post Bike Rental Evaluation form to analyze the characteristics, use, and suggested improvements to the program.

RESULTS: The results showed the geographic census tracts of the target student population, the age, gender, and total bike counts during the morning and afternoon bike counts by location over semesters. The Touch the Earth evaluation disclosed the participants' demographics, use of the rental bikes, and suggested improvements for recommendations to enhance the Touch the Earth Bike Share program.

DISCUSSION: Using the four components of the General Model of health program planning, an intervention was laid out with recommendations about alternative transportation, revitalizing Turner Field, and improvements and expansion suggestions to the Touch the Earth Bike Share program to increase bicycling on campus.

CONCLUSION: The findings and recommendations found in this capstone provide empirical support vital to the Georgia State University Bike Plan and the creation of a superior bicycle friendly campus.

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RECOMMENDATIONS FOR THE GEORGIA STATE UNIVERSITY BIKE PLAN

by

SARAH BRAUNSTEIN M^cCARTHA

B.S., COLLEGE OF CHARLESTON

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of Georgia State University in Partial Fulfillment
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MASTER OF PUBLIC HEALTH

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30303

APPROVAL PAGE

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by

SARAH BRAUNSTEIN M^CCARTHA

Approved:

John Steward, MPH
Committee Chair

Michael Black, PhD.
Committee Member

April 24th, 2017
Date

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In presenting this capstone as a partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the Library of the University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or to publish this capstone may be granted by the author or, in his/her absence, by the professor under whose direction it was written, or in his/her absence, by the Associate Dean, School of Public Health. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this capstone which involves potential financial gain will not be allowed without written permission of the author.



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1 INTRODUCTION

1.1 Background

In the 1960s, the University of California Davis campus was the first American university to ban cars in the central campus area. Without car access, bicycles became the most popular form of transportation. The popularity of the bicycle expanded outside the University to the City of Davis, California, creating a bike friendly culture and the citywide construction of European inspired bike infrastructure (Longhurst, 2015). Bicycling has since become a popular transportation mode on college and university campuses. Starting in 2011, the League of American Bicyclists created its Bicycle Friendly University program with 23 colleges and universities. As of 2015, the current list has 127 colleges and universities with designations from bronze to platinum (Szczepanski, 2015).

In response to the growing interest in bicycling on the Georgia State University (GSU) campus, Faculty Associate Dr. Michael Black and Program Manager Jennifer Asman, of the Georgia State University Office of Sustainability Initiatives, applied for a Livable Center Initiative and Community Choices technical assistance grant from the Atlanta Regional Commission in the Fall of 2013.

The grant had three overall goals. The primary objective of the project was to develop a bicycle plan for the Georgia State University downtown Atlanta campus that supports bicycling to, from, and within the project campus and to act as a connection or nexus between portions of downtown Atlanta surrounding the university. This plan

aimed to increase the awareness about bicycling on campus, increase bicycling infrastructure, and increase the amount of faculty, staff, and students who bike to campus with the overall goal of making the campus healthier and more appealing to potential students. A secondary goal of this plan was to become a catalyst for a grant, funded by the Atlanta Regional Commission, to obtain funding for the implementation of this plan. The plan was designed to incorporate the City of Atlanta's Cycle Atlanta and Connect Atlanta plans, as well as partner with Central Atlanta Progress. Lastly, the plan was intended to help assess the current bicycle support and needed improvements to achieve the League of American Bicyclists Bicycle Friendly University designation.

1.2 Georgia State University's Role in Bicycling

Georgia State University (GSU), located in downtown Atlanta, Georgia, has become a major public research university in the Southeast. After the consolidation with Georgia Perimeter College's five campuses on January 6, 2016, GSU has a total of 50,972 undergraduate and graduate students. GSU's main campus, downtown, has 32,464 students enrolled, and 18,508 students are enrolled in one of the five Georgia Perimeter College campuses ("Quick Facts," 2017). Georgia State University's location and student population provide a unique opportunity to increase cycling on and around GSU as well as parts of downtown Atlanta. Student's geography, bike riding trends, and an evaluation of the Touch the Earth Bike Share program gives relevant data for inclusion in the university's bike plan.

1.3 Research Purpose

As a recognized form of physical activity and mode of transportation, utilitarian bicycling may be viewed as a public health intervention to increase the well-being of Georgia State University's students, faculty, staff, and administrators, while reducing air pollution. The research purpose of this capstone is to examine data about students' geographic residences, campus bike usage trends from bike counts conducted at various locations, and the use of the Touch the Earth Bike Share program.

Before creating a public health intervention, a needs assessment, examining the target populations and specific issues of bicyclists and non-bicyclists, must be conducted (McKenzie, Neiger, & Thackeray, 2013). The students' geographic residences display the locations and number of students living in census tracts located in the Atlanta Region. The bike counts show the total number of bikes, age, and gender of the bicyclists. The bike count form also asked about the direction, helmet usage, sidewalk riding, and riding with the direction of traffic. The Touch the Earth Bike Share evaluation presents demographics, characteristics, and usage of rental bikes to provide information and suggestions for program improvements. Recommendations proposed from the results of this capstone should be incorporated in the university's bicycle plan.

In addition to providing data for the bike plan, this capstone has public health implications. Increasing the number of students, faculty, staff, and administrators who bicycle to, from, and around the GSU campus will create a healthier and less sedentary community.

This community will become a niche of advocates for the university to improve bicycling infrastructure and encourage and popularize bicycling over single motor vehicle transportation.

1.4 Data Sources

This capstone incorporates three primary data sources. First, the geographic locations (Section III) came from students' address responses from the Fall 2014 Bicycling for Transportation survey. The survey was administered online from October 6, 2014, thru October 21, 2014, using Qualtrics® Survey Software ("Qualtrics," 2016). It is the first GSU university-wide online survey to examine bicycling and bicycling attitudes around campus from students, administrators, faculty, and staff. If the students lived on-campus, the survey asked which residence hall they resided. If the students did not live on-campus, another question asked for their address and zip code. The maps display the geographical location of students' residences by census tracts. The maps used census tract and county shapefiles created by the Atlanta Regional Commission ("GIS Data," 2016).

In the Spring of 2009, the Atlanta Bicycle Coalition started collecting bicyclists' travel and demographic patterns around the City of Atlanta ("ABC Fall Bike Counts," 2012). Starting the Fall 2009 semester, Georgia State University began compiling bicycle travel and demographic patterns in downtown Atlanta near the GSU campus. Although it would have been ideal to collect information at all intersections around campus, due to necessary staffing requirements, Piedmont Avenue and Decatur Street and Piedmont Avenue and Edgewood Avenue are the only intersections consistently tallied each semester shown in this

capstone. After each semester gathering, the data were sent to the Atlanta Bicycle Coalition for their records. Volunteers collected the bike count data (Section IV) during the morning and afternoon of Fall 2009, Spring 2012, Spring 2014, Fall 2014, and Spring 2015. Table 1.1 displays each intersection counted for each semester. Fall 2009, Spring 2012, and Fall 2014 bike counts were collected at three intersections: Piedmont Avenue and Edgewood Avenue, Piedmont Avenue and Decatur Street, and Five Points (the intersection of Marietta Street, Decatur Street, Peachtree Street, and Edgewood Avenue). The Spring 2014 count locations included the intersections above as well as the John Wesley Dobbs Avenue and Piedmont Avenue intersection. The Spring 2015 morning intersections were Piedmont Avenue and Edgewood Avenue and Piedmont Avenue and Decatur Street. The afternoon locations included those morning locations with the addition of Piedmont Avenue and Auburn Avenue.

Bike Count Intersections at Georgia State University

Semester	Piedmont Ave./Edgewood Ave.	Piedmont Ave./Decatur St.	Five Points	Piedmont Ave./John Wesley Dobb Ave.	Piedmont Ave./Auburn Ave.
Fall 2009*	X	X	X		
Spring 2012*	X	X	X		
Spring 2014*	X	X	X	X	
Fall 2014*	X	X	X		
Spring 2015 AM**	X	X			
Spring 2015 PM**	X	X			X

*Intersections same in the AM and PM

**Intersections differ from the AM and PM

Table 1.1 Bike Counts by Intersection

Lastly, an evaluation of Georgia State University's bike share program within Touch the Earth (Section V), the university's outdoor

recreation program, was conducted using the Post Bike Rental Evaluation form. The form was created specifically for the Fall 2014 semester evaluation, in which the renter voluntarily completed the form after returning the bicycle. The Post Bike Rental Evaluation asked multiple choice and short answer questions about demographics, bike ownership, bike confidence, bike usage, issues, and wanted improvements to the Touch the Earth Bike Share program.

2 LITERATURE REVIEW

2.1 Health Benefits

The bicycle boom during the early 20th century made bikes accessible for all income levels and geographic areas (Herlihy, 2004). Dwight Eisenhower's presidency helped shift the focus from bicycles to cars and highways (Troy, 2012). The Federal-Aid Highway Act of 1956, signed by President Eisenhower, highly incentivized highway construction. The act authorized all states to be liable for only 10% of the construction costs. The act also granted the federal government right-of-way jurisdiction (Troy, 2012). The formation of an auto-centric culture led to a decrease in utilitarian bicycling (Longhurst, 2015). This reduction gave bikers less political clout, allowing state laws to marginalize utilitarian bicyclists further. The increase in highway construction and suburban living helped relegate bikes to be used for children and adolescents transportation (Longhurst, 2015). In the southeastern part of the United States during the 1950s, the states went from mostly rural areas to urban areas (Godwin & Price, 2016). Compared to the rest of the country, the southern states' urban sprawl

created low-density population urban areas. These areas were more spread out and automobile-centric, making the bicycling environment unfriendly (Godwin & Price, 2016). The car mindset was secured until the 1970s-environmental movement and the Energy Crisis of 1973 leading to the bicycle's resurgence (Longhurst, 2015). The increase in bikes created enormous logistical and safety issues for bicyclists and motorists on the roads (Longhurst, 2015).

Bicycling in the United States has focused on fitness and recreation instead of transportation (Troy, 2012). Nevertheless, utilitarian bicycling provides the health benefits of exercise and a decrease in air pollution and greenhouse gas emissions while offering a means of getting to a wanted destination.

Bicycling for transportation can meet the exercise recommendations from The American College of Sports Medicine and the American Heart Association (Haskell et al., 2007). The exercise recommendations are either at least 30 minutes of moderate aerobic exercise, five days a week or at least 20 minutes of vigorous aerobic activity, three days a week to gain significant health effects. The activity can be split into at least 10-minute increments (Haskell et al., 2007). In Portland, Oregon, Dill (2009) researched whether bicycling for transportation would allow bicyclists to get the recommended amount of 150 minutes of moderate exercise. The study found that 59% of participants achieved at least 150 minutes of exercise over seven days (Dill, 2009). For health, bicycling for recreation and transportation allows people to get the recommended amount of exercise.

Fine particulate matter ($PM_{2.5}$) and ozone (O_3) have direct detrimental respiratory health effects (Grabow et al., 2012). Decreasing their emissions, especially in the metropolitan Atlanta area, will assist with the overall health of GSU students, staff, faculty, and administrators. According to the American Lung Association's State of the Air 2014, out of 277 metropolitan areas, the Atlanta-Athens-Clarke County-Sandy Springs, GA metropolitan area ranked 18th for annual particulate pollution, 32nd for high ozone days, and 77th for 24-hour particulate pollution (American Lung Association, 2014). Multiple studies have examined the role of active transportation, such as riding a bike to work, walking, or using public transit and their effect on fine particulate matter, ozone, and greenhouse gasses. Mathematical models and relative risk equations are used to calculate the estimated changes in fine particulate matter ($PM_{2.5}$) and ozone (O_3) levels, and fine particulate matter ($PM_{2.5}$) and greenhouse gas levels (CO_2), respectively, and the burden of disease (Grabow et al., 2012; Maizlish et al., 2013). These studies show that by decreasing car use and increasing exercise through active transport, especially for short trips (1.5 miles to 5 miles and 2.5 miles or less), greenhouse gas emissions and the burden of disease are significantly reduced (Grabow et al., 2012; Maizlish et al., 2013). Building infrastructure to promote safe bicycling is expensive; however, the health impact benefits may outweigh the cost.

2.2 Economic Health Impact of Bicycling

A significant barrier to building bicycle infrastructure is the expense, which its cost-benefit is still debated. A study comparing

three cities in Norway (Hokksund, Hamar, and Trondheim) examined the cost-benefit factors of walking and cycling tracks versus health costs, cycling apprehension, and the cost of car traffic in respects to pollution and noise (Sælensminde, 2004). The study found the benefit/cost ratios are: Hokksund 4.09, Hamar 14.34 and Trondheim 2.94. Each of the three cities ratios was greater than 1 concluding significant benefits of walking and cycling tracks versus the building cost (Sælensminde, 2004). A health impact study in Flanders, Belgium examined the health impact of switching from cars to bicycling and walking compared to the cost of creating two bike highways, the Antwerpen-Mechelen highway, and the Leuven-Brussel highway, over a 20-year period (Buekers, Dons, Elen, & Int Panis, 2015). The benefit/cost ratio for the construction of the Antwerpen-Mechelen highway would increase from 0.7 to 3.9, by a factor of 5. For the Leuven-Brussel highway, the ratios would increase from 0.6 to 4.2, by a factor of 7. These ratios conclude that the health benefits of bicycling and walking outweigh the cost of building the bike highways (Buekers et al., 2015). Although expensive to design and construct, the physical activity/health benefits of bicycling outweigh the cost of building the needed infrastructure.

2.3 Importance of Geographical, Bike Count, and Touch the Earth Evaluation Data

Tolley (1996) stated that 8 km (approximately 5 miles) or 30 minutes was a "reasonable cycling distance" (the distance in which a bulk of the students and numerous faculty and staff reside from the university campus) (Tolley, 1996). Multiple studies have used the 5-mile

parameter as well. A study conducted at the University of Western Australia used a walking distance of 1 km (0.62 miles) and biking distance between 1km and 8 km (Shannon et al., 2006). A study conducted at the University of Michigan-Flint Campus had 1-mile walking and 5-mile bicycling radius as parameters (Rybarczyk & Gallagher, 2014). An article using Kent State as a case study asked a question about distance students will bike, and "[m]ost students claimed that they were willing to bike within five miles" (Kaplan & Knowles, 2015). When looking at greenhouse gas effects on health, Grabow et al. (2012) considered 4 km (approximately 2.5 miles) one-way or 8 km both ways a short car trip in her analysis (Grabow et al., 2012).

Bicycle counts show the number of bicycles that go through a fixed period at various locations on the same day. Bike count data can be used for purposes such as piloting bike count methodology and evaluating the impact of downtown improvements on walking and biking. (Schasberger, Raczkowski, Newman, & Polgar, 2012). Bicycle count data can also be used to create models with the ability to compute bike traffic estimates in streets lacking the necessary data and to estimate the change in the number of bicycles in areas with altered built environments (Hankey et al., 2012).

Evaluations are commonly used in public health. The role of a public health evaluation "is a systematic way to improve and account for public health actions by involving procedures that are useful, feasible, ethical, and accurate" ("Framework for Program Evaluation," 2016). Kaplan and Knowles (2015) provide an outline to develop a

successful bike share program on college campuses and universities. The authors claim "[b]icycling offers tremendous mobility while also being environmentally friendly; it costs less in parking and roadway infrastructure and introduces exercise into people's daily lives"(Kaplan & Knowles, 2015). Therefore, bicycling should be a preferred method of transportation at college campuses. An evaluation of the Kent State University's bike share was conducted examining the demand, success, and impediments to bike use around the campus and the City of Kent (Kaplan & Knowles, 2015). Interestingly, the bike share program expansion and upgrades are similar to the Relay Bike Share with the City of Atlanta. The City of Atlanta Relay Bike Share allows bikes to be rented by the hour for a small semester fee at self-checkout kiosks around the city ("Relay Bike Share," 2016). Flashfleet, the Kent State University bike share program, is implemented by a bike share company, has an electronic checkout system, and the bikes are rentable for 3 hours at no cost. Afterward, a fee is charged (Kaplan & Knowles, 2015).

The Touch the Earth evaluation asked a question about bicycle confidence. In 2006, Mr. Roger Geller, Bicycle Coordinator for the Portland Office of Transportation, wrote a report separating bicyclists in Portland, Oregon into four categories (Geller, 2006). The four types of bicyclists are The Strong and the Fearless, The Enthused and the Confident, The Interested but Concerned, and The No Way No How groups (Geller, 2006).

2.4 Universities' Role in Bicycling

Universities are the perfect microcosms conducive to impacting the future generation of leaders, employers, and employees in the workforce (Tolley, 1996). Given the young age of most college students, universities have the unique potential to influence new green lifestyles which will then follow the students into the workplace (Tolley, 1996). With their perpetual parking space shortage, universities are excellent places to create bike plans as a way of reducing the cost of air pollution, reducing the need to set up and maintain parking amenities, and promoting physical activity. Greener universities have attracted more students and become more competitive for funding for environmental sustainability studies (Tolley, 1996). Now that the importance of health, economics, geography, bike counts, and bike share evaluations data are available, the data's role at Georgia State University will be discussed.

3 METHODS AND RESULTS GEOGRAPHY

3.1 Geographic Locations of Students Methods

The Fall 2014 Bicycling for Transportation survey had a total of 5,484 respondents consisting of students, faculty, staff, and administrators. Students composed the majority of respondents comprising 68.4% ($n=3752$), and faculty, staff, and administrators constituted 22.6% ($n=1240$) of the total number of respondents. There was a total of 466 respondents (8.5%) who did not specify their classification, nine respondents preferred not to answer, and 17 respondents were not students, administrators, faculty, or staff. Only

student survey participants were asked to provide either the address of where they live during the school week or the name of their on-campus residence hall. Out of the total of 3,752 student respondents, 89% ($n=3,352$) gave an address, zip code (or both), or campus residence hall. A total of 540 respondents resides in a campus residence hall. Joseph Michael Bryan, Jr., an epidemiologist at the Georgia Department of Public Health, geocoded the addresses down to the census tract level using the Centrus software. The match rate for geocoding addresses was 87% ($n=2,932$), which is considered a good match ("Geocoding Options Properties," 2013). After receiving the completed geocoded data, the data were converted into a shapefile and spatially joined with an Atlanta Region census tract shapefile, created by the Atlanta Regional Commission, in ArcGIS 10.4 ("Census 2000 Tracts Atlanta Region," 2016). The newly joined shapefile contained the data used to create geographical maps showing student residences.

3.2 Geolocation of Students Results

Atlanta Regional Counties Where Student Respondents Reside Bicycling for Transportation Survey, October 2014

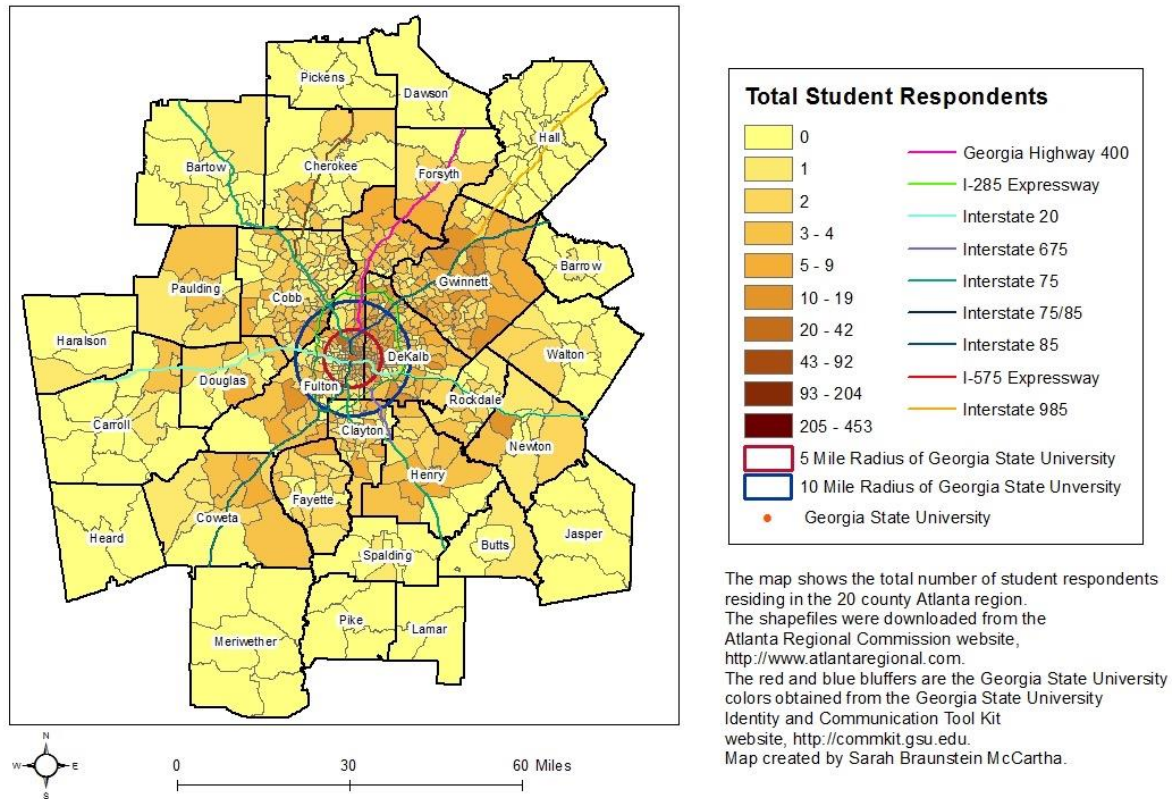


Figure 3.1 Students Residence in the Atlanta Regional Counties

The county and census tract shapefiles displayed in Figure 3.1 came from the Atlanta Regional Commission, which manages data from the above counties ("About ARC, 2016"). Figure 3.1 shows the effect of southeastern urban sprawl because students reside and travel long distances to and from campus.

Student Respondents Residing Within 5 to 10 Miles of Georgia State University, by Census Tract Bicycling For Transportation Survey, October 2014

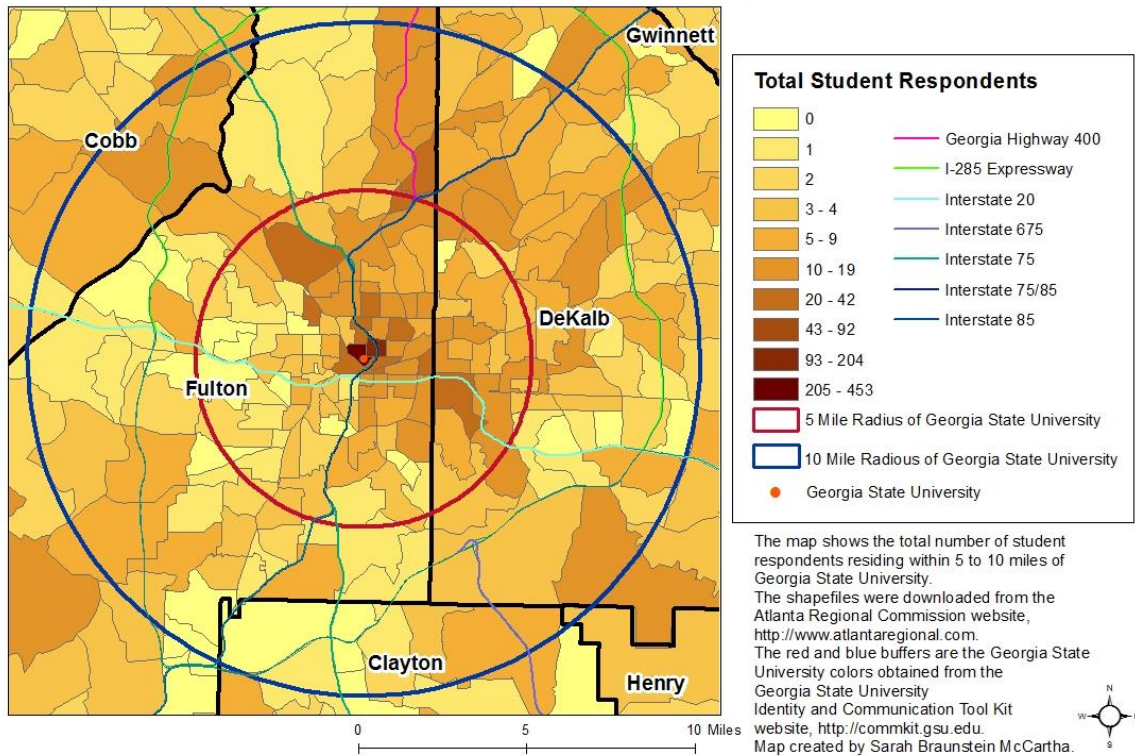


Figure 3.2 Students Residence Within 5 and 10 Miles of Campus

Student Respondents Residing Within 5 Miles of Georgia State University, by Census Tract Bicycling For Transportation Survey, October 2014

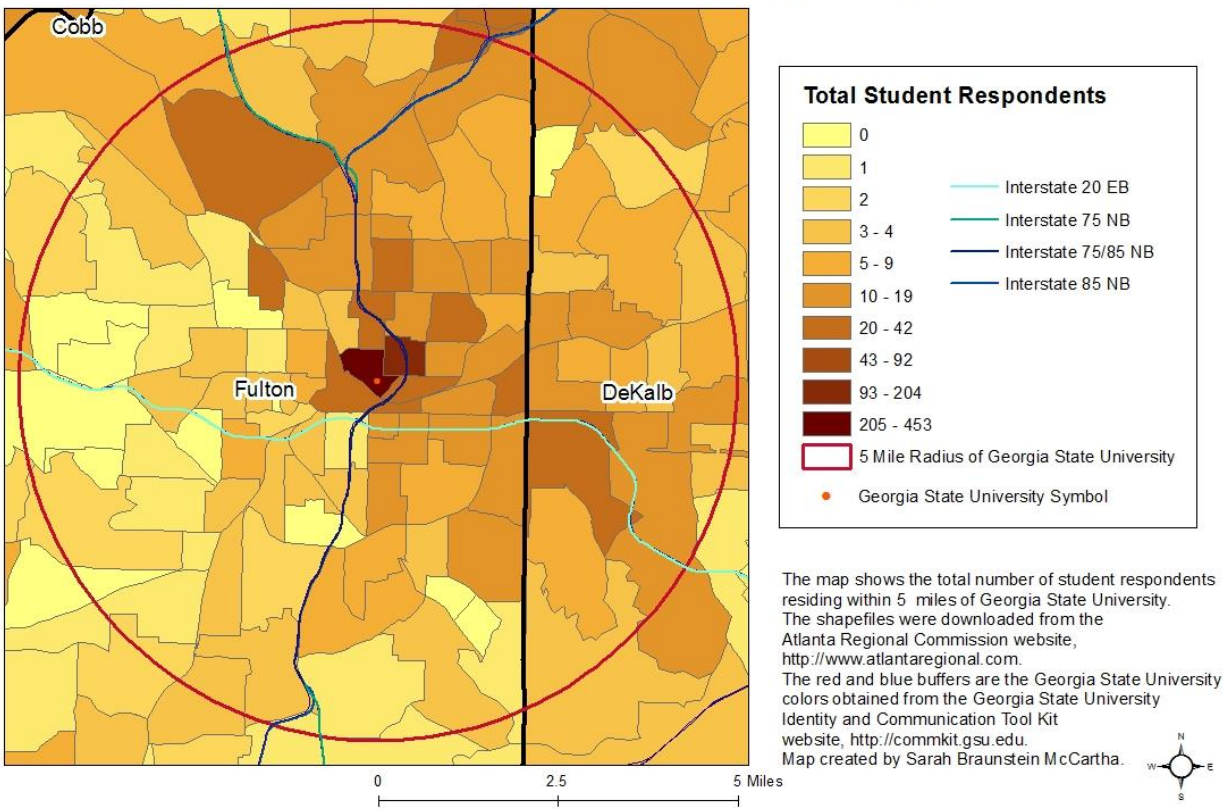


Figure 3.3 Census Tracts with the Largest Number of Students Residing Around Campus

Figure 3.2 details the number of students living within five and 10 miles of the GSU campus. Within the five-mile radius of campus, as shown in Figure 3.3, two census tracts, located within and above GSU's census tract location, had the most students with 453 and 158 respectively. These census tracts, 002700 and 002800, have the most students due to the locations of the Georgia State University residence halls.

Student Respondents Residing Within 5 Miles of Georgia State University Not Including Residence Halls, by Census Tract, Bicycling For Transportation Survey, October 2014

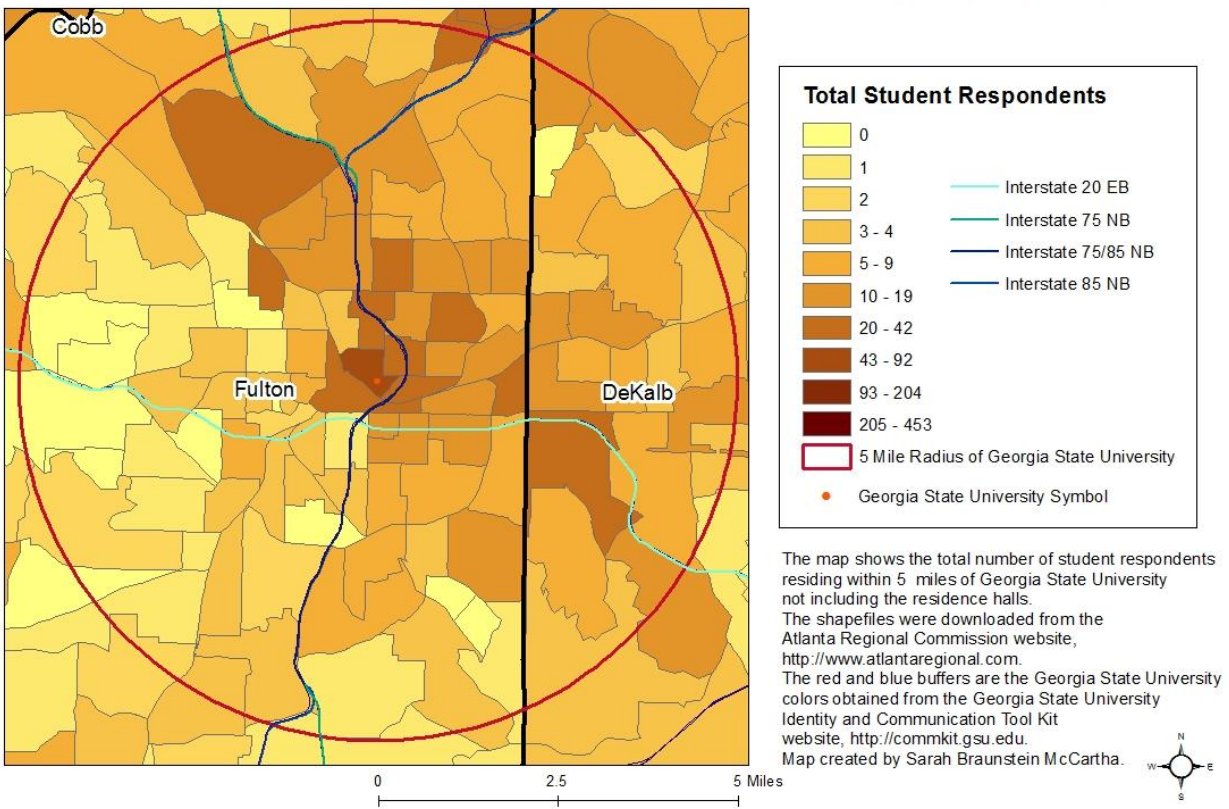


Figure 3.4 Census Tracts Without Residence Hall Residents

After extracting the residence hall populations, these census tracts contain considerably fewer students (47 students versus 453 students). Therefore, the census tract with Georgia State University has a much lighter color seen in Figure 3.4.

3.3 Geolocation of Students Bicyclists to Campus

Student Respondents Who Bicycle All or Most of the Time to Georgia State University and Live Within 5 miles of Campus, by Census Tract, Bicycling for Transportation Survey, October 2014

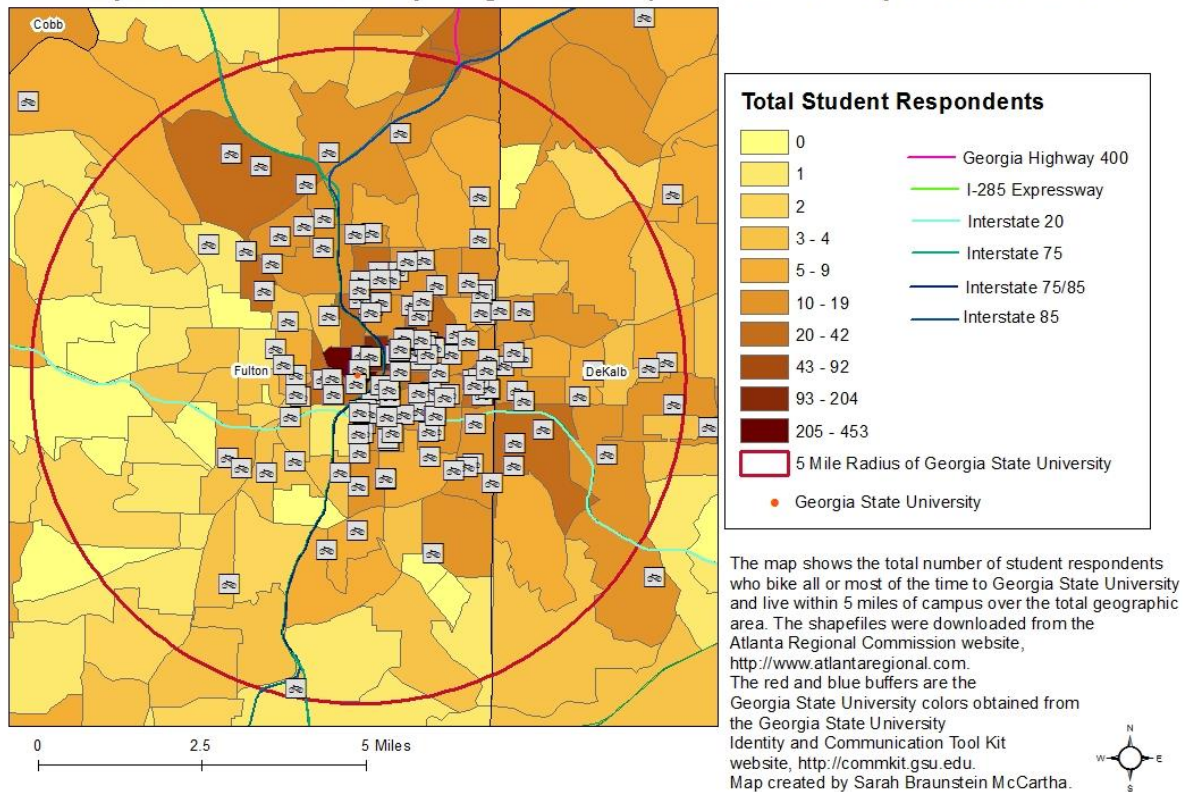


Figure 3.5 Census Tracts that Student Reside Within 5 Miles and Bicycle All or Most of the Time to GSU

Student Respondents Who Bicycle All or Most of the Time to Georgia State University, by Census Tract, Bicycling for Transportation Survey, October 2014

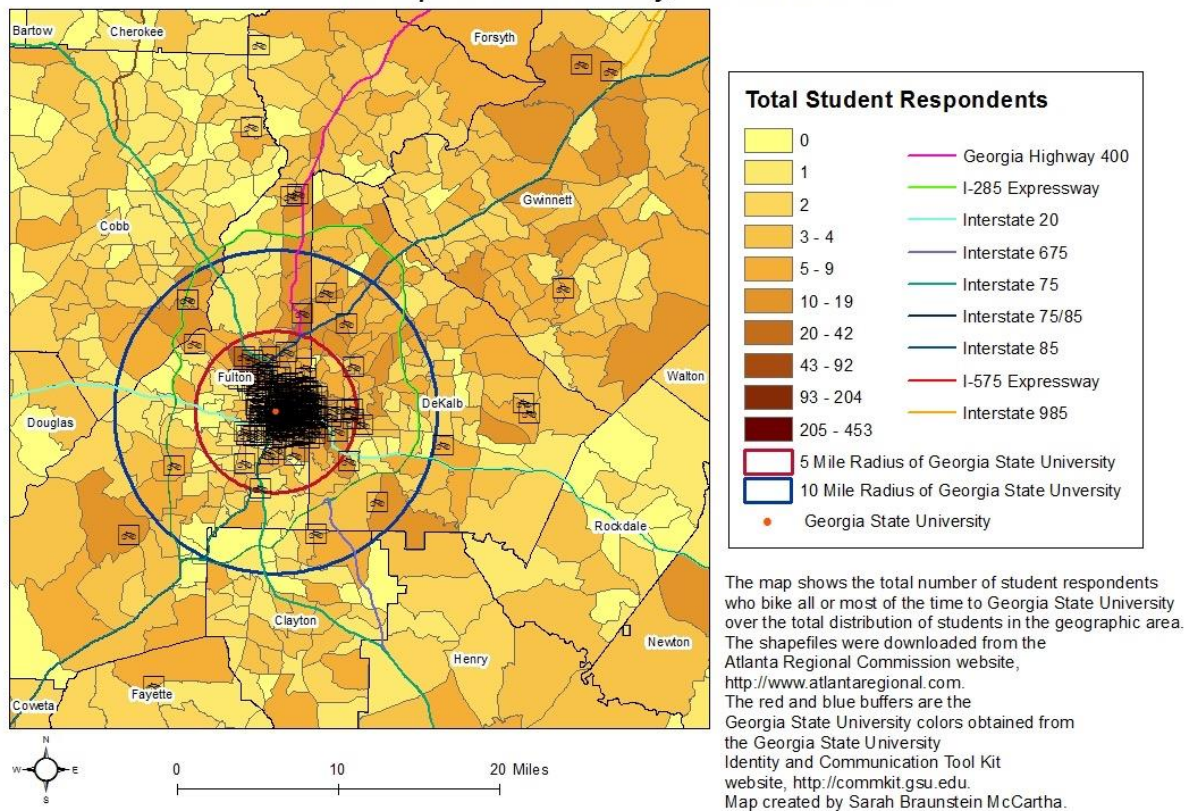


Figure 3.6 Census Tract Where Students Reside and Bicycle All or Most of the Time to GSU

When looking at the students who reported bicycling All the Time or Most of the Time to, from, and around GSU, these students mostly live within 5 miles of campus (Figure 3.5 and Figure 3.6). However, some students living greater than 10 miles away from campus stated that they bicycle to, from, and around GSU All or Most of the Time.

3.4 Residence Housing and Bicycling to Campus

A comparison can be made between students living on-campus and off-campus and bicycling to Georgia State. Table 3.1 compares housing and

bicycling to campus. Only 16 students who live on-campus responding bicycling All or Most of the Time.

Residence and Bicycling for Transportation to GSU

Live in Georgia State University Housing?	Bicycling for Transportation to Georgia State University						
	All of the Time	Most of the Time	Sometimes	Rarely	Never	Missing	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	N
Yes	2 (0.4)	14 (2.7)	30 (5.8)	43 (8.3)	424 (82.0)	4 (0.8)	517
No	88 (3.1)	126 (4.4)	218 (7.6)	258 (9.0)	2115 (74.2)	46 (1.6)	2851

Table 3.1 Residence and Bicycling for Transportation to Georgia State University

4 GEORGIA STATE BIKE COUNTS

4.1 Bike Count Data Methods

Knowing the commuting patterns of the bicyclists to and from Georgia State University is paramount to being able to identify the desired type and location of infrastructure investments. Volunteers counted the number of bicycles that rode through each intersection during a two-hour period of a scheduled bike count day. Counts were conducted in both the morning and afternoon. The bicycles were counted as they passed through the intersection. The volunteers collected data about the direction, the gender, and the age of the bicyclists, whether the bicycle was ridden on the street or sidewalk, whether it was going with or against traffic, and whether the bicyclist was wearing a helmet. Although written instructions were given to each volunteer, no formal training was conducted. Interrater reliability was not established. This capstone used bike count data from Fall 2009, Spring 2012, Spring 2014, Fall 2014, and Spring 2015 to follow trends over time.

Fall 2009, Spring 2012, and Fall 2014 data were collected at three significant intersections around campus: Piedmont Avenue (Ave.) and Edgewood Avenue, Piedmont Avenue, and Decatur Street (St.), and "Five Points," where Peachtree St., Marietta St., Decatur St., and Edgewood Ave. intersect. In addition to the three intersections above, the Spring 2014 data included bike counts conducted at the intersection of Piedmont Ave. and John Wesley Dobbs Ave. The morning Spring 2015 counts were performed at the intersections of Piedmont Ave. and Edgewood Ave. and Piedmont Ave. and Decatur St. The afternoon Spring 2015 counts took place at the intersections of Piedmont Ave. and Decatur St. and Piedmont Ave. and Auburn Ave. The Five Points intersection was not counted during the morning or afternoon Spring 2015 counts. During each semester, the morning and afternoon bike counts were conducted on the same day. For each semester, the morning bike counts were carried out at either 7am-9am or 8am-10am, and the afternoon bike counts took place at either 4pm-6pm, 4:30pm-6:30 pm, or 5pm-7pm. The Fall 2009 and Spring 2012 data were chosen based on having consistent location data. The Fall 2014 counts were conducted around the same time as the Fall 2014 Bicycling for Transportation survey, and the Spring 2015 data are the most current available data. Table 4.1 shows the intersections and times for each semester bike count. At the end of each bike count session, the completed form was collected, and the data entered into the computer. Once all the information was entered, the bike counts were sent to the Atlanta Bicycle Coalition for their records.

Bike Count Intersections and Times at Georgia State University

Semester	Piedmont Ave./Edgewood Ave.	Piedmont Ave./Decatur St.	Five Points	Piedmont Ave./John Wesley Dobb Ave.	Piedmont Ave./Auburn Ave.	Morning Time (AM)	Afternoon Time (PM)
Fall 2009*	X	X	X			7-9	4:30-6:30
Spring 2012*	X	X	X			8-10	4:30-6:30
Spring 2014*	X	X	X	X		8-10	5-7
Fall 2014*	X	X	X			8-10	4-6
Spring 2015 AM**	X	X				8-10	
Spring 2015 PM**	X	X			X		4-6

*Intersections same in the AM and PM

**Intersections differ from the AM and PM

Table 4.1 Bike Count Intersections and Times by Semester

For this capstone, all of the selected semester bike count data were synthesized, and the gender and age information was tallied and created into pie charts at each location on the map. Each intersection point was found using Google Earth Pro and imported into ArcMap 10.4. The pie graphs were created in Microsoft Excel and imported into ArcMap 10.4. The total number of bicycles counted for each site are shown in between the gender and age pie charts. Age and gender were determined based on sight as the bicyclist rode through the intersection.

4.2 Bike Count Results

The gender and age of the bicyclists riding along with the total counts during the morning and afternoon are shown on maps at their respective locations. The locations of each bicycle count included Five Points, the intersection of Piedmont Ave. and Edgewood Ave., the intersection of Piedmont Ave. and Decatur St., the intersection of

Piedmont Ave. and John Wesley Dobbs Ave., and the intersection of Piedmont Ave. and Auburn Ave. The descriptions are shown on each map.

Fall 2009 AM Bike Counts

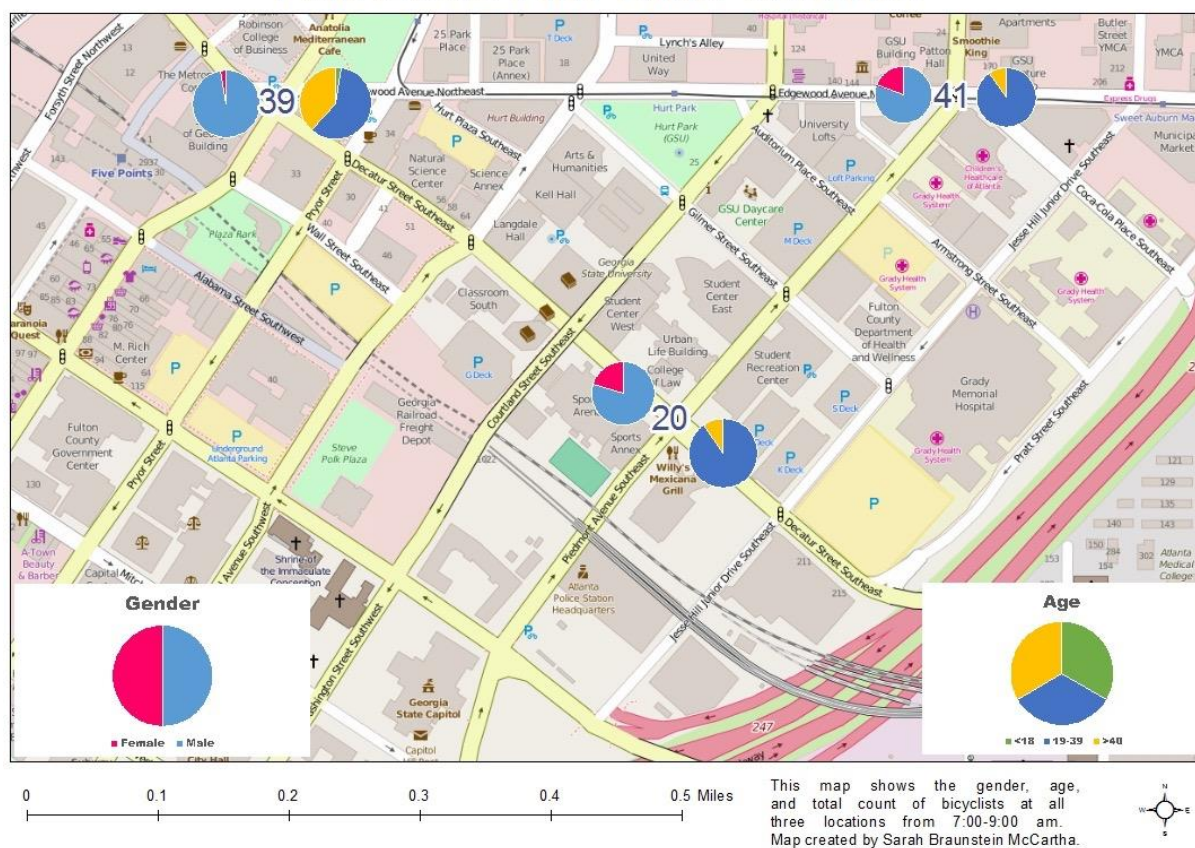


Figure 4.1a Bike counts During a Morning in the Fall of 2009

Although the numbers change, each semester male bicyclists outnumbered female bicyclists, and most of the bicyclists were between the ages of 19 and 39.

During the morning of Fall 2009, bike counts were conducted at Five Points, the intersection of Piedmont Ave. and Edgewood Ave., and the intersection of Piedmont Ave. and Decatur St. from 7:00 am to 9:00 am (Figure 4.1a). The greatest number of total bicyclists counted were at the intersection of Piedmont Ave. and Edgewood Ave. with Five Points

being a very close second. The total number of bicycles counted in the morning was 100.

Fall 2009 PM Bike Counts

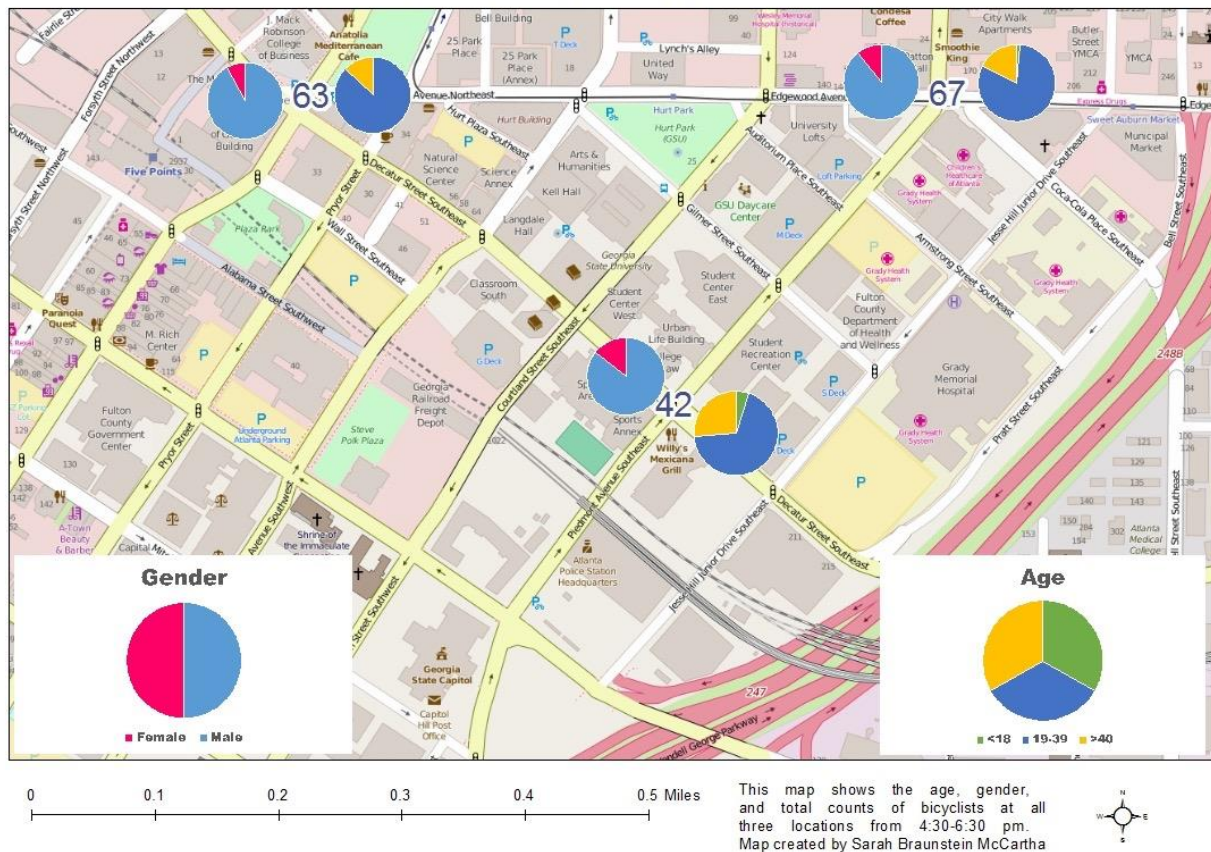


Figure 4.1b Bike counts During an Afternoon in the Fall of 2009

The number of bikes counted in the afternoon of Fall 2009 at each location was greater than the number of bikes counted in the morning of Fall 2009 at the same location (Figure 4.1b). The intersection of Piedmont Ave. and Edgewood Ave. had the most counts in the morning and afternoon. The total number of bicycles counted in the afternoon was 172, making 272 the total number of bicycles counted at all locations during both time periods.

Spring 2012 AM Bike Counts

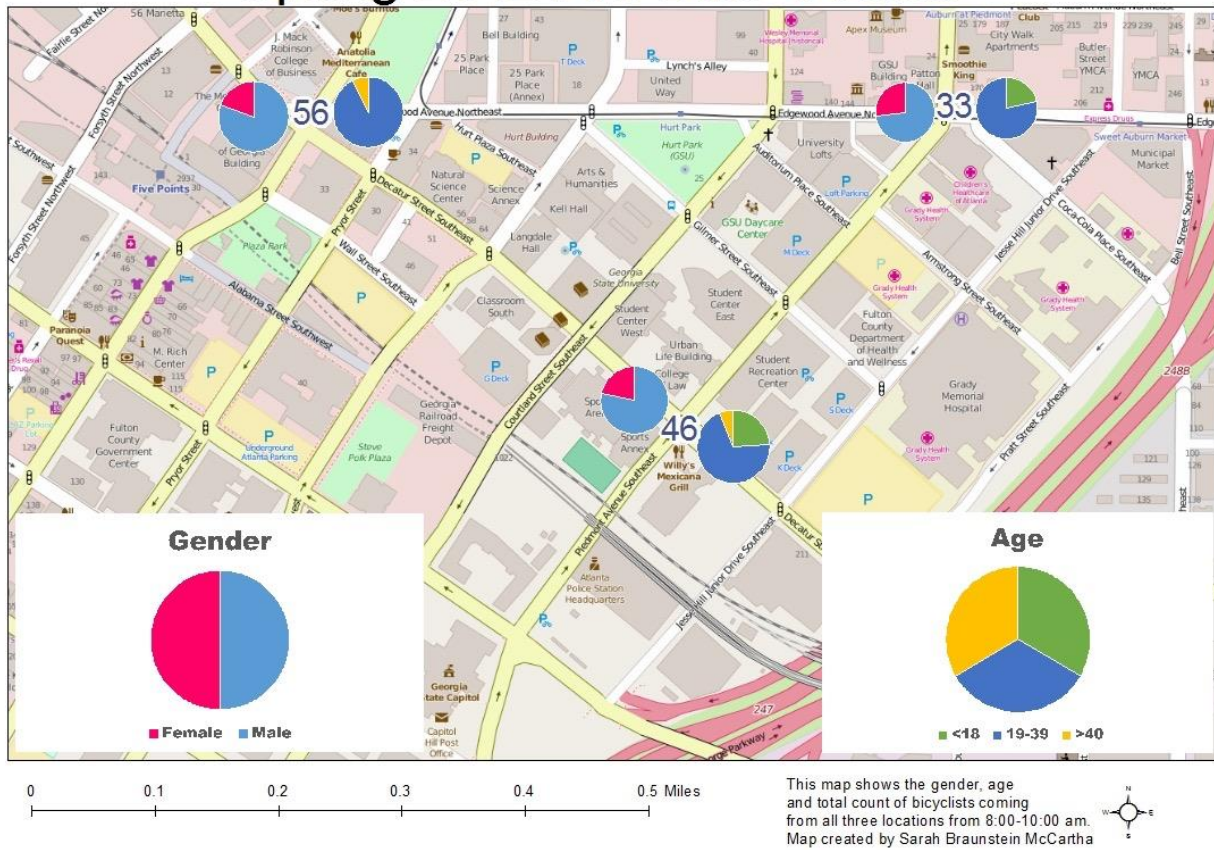


Figure 4.2a Bike counts During a Morning in the Spring of 2012

In the morning of Spring 2012, Five Points had the greatest number of bicycles counted followed by the intersection of Piedmont Ave. and Decatur St. (Figure 4.2a). The total number of bicycles counted was 135, higher than Fall 2009.

Spring 2012 PM Bike Counts

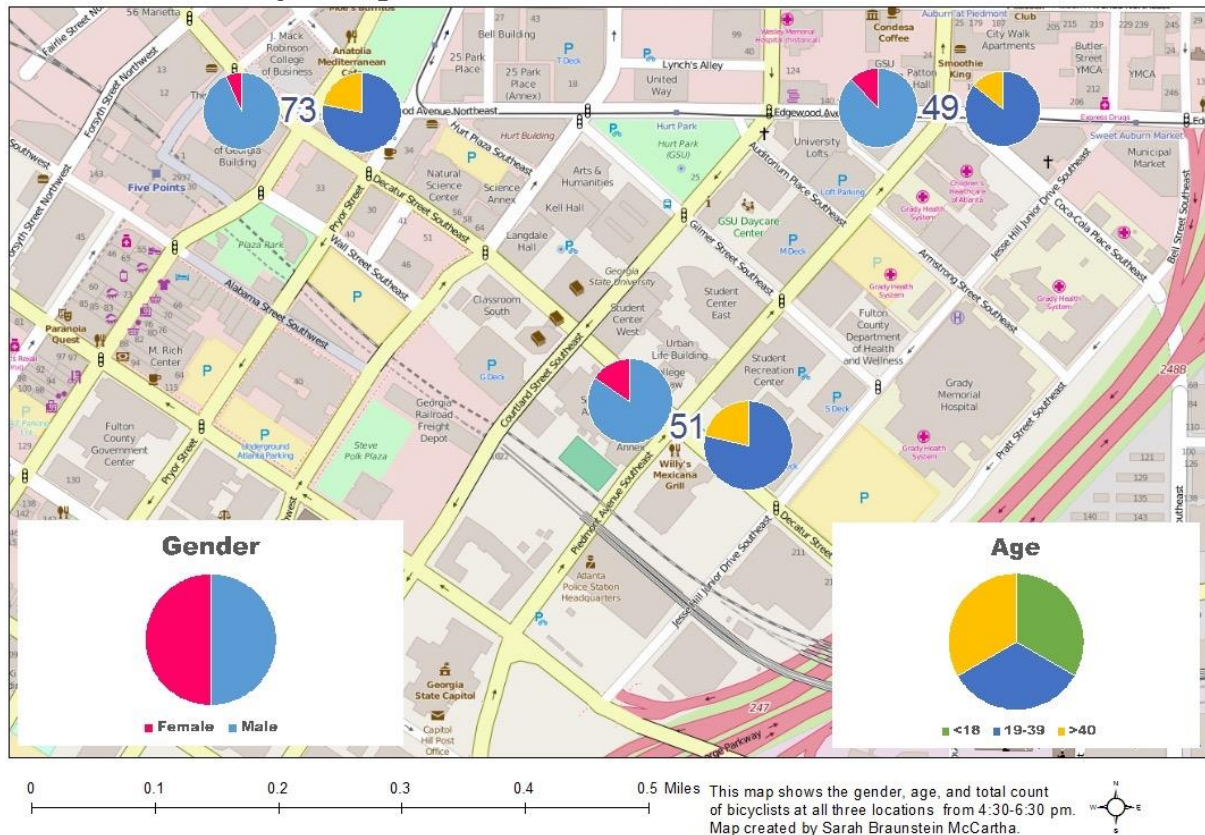


Figure 4.2b Bike counts During an Afternoon in the Spring of 2012

The Spring 2012 afternoon bike counts had greater counts (compared to the morning) with the most bikes counted at Five Points followed by Piedmont Ave. and Edgewood Ave. The total number of bicycles counted during the afternoon at all locations was 173. The total number of bike counted was 308, more than the Fall 2009 total. The Spring 2012 afternoon bike counts are shown in Figure 4.2b.

Spring 2014 AM Bike Counts

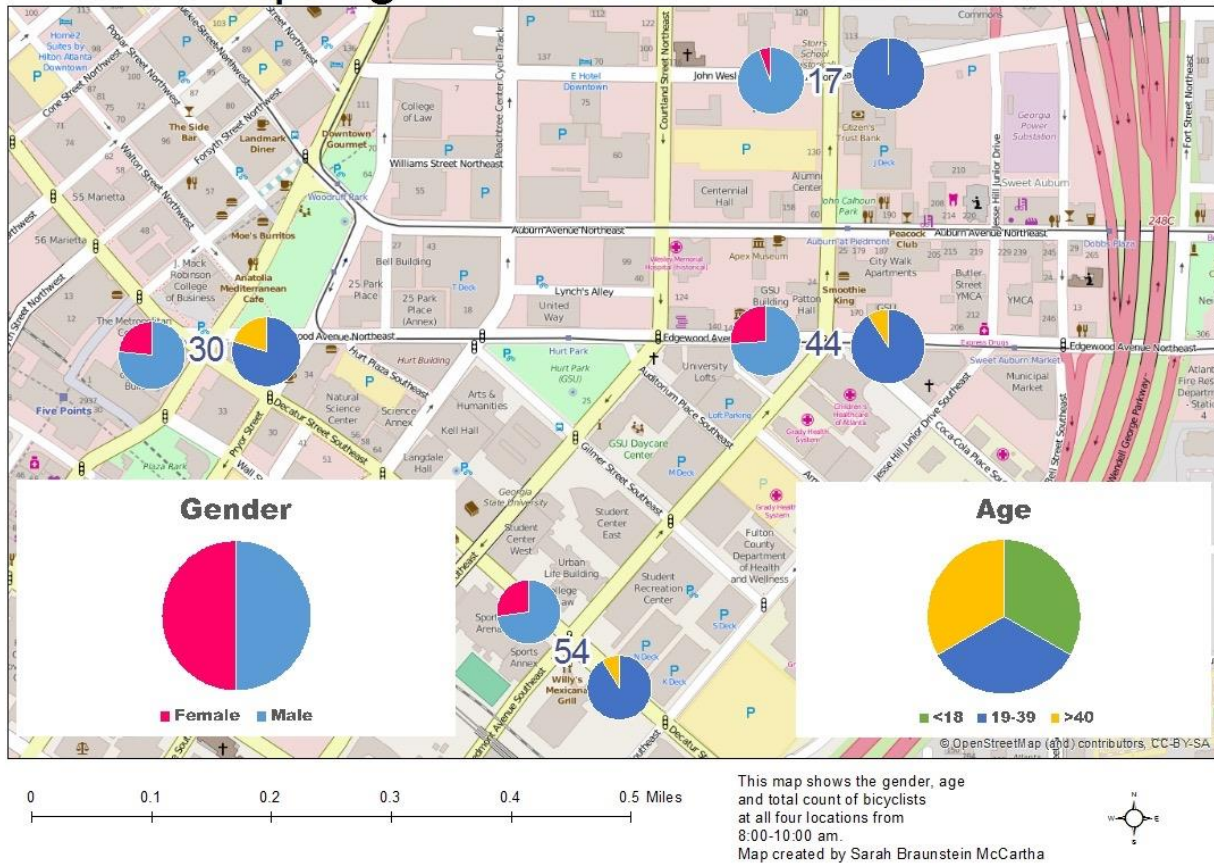


Figure 4.3a Bike counts During a Morning in the Spring of 2014

During Spring 2014, a new intersection, John Wesley Dobbs Ave. and Piedmont Ave. was counted (Figure 4.3a). Piedmont Ave. and Decatur St. had the most bicycles counted, followed by Piedmont Ave. and Edgewood Ave. The total number of bicycles counted in the morning was 145.

Spring 2014 PM Bike Counts

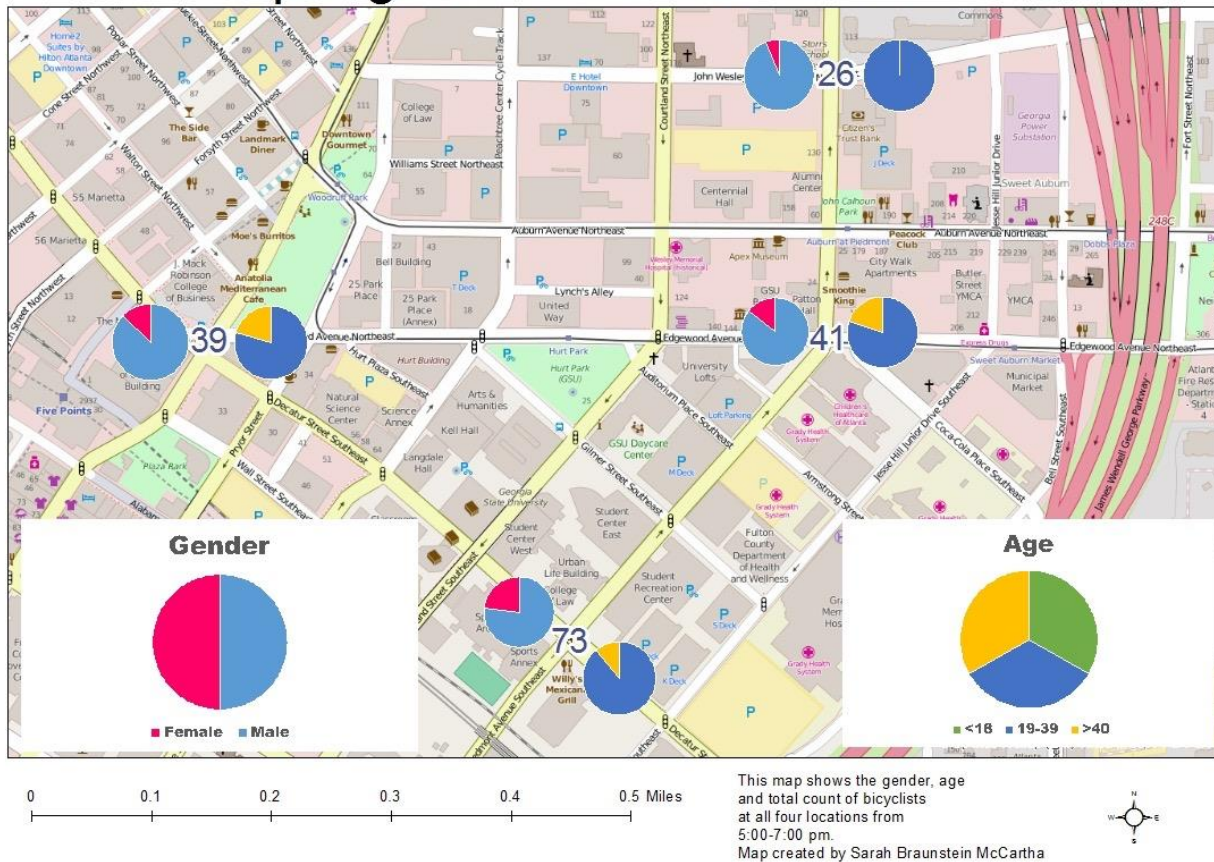


Figure 4.3b Bike Counts During an Afternoon in the Spring of 2014

The Spring 2014 counts were highest at Piedmont Ave. and Decatur St. followed by Piedmont Ave. and Edgewood Ave. (Figure 4.3b). The total bikes counted in the afternoon was 179. The total number of bicycles counted from all locations and time periods was 324.

Fall 2014 AM Bike Counts

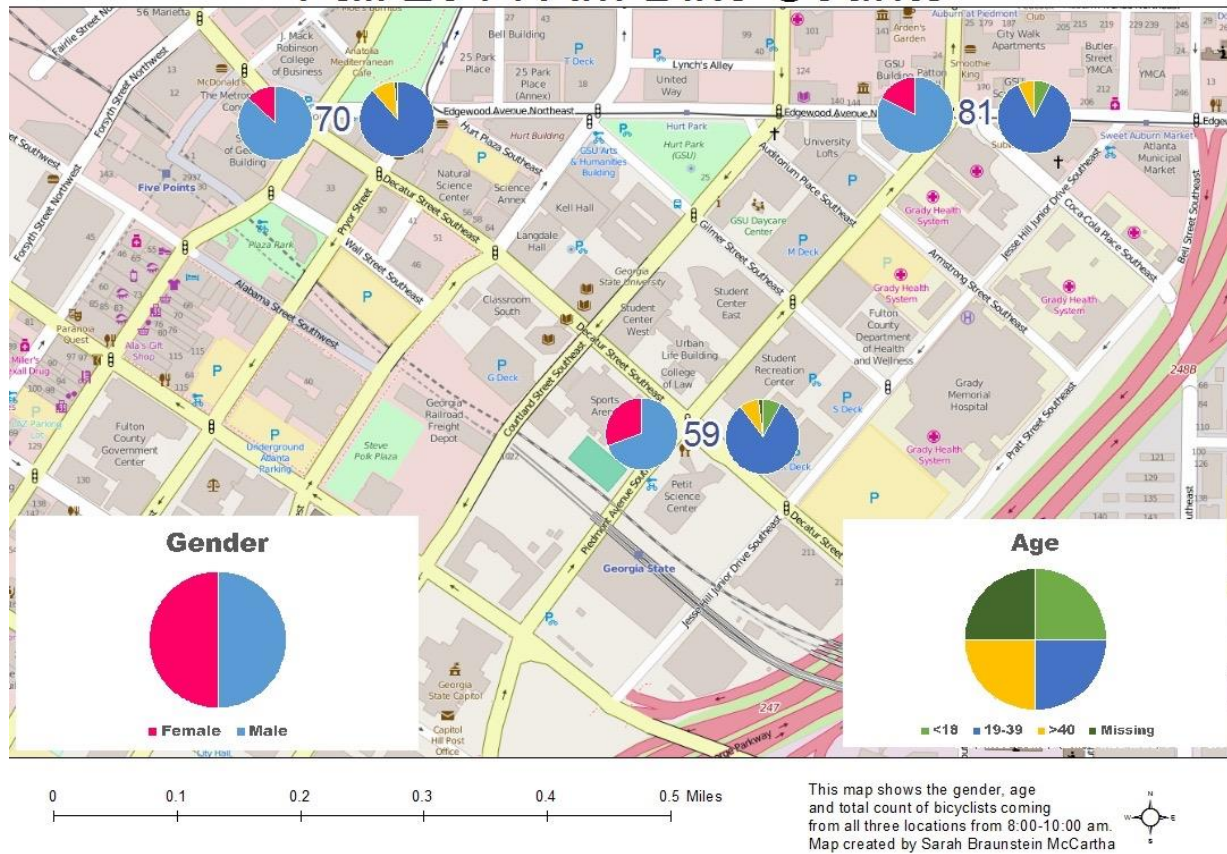


Figure 4.4a Bike Counts During a Morning in the Fall of 2014

The Fall 2014 morning counts were the highest total morning counts of any semester. The total bicycle count was 210 with the most counted at Piedmont Ave. and Edgewood Ave. followed by Five Points. Figure 4.4a displays the bike counts for the Fall 2014 morning.

Fall 2014 PM Bike Counts

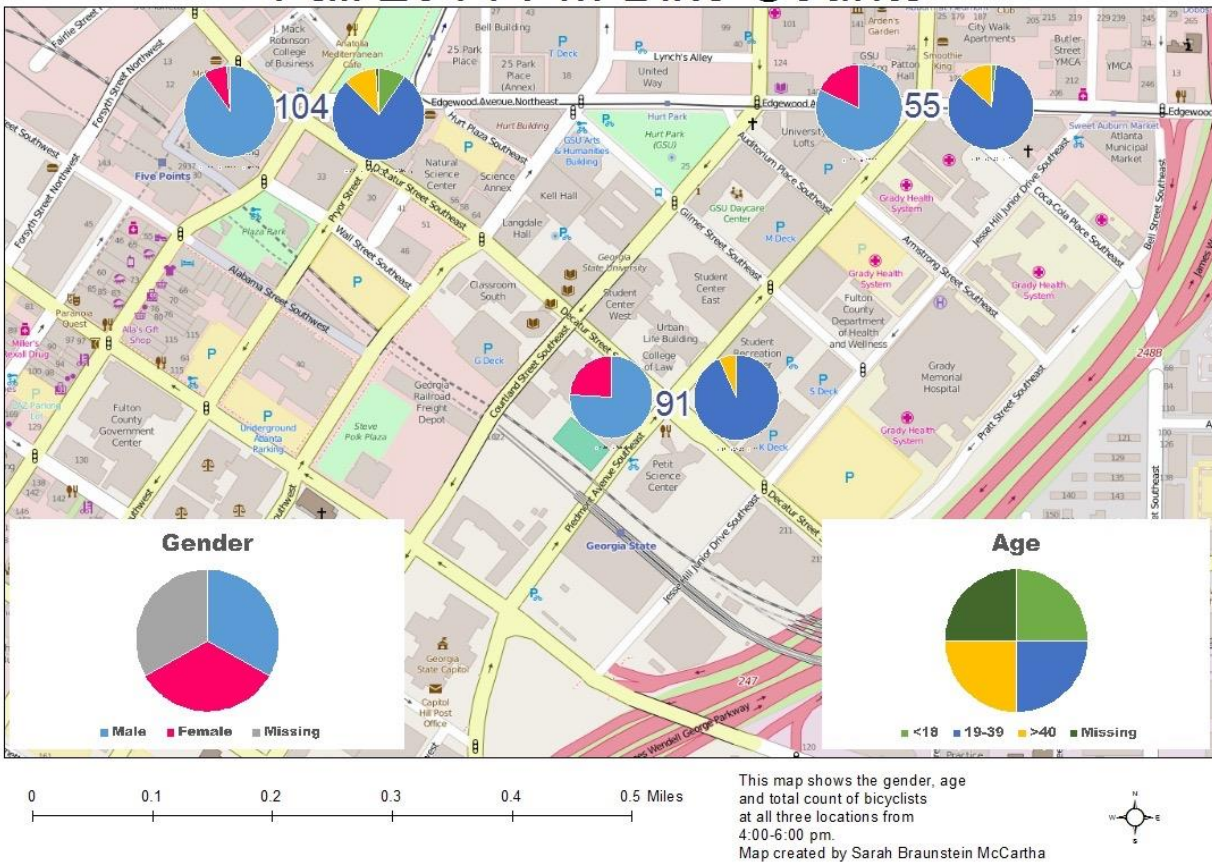


Figure 4.4b Bike Counts During an Afternoon in the Fall of 2014

The Fall 2014 data had the most afternoon total bike counts of any other semester at 250. Fall 2014 had the highest numbers of bicycles counted at both times and locations with a total of 460 bikes counted. The Fall 2014 afternoon counts are displayed in Figure 4.4b.

Spring 2015 AM Bike Counts

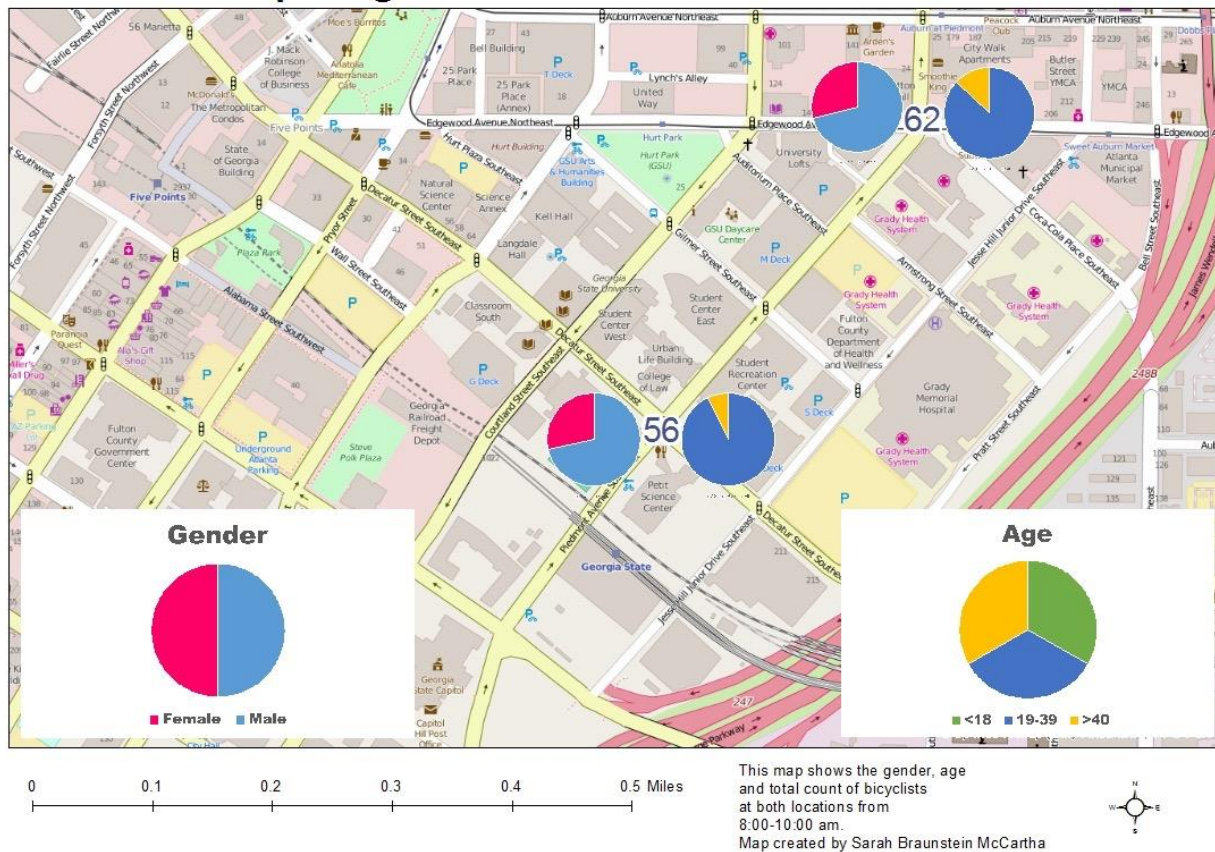


Figure 4.5a Bike Counts During a Morning in the Spring of 2015

During the Spring 2015 morning, 118 bikes were counted in the two locations. The Piedmont Ave. and Edgewood Ave. intersection had the greatest number of bicycles recorded. The Spring 2015 morning bike counts are shown in Figure 4.5a.

Spring 2015 PM Bike Counts

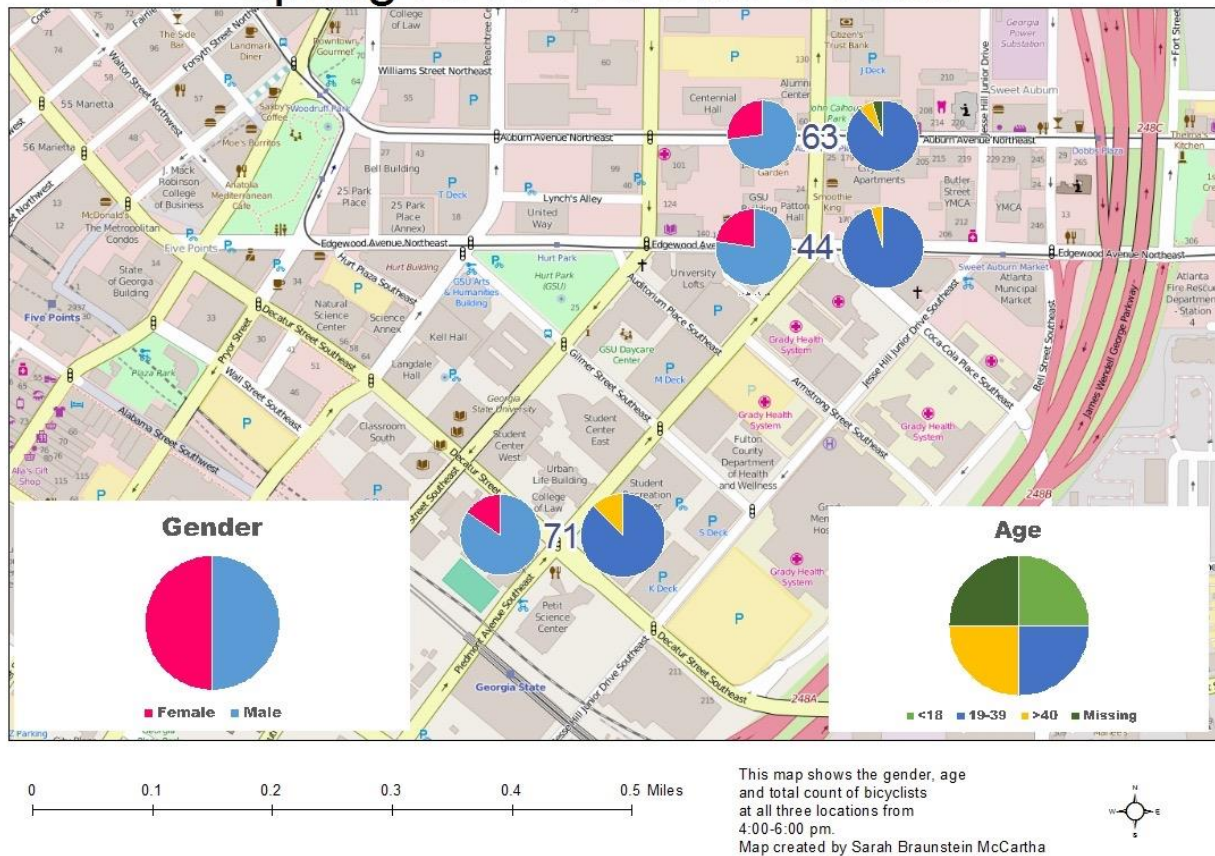
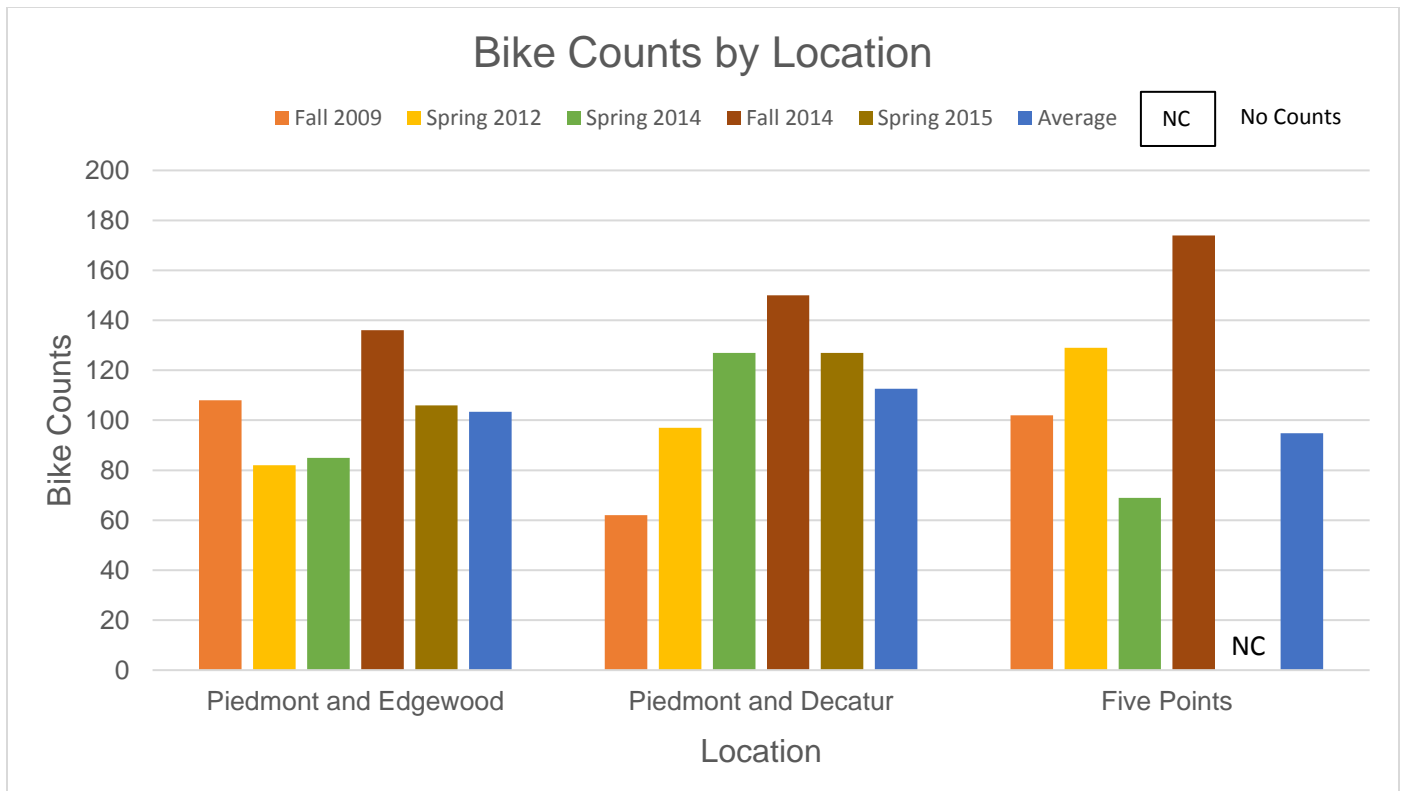
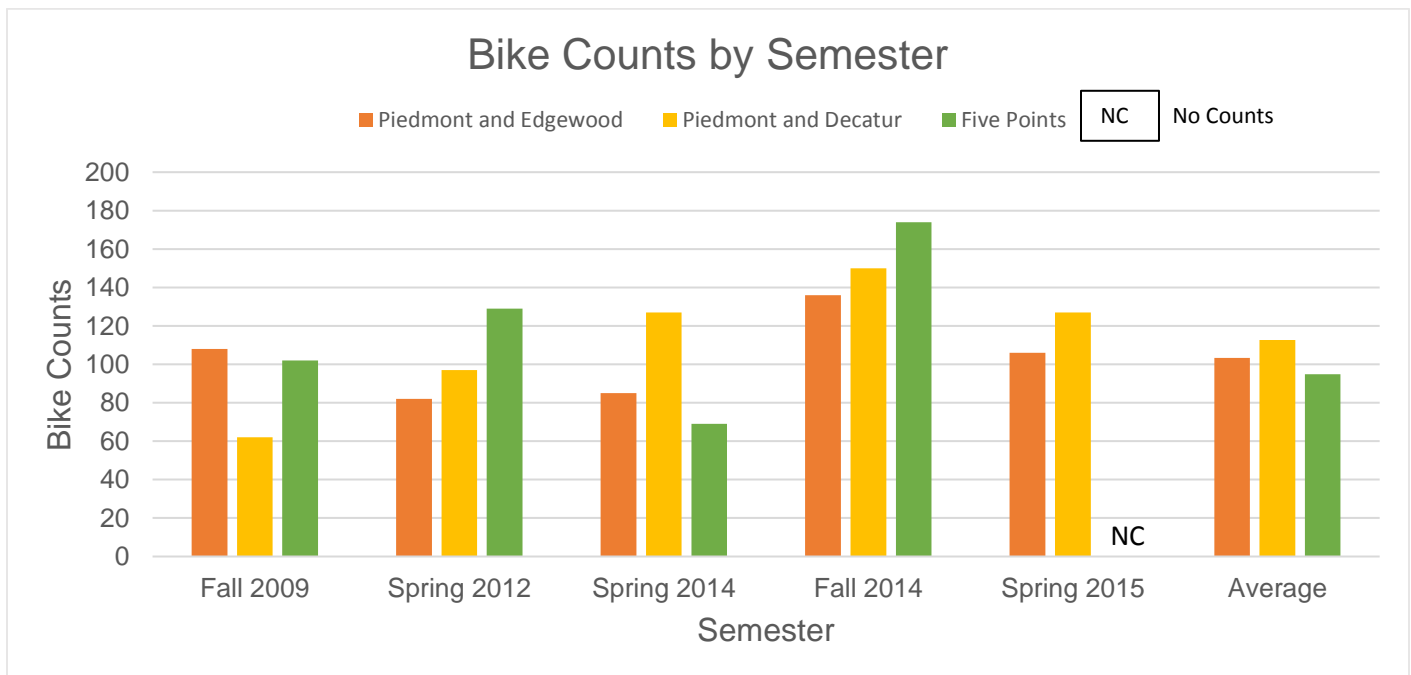


Figure 4.5b Bike Counts During an Afternoon in the Spring of 2015

During the afternoon of Spring 2015, three locations were counted (Figure 4.5b). However, the intersection of Piedmont Ave. and Auburn Ave. was counted instead of Five Points. The total afternoon count was 178. The most bicycles were counted at Piedmont Ave. and Decatur St. followed by Piedmont Ave. and Auburn Ave. Three bicyclists are missing age data. The total number of bikes counted for the semester was 296.



Graph 4.1 Bike Counts over Time by Location



Graph 4.2 Bike Counts by Location over Time

As mentioned before, there were more male bicyclists than female bicyclists, and the most common age group was 19-39 at all time periods and places. Only the three main intersections were compared for the most bike counts and bike count trends because the other sites do not have comparable data. Graphs 4.1 and 4.2 compare the three main intersections, Piedmont Ave. and Edgewood Ave., Piedmont Ave. and Decatur St., and Five Points by location and semester, respectively. When comparing years, the Fall 2014 semester had the most bicycles counted. The Piedmont Ave. and Decatur St. intersection has the greatest average with an average of 112.6 bikes for all time periods and semesters. Piedmont Ave. and Edgewood Ave. intersection had the lowest average number of bikers over time.

5 TOUCH THE EARTH BIKE SHARE PROGRAM

5.1 Touch the Earth Bike Share Program Evaluation Methods

During the 2014 Summer semester, a survey was developed to be used during the Fall 2014 semester to evaluate the Touch the Earth Bike Share program, shown in Appendix 11.1. Touch the Earth is Georgia State University's outdoor recreation program. As part of the program, bikes are rentable for free for a maximum of three consecutive business days ("Touch the Earth," 2016). The survey was voluntarily available to every bicycle renter at the completion of the rental period. Touch the Earth staff provided a paper form and collected it upon completion. The evaluation contained three parts: the demographics of people who rented the bikes, bike ownership, and biking confidence, and bike usage through Touch the Earth.

The demographics examined in the survey were gender, classification, and residence. The classifications were freshmen, sophomore, junior, senior, graduate student, faculty/staff and other. The respondents were asked whether they lived in on-campus housing (Patton Hall, Greek Housing, Piedmont North, University Commons, and The Lofts), lived downtown in an off-campus location, or lived off-campus and not in a downtown location.

The next section explored bicycle ownership and bicycle confidence. Bicycle ownership asked if the participants presently had a bike in order to find out why the participants rented the bikes. Bicycle confidence was established by using modified categories and definitions based on Mr. Geller's Four Types of Transportation Cyclists (Geller, 2006). The following five categories were used to measure bicycle confidence:

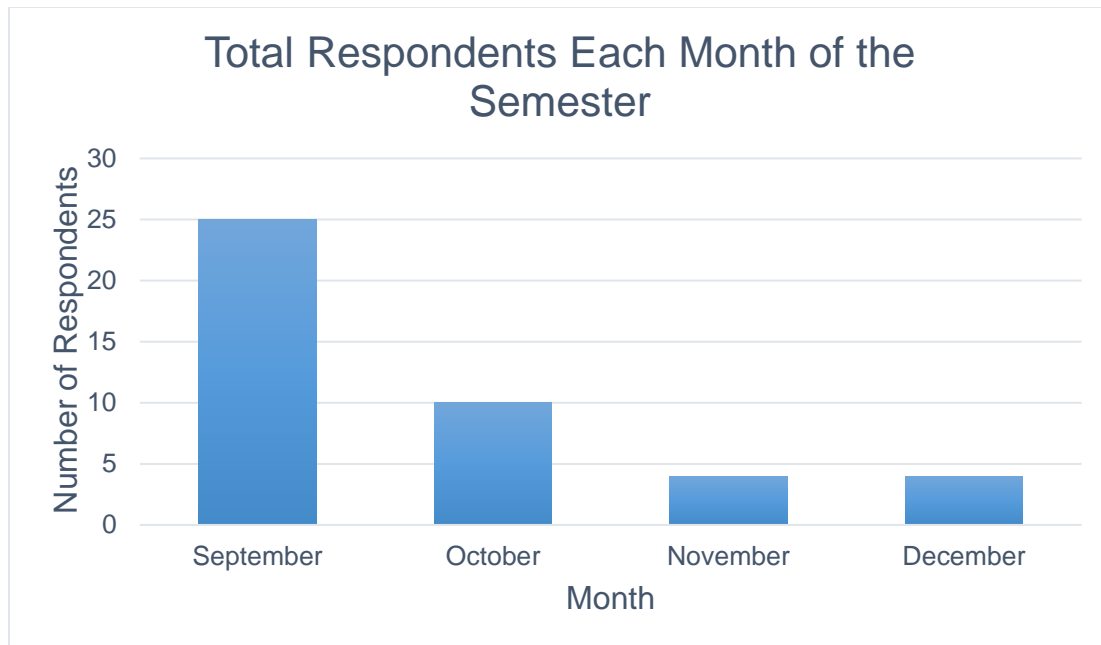
- Strong & Fearless - I am willing to ride my bike in any situation. I consider myself a cyclist as part of my identity.
- Enthused & Confident - I am confident sharing the road with vehicles but prefer areas geared to cyclists.
- Comfortable, but Cautious - I am comfortable on most roads, but strongly prefer areas geared to cyclists. I will choose another mode depending on the areas.
- Apprehensive, but Interested - I have heard a lot about cycling and was curious to try it, but I require areas geared to cyclists.
- I may not bike again - Due to weather, physical condition or lack of interest, I am not interested in cycling anymore.

Knowing the ownership status and biking confidence of the bicyclists helps determine which populations of bikers are attracted to the bike share program.

The last section asked how the bicycle was used and how Touch the Earth can improve its program. This section examined how often the participants rented bikes through the program, the length of time the bicycle was rented, how the bike was used during the rental, and if the bicycle was transported in a car to the bicycling destination. The last questions asked how the participants heard about the program, the participants' satisfaction with bike's condition and the renting process, how to improve the program, and what was the participants best part of the bicycle rental. These questions are looked at separately with the results and will be used to determine recommendations to improve the program. The evaluation form can be found in Appendix 11.1.

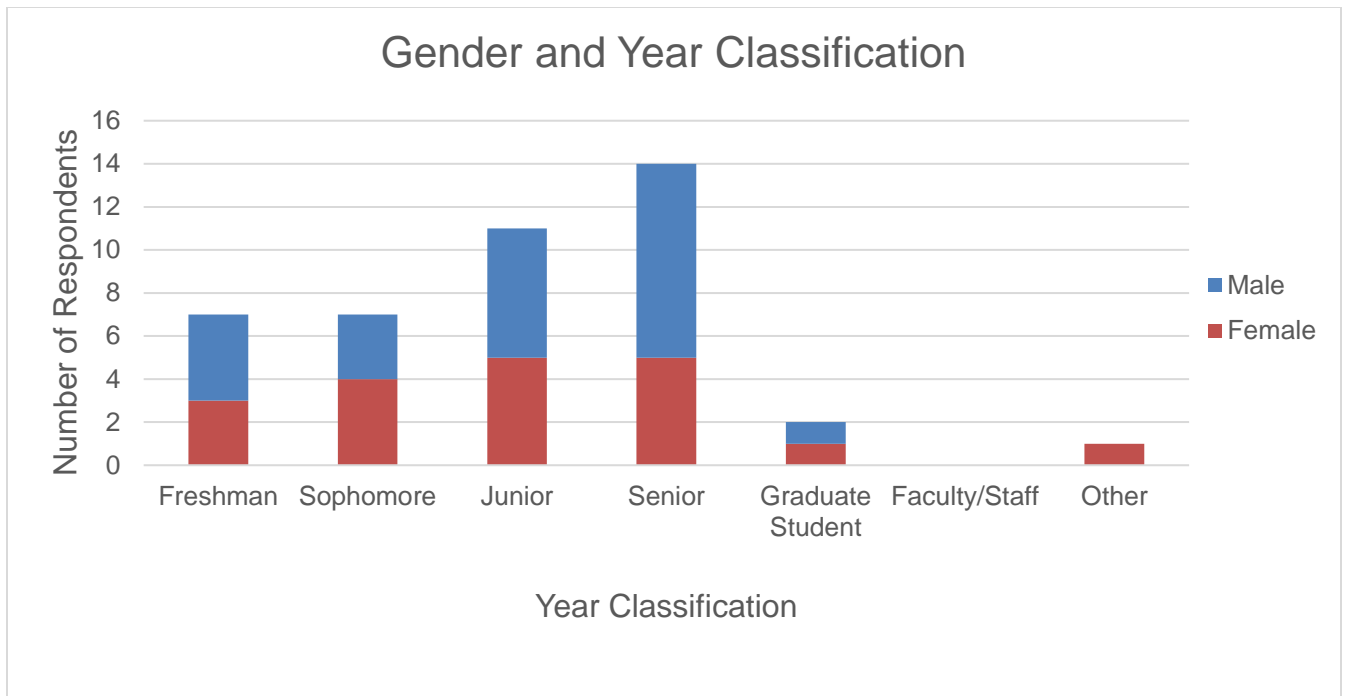
5.2 Touch the Earth Evaluation Results: Multiple Choice Questions

During the Fall semester of 2014, there was a total of 300 bike rentals through the Touch the Earth Bike Share program. The length of rental stated by the survey participants ranged from only renting one day to renting up to 5 days. Out of the 300 bike rentals, 14% (n=43) of bike rental participants completed the survey, and only one participant declined. The evaluation was based on the participants' experience with the rental bike at the point of return. The graphs 5.1-5.11 show the breakdown of each multiple choice question on the survey.



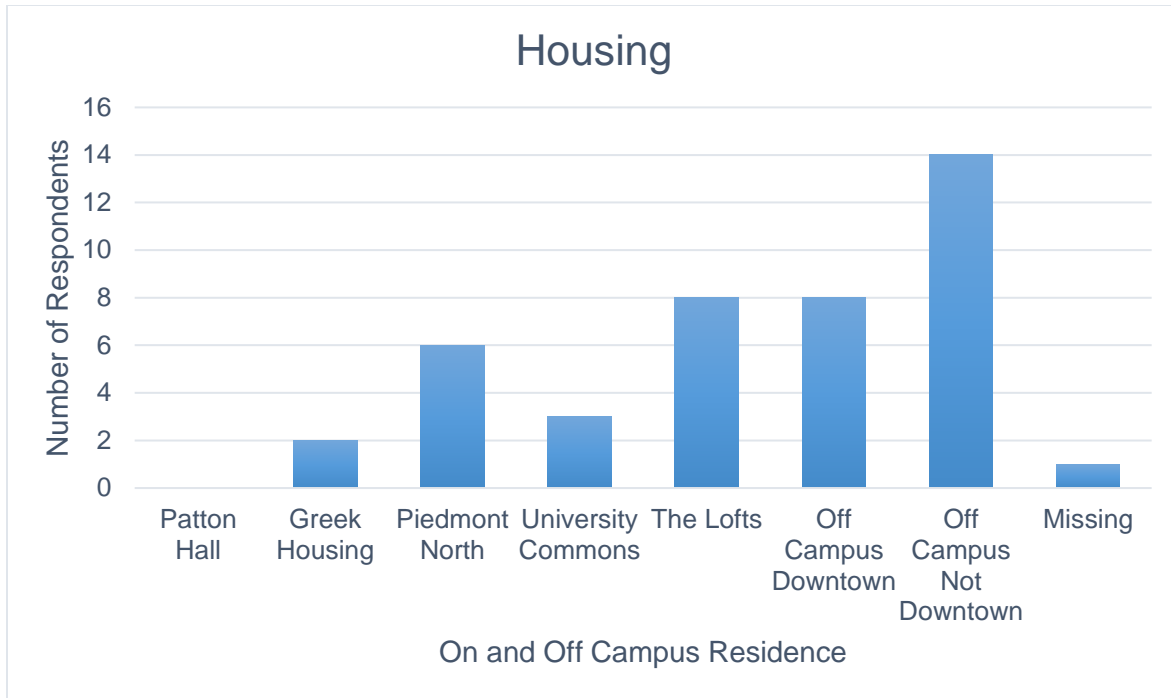
Graph 5.1 Total Respondents Each Month of the Fall 2014 Semester

The evaluation was launched in September 2014. The response totals for each month are shown in Graph 5.1. There are many reasons why the response rate was significantly higher in September. First, the student workers at Touch the Earth were more likely to remember to give out the survey in September since it was new at the beginning of the semester. During the month of November, the campus was closed for the week of Thanksgiving. In the middle of December, winter break started, so students were only on campus for the first couple of weeks limiting the number of days students could rent the bikes.



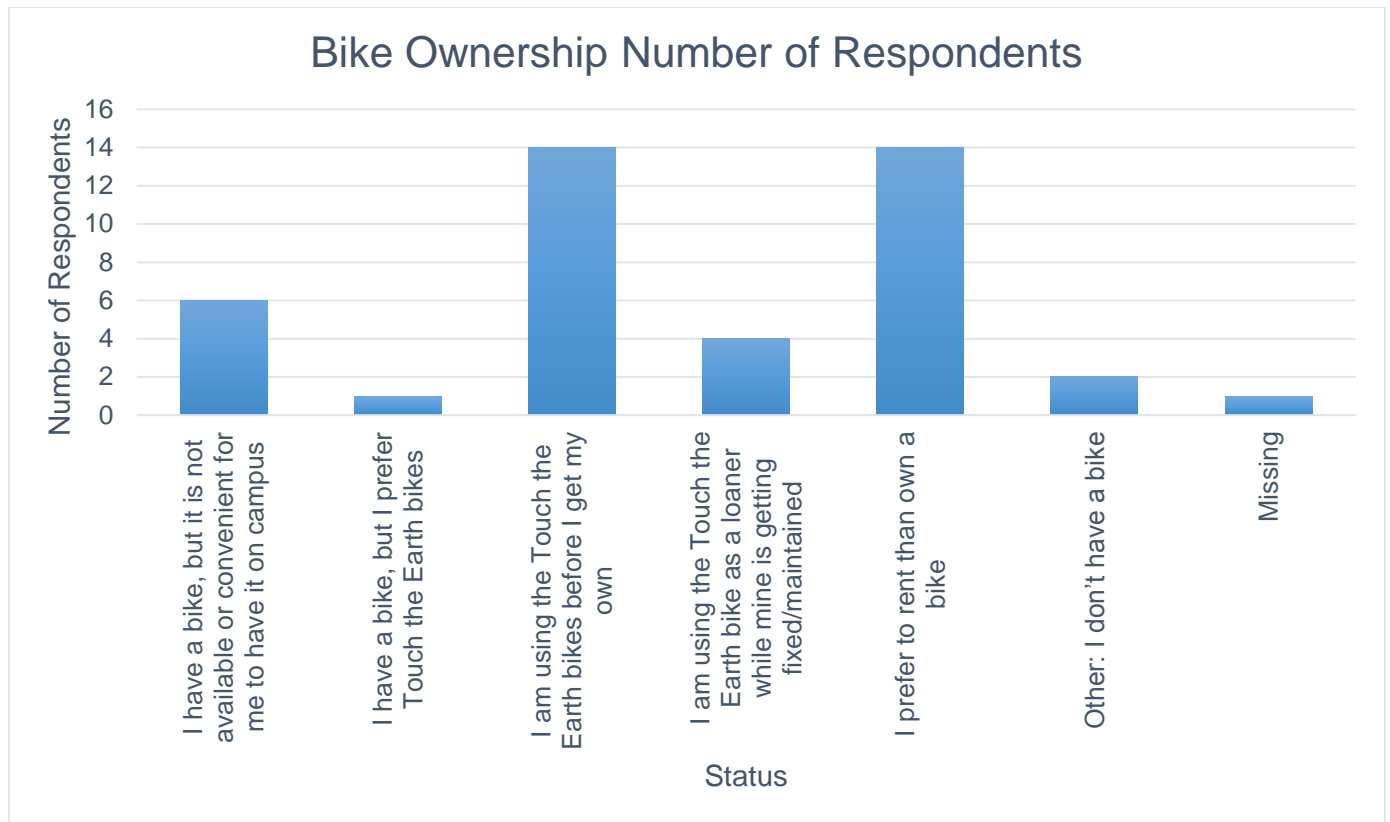
Graph 5.2 Gender and Year Classifications of Total Respondents

More males than females rented bikes. The evaluation had similar findings to the bicycle counts conducted in Section IV: more males rode bicycles than females. More seniors rented bikes than any of the other classifications. Graph 5.2 displays the gender and year classification results.



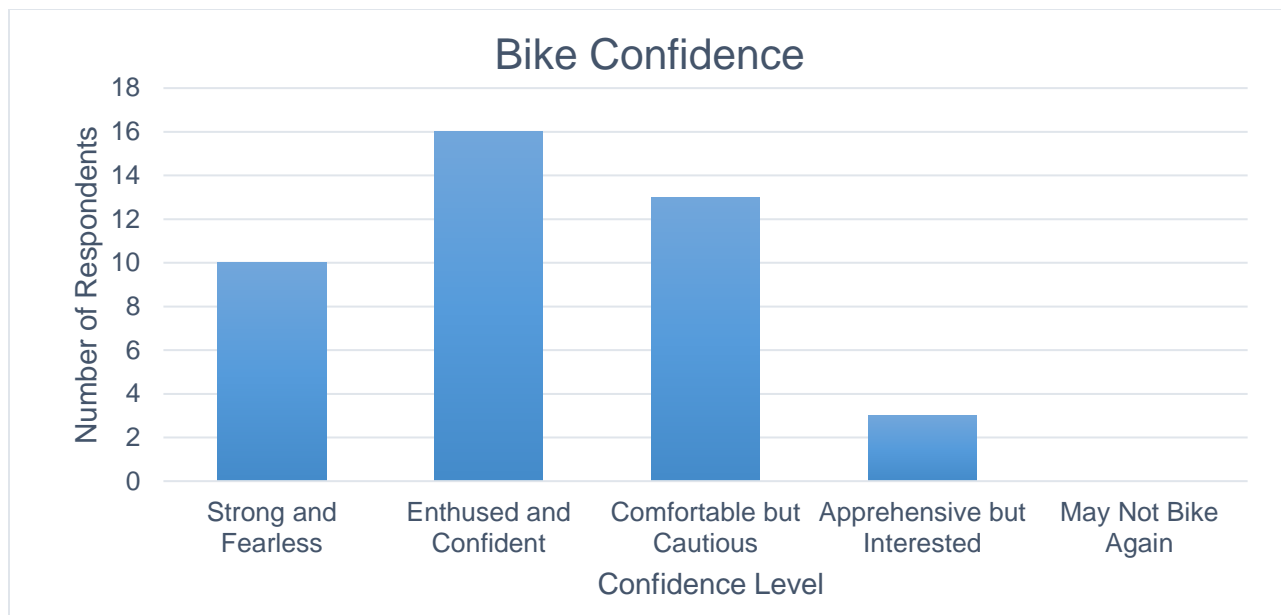
Graph 5.3 Residence of Respondents

Most of the respondents lived off-campus and not downtown as shown in Graph 5.3. The students living off-campus and not downtown might not have a convenient way to store and get a bike downtown.



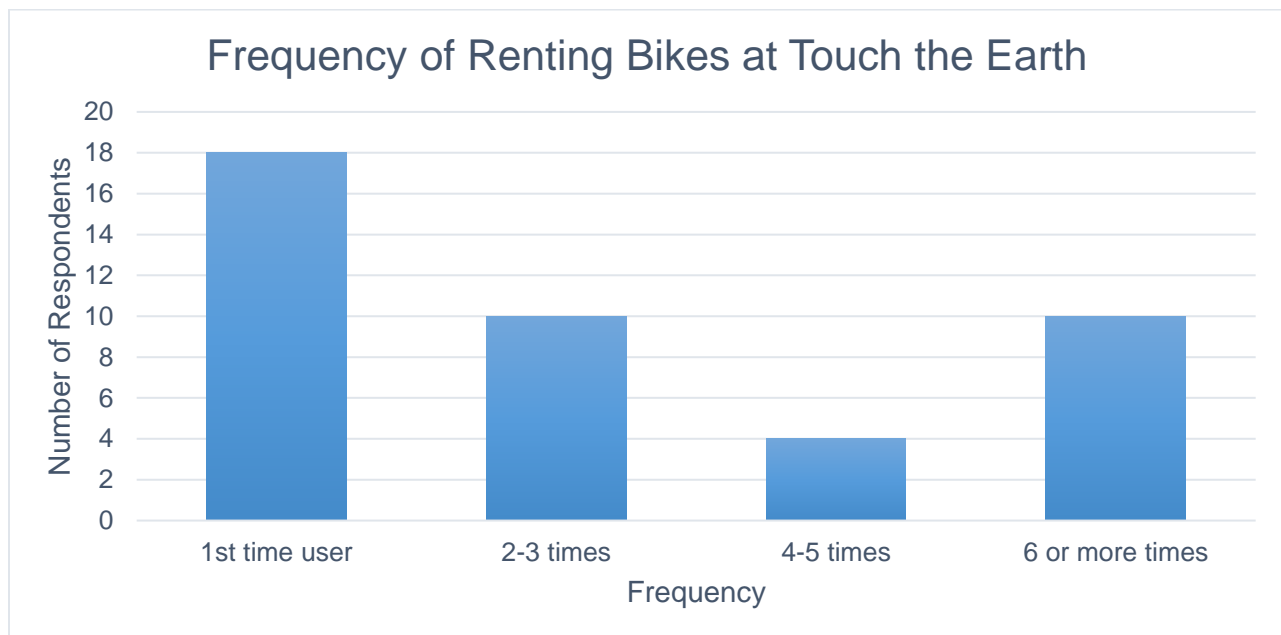
Graph 5.4 Bike Ownership Status of Respondents

The bike ownership question helps explain why the participants rented the bikes. The two highest explanations for renting the bikes were that participants were trying out biking with the Touch the Earth bikes before investing in their own, and students would rather rent than own a bike. Bike ownership status is found in Graph 5.4.



Graph 5.5 Bicycling Comfort Levels of Respondents

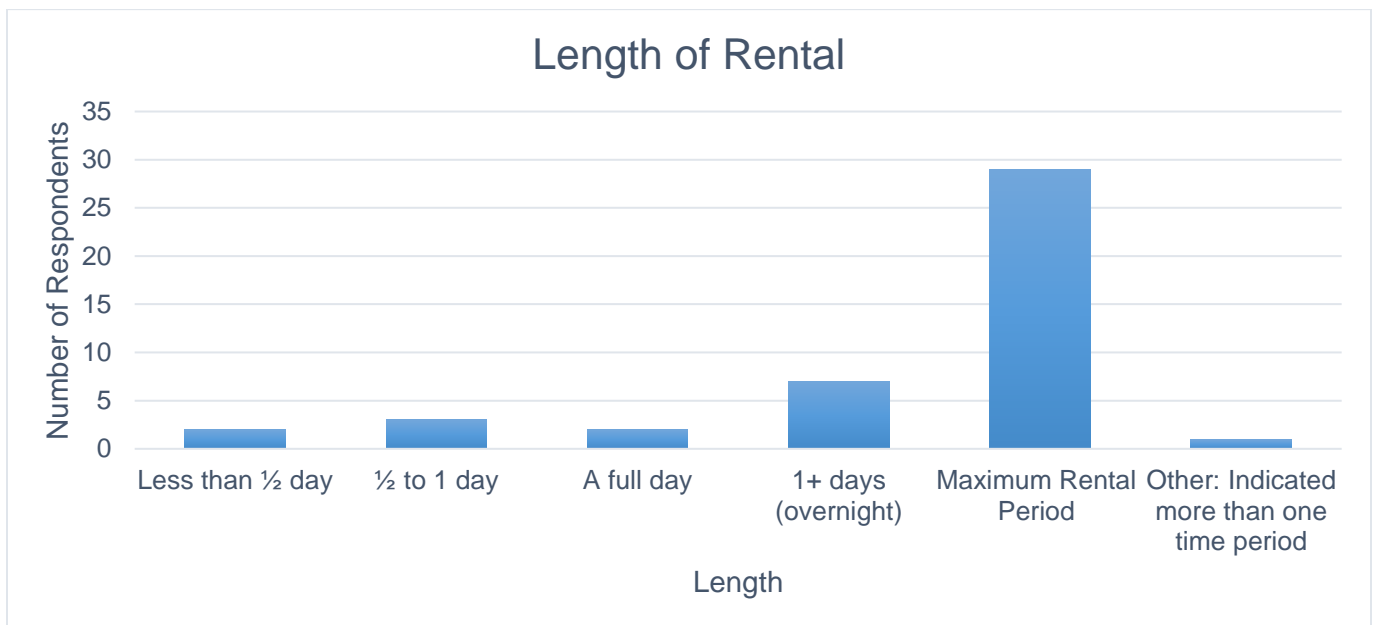
The evaluation found that more respondents indicated they were Enthused and Confident. None of the respondents marked that he or she many not bike again. Graph 5.5 displays the bicycling comfort levels of the respondents.



Graph 5.6 Frequency of Renting Bikes

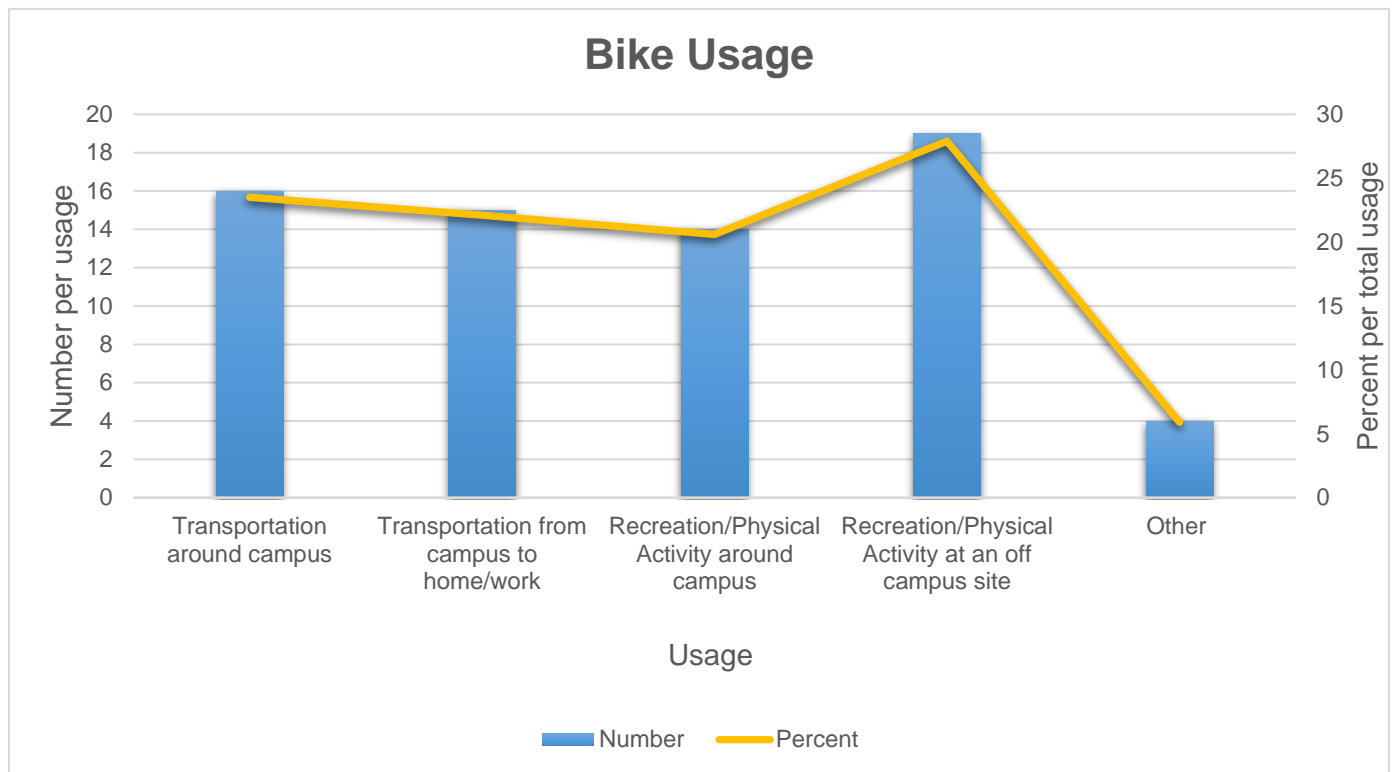
The majority of participants were first-time renters when filling out the survey as seen in Graph 5.6.

An overlap exists between bike frequency and confidence levels. Ten of the first-time renters (55%) stated a confidence level of Confident but Cautious. All participants who stated a confidence level of Apprehensive but Interested were first-time renters ($n=3$). Lastly, half ($n=6$) the participants who rented bikes six or more times stated a confidence level of Strong and Fearless, and the other half ($n=6$) stated an Enthused and Confident confidence level, see Appendix 11.2.



Graph 5.7 Length of Bicycle Rental

Most respondents rented the bikes for the 3-day free maximum rental period. The length of bicycle rental is presented in Graph 5.7.

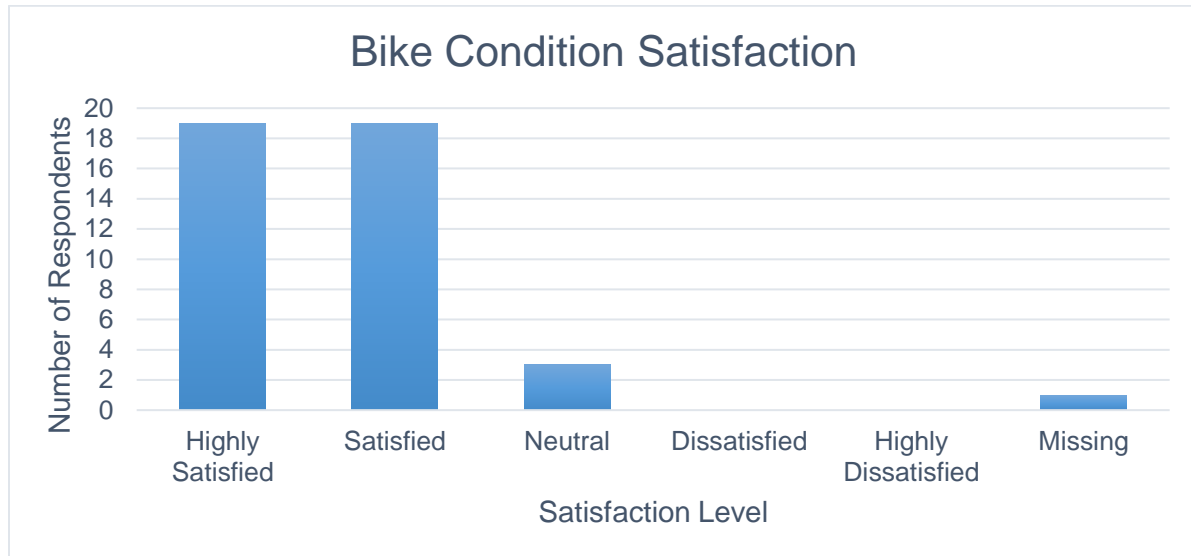


Graph 5.8 Bike Usage During Rental Period

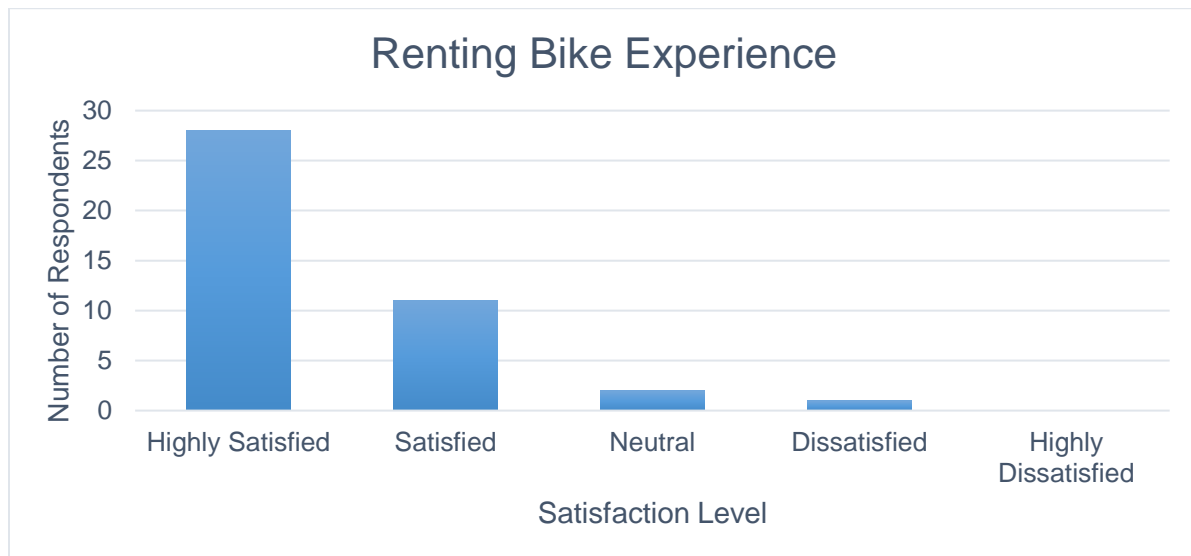
For bicycle usage, the question allowed multiple answers; therefore, the respondents could have used the bike for one or more purposes. As presented in Graph 5.8., the columns show the total number of usage for each category. The yellow line represents the percent each category represents of the total number of usages. The bikes were used most for off-campus recreation/physical activity.

Carson Tortorice, Touch the Earth Coordinator, was curious if the bikes were transported in a vehicle when the bike was used for off-campus recreation. If a participant marked that the bike was used for off-campus recreation, a follow-up question asked whether the bike was transported in a vehicle. However, most of the respondents did not

check yes or no, but eight students stated they did not transport the bike in a vehicle.



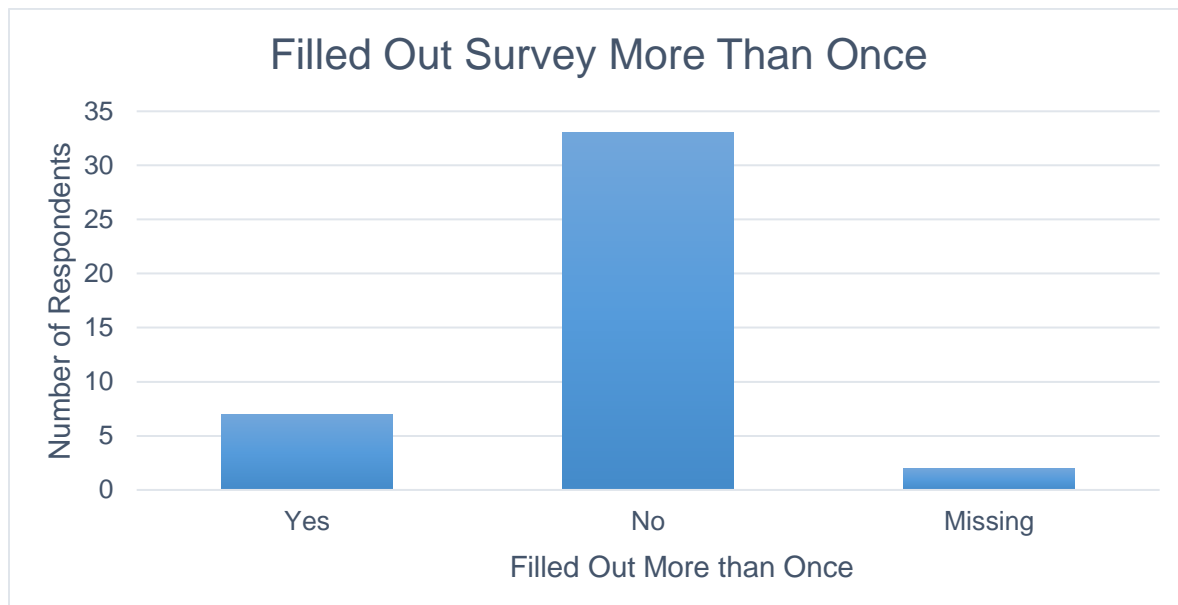
Graph 5.9 Satisfaction Levels with Bicycle Condition



Graph 5.10 Satisfaction Levels with Renting Bicycle Experience

Graph 5.9 and Graph 5.10 reveal, overall, the respondents were either highly satisfied or satisfied with the condition of the bicycles and

the renting experience. Only one respondent was dissatisfied with the bike renting experience.



Graph 5.11 Respondents Who Filled Out Survey More than Once

At the end of the evaluation, a question was asked to see if respondents answered the survey more than once.

Seven respondents checked the yes box after the question: Have you previously filled out this form? Two respondents went from a confidence level of Comfortable but Cautious to Strong and Fearless, and one respondent went from Comfortable but Cautious to Enthused and Confident. Another respondent went from Enthused and Confident to Strong and Fearless. One respondent filled out the evaluation three times, but the confidence level never changed from Comfortable but Cautious. One respondent possibly checked yes by mistake because the respondent did not match any other respondents' demographics, marked the first-time renter box, and completed the evaluation at the beginning of the semester.

Since five respondents completed the evaluation more than once, five demographics and answers are duplicates.

5.3 Touch the Earth Evaluation Results: Open Ended Questions

The evaluation asked four open ended questions:

1. How did you learn about the Touch the Earth Bike Rental Program?
2. Please indicate any specific ways Touch the Earth could improve its bike rental (i.e. location, better bikes/condition, check out/return, more information, etc.)?
3. What was the best thing about your bicycling experience this rental?
4. Suggestions/Other comments

Most respondents ($n=18$) learned about Touch the Earth Bike Rental Program from friends, followed by the student recreational services magazine, The Rap-Up ($n=8$). The Fall 2014 Rap-Up highlighted the bike rental program on its cover so that students could learn about it. Flyers were another way that respondents ($n=3$) heard about the rental program. The following responses had one respondent each: Google, orientation, people who used the program, some signs, recreation center employee, brochure, working at the recreation center, word of mouth, advertisement, research, did not remember, and the magnet listing what students can do at the recreation center. The magnets were placed in the on-campus students' rooms before move-in. Some of the respondents ($n=6$) did not respond to the question.

Next, respondents were also asked how Touch the Earth can improve its program. From the responses, three major themes emerged: the bikes themselves, rental policies, and the physical environment of Touch the Earth. For the bikes, many respondents stated that the seats were uncomfortable, the bikes were too big, and the bikes would break

during the rental. The respondents also suggested more bikes specifically, bikes for girls and different types of bikes such as street bikes, hybrid bikes, and mountain bikes. The lack of girl bikes may have affected whether females rented the Touch the Earth bikes. This issue could have led to more males renting Touch the Earth bikes than females. For the rental policies, respondents wanted longer rental periods including weekend and semester rentals as well as better check in hours. As for Touch the Earth's environment, respondents wanted a better set up of the front desk and more Touch the Earth employees who can inspect and fix bikes.

The question about the best part of the biking experience was asked to see what students enjoyed most about the bike share program experience. Common answers to this question are split into actual bike rental and the real biking experience. For the rental, the respondents found it convenient, affordable and having good quality bikes. The students also liked being able to have the bikes for multiple days. As for the experience, respondents were happy they could bike to parks and explore Atlanta and having the option to rent bikes made the overall experience alone and with friends better.

The respondents' answers to the suggestions question were the same issues as with how Touch the Earth can improve the program. These suggestions were specifically brought up: wanting more bikes and bike with different heights especially x-small bikes. A respondent also wanted better bike cushions.

Touch the Earth Bike Share program offers a necessary service to students. This evaluation helps to understand that most students do

not want to buy a bike but instead want to have more of a long-term bike share. From a health perspective, students mostly used the bikes as a form of recreation or physical activity, especially off-campus. Touch the Earth Bike Share program's recommendations will be found in the recommendations section.

6 Intervention and Recommendations

6.1 Interventions

Mikael Colville-Andersen, known "as Denmark's unofficial ambassador of bicycle culture," uses the concept of 'A to Bism' when advancing urban cycling (Troy, 2012). The concept is people choose the easiest route to get to a destination; therefore, to increase bicycling, it has to become the easiest option of travel. A public health bicycling intervention program focuses on incentives and the physical environment to help increase bicycling. The intervention will use the four components of the General Model of health program planning: assessing needs, setting goals, developing interventions, and evaluating (McKenzie et al., 2013).

- 1.) **Assessing Needs:** The geographical data established the location of student residences and the target population for increasing bicycling and alternative forms of transportation. The bike count data show the trend in bicycling over multiple semesters at busy intersections around campus. The Touch the Earth evaluation provides data on who were renting bikes on campus, how the bikes are being utilized, and suggestions for improvements.
- 2.) **Setting Goals:** The overall aims of the intervention are to make bicycling the easiest travel method/route to get to, from, and around the Georgia State University campus. Other secondary goals include increasing alternative transportation to and from campus and decreasing single-occupant vehicle use as a mode of transportation to and from GSU by students, faculty, staff, and administrators.

This goal has an emphasis on students, faculty, staff, and administrators who live within five miles of campus or have access to public transportation. The ability for students to have access to bicycles for recreational activity would also be a goal to increase overall bicycling.

- 3.) **Developing Interventions:** The intervention will focus on using incentives and promoting environmental changes to change the traveling method behaviors of students, faculty, staff, and administrators.
- 4.) **Evaluating:** To assess the intervention: bike counts trends can see if there is an increase in more students bicycling in the busy intersections, an increase in the number of students who use the Touch the Earth Bike Share program, and an increase in bikes parked at bicycle racks. Although not evaluated in this capstone, evaluating if there is decreasing trend in the number of parking permit requests per total population at the downtown location and an increase in MARTA and GRTA passes requested.

As shown in Figure 6.1, public transportation is accessible to a large number of students. Only MARTA (Metropolitan Atlanta Rapid Transit Authority) and GRTA (Georgia Regional Transportation Authority) have stops located near the downtown campus; however, Cobb Community Transit (CobbLinc) and Gwinnett County Transit allows transfer to MARTA to and from designated MARTA stations. All four transit options are compatible with MARTA, and the fares can be bought at any MARTA rail station ("ATLtransit," 2016). Bicycles are allowed on MARTA trains, and there is dedicated storage for bikes on the buses. There is also free bike parking at stations, and select train stations have bike fix-it stations ("Take Your Bike for a Ride," n.d.). The cost of each mode of transportation is shown in Table 6.1. Overall, taking the GRTA buses is the most expensive transportation option for students, faculty, staff, and administrators to get to and from campus ("Transportation," 2016). Table 6.1 shows the significant

differences in prices found on the GSU Transportation and Parking websites ("Parking," 2016; "Transportation," 2016).

Student Respondents Residing Within the Atlanta Region with Access to Public Transportation, by Census Tract, Bicycling for Transportation Survey, October 2014

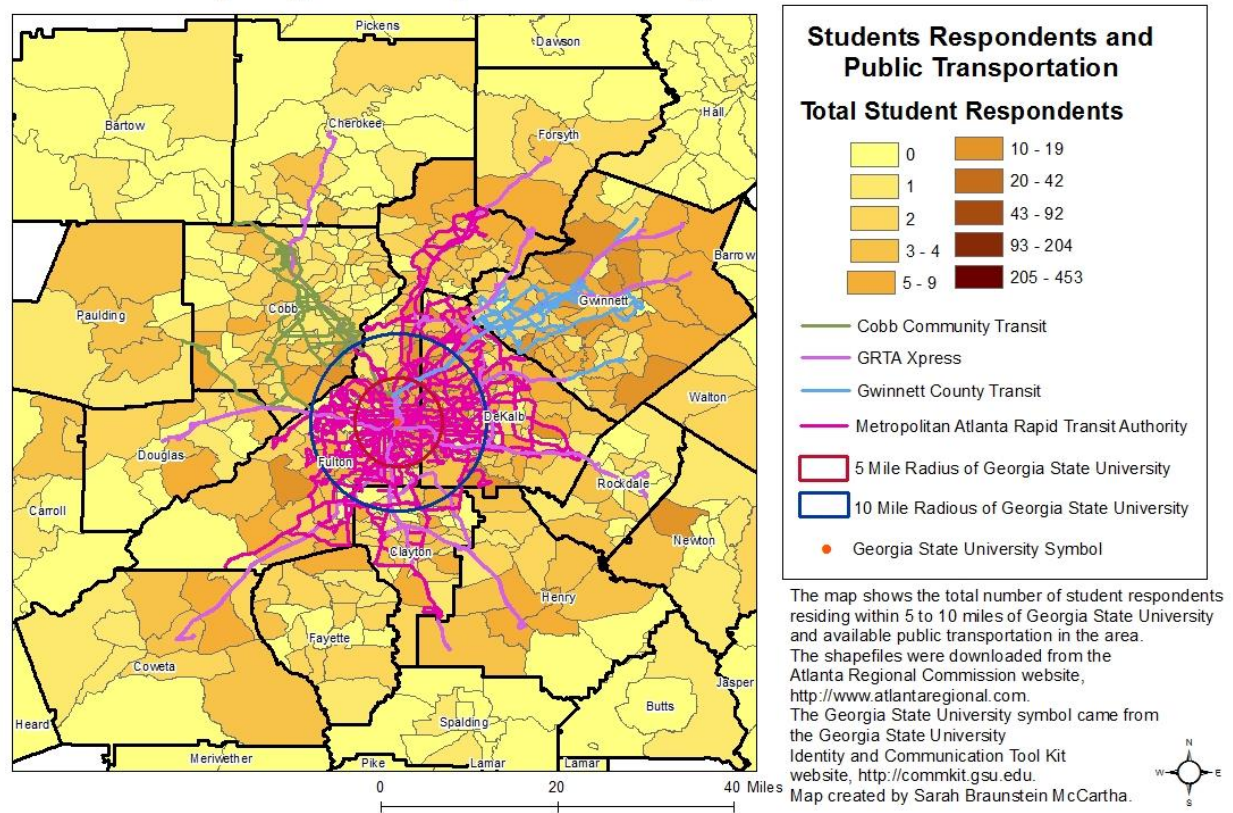


Figure 6.1. Available Public Transportation for Students, Staff, Faculty, and Administrators

Cost Comparison of Transportation Methods to and from GSU

Classification	Semester/Monthly Campus Parking	MARTA (If bought before the 15th of each month)	MARTA (If bought after the 15th of each month)	GRTA (31-day pass)
Students	\$43.00/month \$215.00/semester (August-December)	\$61.00/month \$305 total (August- December)	68.50/month \$342.50 total (August-December)	Green Zone \$92.00 \$460.00/semester (August-December) Blue Zone \$117.00 \$583.00/semester (August-December)
Faculty/Staff/Administrators	\$55.00/month \$275/semester (August-December)	\$77.00/month \$385/semester (August-December)	\$83.80/month \$419.00/semester (August-December)	Green Zone \$93.00 \$465.00/semester (August-December) Blue Zone \$118 \$590.00/semester (August-December)

Table 6.1 Cost Comparison Between Campus Parking and Transit to and from Campus

Table 6.1 compares the cost of the alternative methods, MARTA and GRTA, for students and staff/faculty/administrators per month with the cost of the semester and monthly parking permit. The above prices reflect the cost seen by students, staff, faculty, and administrators when paying for parking. The prices do not take into account the additional cost of car insurance and gas for driving, which are not visibly shown.

Studies looking at changes in transportation and environmental behavior change find that both financial incentives (cash and noncash) increase alternative transportation (Maki, Burns, Ha, & Rothman, 2016; Martin, Suhrcke, & Ogilvie, 2012). Maki et al. (2016) conducted a 22 article meta-analysis examining the role of both financial and

nonfinancial incentives and pro-environmental behavior including travel behavior. The researchers concluded that both financial and nonfinancial incentives increased the usage of alternative transportation (Maki et al., 2016). Martin et al. (2012) also conducted a meta-analysis except this study focused on active transportation. The authors decided that both positive financial incentives (free bicycles and public transit passes) and negative financial incentives (increased gas prices and congestion charges) increased the use of active travel (Martin et al., 2012). To increase alternative transportation use, GSU must find solutions to help subsidize/incentivize public transit options. Incentivization/subsidization options could include reallocation of transportation fee or negotiations for lower fares between MARTA and GSU could take place.

In November 2016, Georgia State University's redevelopment plan for Turner Field (former Braves stadium) was approved (Bloom & Trubey, 2016). Parts of the project include turning the baseball field into a football field and relocating the hospitality school. Housing, classrooms and retail space are proposed to be added to the area (Bloom & Trubey, 2016). Google Maps shows that Turner Field is between 1.3-1.6 miles away from the GSU main downtown campus by car, bike, or foot ("Google Maps," 2017). According to the literature, 1 mile is an acceptable walking distance, and 5 miles is an acceptable biking distance (Kaplan & Knowles, 2015; Rybarczyk & Gallagher, 2014; Shannon et al., 2006; Tolley, 1996). Therefore, the Turner Field area is a little too far to walk, but it is definitely within acceptable biking

distance. This redevelopment provides a unique opportunity for Georgia State University to increase bicycling on campus. The Panther Express Blue Route is the only school provided transportation to and from Turner Field to and from the main downtown campus, and it runs from 7:00am-10:30 pm ("Panther Express," 2017). Although the shuttle service will probably be expanded when the new area is complete, bicycling can be another form of transportation. There are two options for bicycle expansion at Turner Field. One option would be the placement of one or more Relay Bike Share stations (partnered with the City of Atlanta) near the Turner Field area for residents living in the area and students, faculty, staff, and administrators working at either the main campus or Turner Field to get from one area to the other. The second option would be to expand the Touch the Earth Bike Share program. The top responses of bicycle usage from the evaluation are that students prefer to use the Touch the Earth bikes before getting one and prefer to rent rather than own a bike. Creating a long-term bike rental program, such as semester bike rental would be a popular option. A small number of respondents checked that they have a bike, but it is either not available or inconvenient to have it on campus. Therefore, semester rentals would allow these students the opportunity to have bicycles during the school year. For students, faculty, staff, and administrators who prefer public transportation, the bikes can be used to get from the Five Points Station to the Turner Field area without having to take a bus or shuttle. Hopefully, by making bicycling the easiest option to, from, and around campus, students, faculty, staff, and administrators will bike instead of

drive from the main campus to the Turner Field area. A push for necessary environmental changes is needed such as an increase in secure bicycle parking and bicycle infrastructure around and through campus to make bicycling the easiest option. With the new development around Turner Field, Georgia State University has an incredible opportunity to incentivize bicycling and alternative transportation and disincentive single automobile usage. With the distance between the main campus and the Turner Field area, not incentivizing and environmentally restricting the ability of students, faculty, staff, and administrators to drive to and from the main campus to the Turner Field area would be an excellent accomplishment in reducing harmful pollutants and the burden of disease.

6.2 Touch the Earth Recommendations

In addition to expanding the Touch the Earth Bike Share program to include semester-long rentals, a flexible bike share program allowing students, faculty, staff, and administrators to rent different types of bikes for different lengths of time, especially weekends, would encourage cycling for transportation and recreation. To coordinate with the Relay Bike Share program, Touch the Earth could focus less on hourly and daily rentals, and more on weekend and semester rentals. One way to accomplish this coordination is to have Relay Bike Share flyers at the Student Recreation Center, so students, faculty, staff, and administrators can learn more about it. The second option would be for the Touch the Earth staff to learn about how the Relay Bike Share works. When a renter asks for a bike, the Touch the Earth staff could

ask the renter if the bike will be used for a short time (less than a day). If the bike is going to be used for a short period, the Touch the Earth staff could suggest using the Relay bikes instead. Touch the Earth could limit the number of bikes it rents for short time rentals, so students would have to use the Relay bikes as the next option. Touch the Earth could also focus more on long-term rentals (longer than a day) and rentals of bikes for recreational purposes. Most students used the Touch the Earth bikes for off-campus recreation. An evaluation of the BIXI public bike share program in Montreal, Quebec revealed that bike share programs could increase both utilitarian and recreational bicycling (Fuller et al., 2013). Therefore, having a Touch the Earth flexible bike share program allows students, faculty, staff, and administrators to enjoy biking for a longer rental time and in different environments.

In addition to flexible lengths of time, the Touch the Earth evaluation revealed that some students stated that they wanted the following types of bikes: street bikes, hybrid bikes, and mountain bikes. The different bicycle types would allow students to have more flexibility to explore the City of Atlanta and the State of Georgia. As for size, students recommended smaller size bikes and bikes for girls, making it easier for more petite and female students. Although storage space for the various kinds and sizes of bikes would be limited, having mountain bikes for rental would be useful for students who want to rent the bikes to go mountain biking, and having smaller size bikes would be more comfortable for petite students than the Relay bikes.

6.3 Bicycle Friendly University

The culmination of data can be used to help Georgia State University qualify for Bicycle Friendly University (BFU) designation by the League of American Bicyclists. The purpose of the BFU program is to recognize "institutions of higher education for promoting and providing a more bikeable campus for students, staff, and visitors. The BFU program provides the roadmap and technical assistance to create great campuses for cycling" (Murphy, 2013). The League of American Bicyclists focuses on five components for their Bicycle Friendly University (the 5Es): Engineering, evaluation, enforcement, education, and encouragement. Before starting the BFU application, the League of American Bicyclists Bicycle Friendly University has a quick assessment focusing on the five components, above see Appendix 11.3 ("Quick Assessment," 2013). From the quick assessment, GSU has met the requirements of having a comprehensive bike plan, a bike advocacy group, Panther Bikes, and Touch the Earth for bike rentals and repairs. However, for the application, GSU has work to be done. For the engineering component, GSU needs to acquire the required information requested. The encouragement component can be completed by Panther Bikes continuing to organize campus bicycling events, and support, advertise and sponsor bicycling events in the Atlanta area. Unfortunately, the accomplishing the other three components will not be as easy. For the education component, GSU needs to incorporate bicycle and motorists' safety awareness for all incoming students, faculty, staff, and administrators. The university needs to establish formal classes on smart cycling, cycling skills, and bike maintenance.

The enforcement component focuses on bike theft prevention, increasing knowledge of and enforcing laws for both bicyclists and motorists to keep everyone safe. Specifically, GSU needs to create bike theft prevention, awareness, and enforcement programs. GSU can also confirm, request, and support police officer bike related training courses. Lastly, to fulfill the evaluation and planning component, a bike program manager or a bicycle advisory committee must be established. The main role of the bike program manager or bicycle advisory committee would be to obtain funding. The funding would be used for multiple purposes to achieve BFU designation. First, funding would be used to create and coordinate educational bicycling programs as well as provide information to both bicyclists and motorist about the laws and how to safely share the road. Second, funding would be used to create, coordinate, and implement a bicycle theft prevention program, such as bike registration. Lastly, funding would be used to help police officers obtain bicycle law and safety related training. Another role of the manager or committee would be to gather data about bicycling metrics such as student, faculty, staff, and administrators' ridership, statistics on accidents involving bicycles, and bicycling satisfaction surveys.

7 Discussion

This capstone considered the recommendations to increase bicycling to, from, and around Georgia State University. Three pieces of data- student geography, bike trend usage data, and the Touch the Earth Bike Share evaluation- were examined for barriers to bicycling on campus,

and how these obstacles could be mitigated. This capstone examined multiple components to this question. First, the demographics of the student population and the target population of bikers riding to and from home or work was established. The demographics of the bike riders to and from GSU begs the question: while the majority of students who ride to GSU live within 5 miles of campus, which route(s) and method(s) do students who reside in counties such as Cobb, Gwinnett, Forsyth, and Fayette use to bike to campus? Possible methods could be finding bike routes into GSU. Another option could be driving or taking public transportation to GSU and biking around campus. With the expansion of GSU into former Turner Field, an increase in student housing would increase the number of student who live within 5 miles of campus who would be potential bicycle riders versus drivers to, from, and around campus. An alternative way to increase the number of students living within 5 miles of campus would be for GSU to advocate for, promote, and incentivize affordable student housing around Atlanta, specifically within 5 miles of campus. For the second component, the gender, age, and total number of bike counts were taken at the following intersections: Five Points, Piedmont Avenue and Edgewood Avenue, Piedmont Avenue and Decatur Street, Piedmont Avenue and John Wesley Dobbs Avenue, and Piedmont Avenue and Auburn Avenue. In April 2009, Decatur St. in the heart of Georgia State University campus went through a transformation by reducing the number of driving lanes and widening the sidewalks during the summer of 2009. The construction was expected to be completed in October 2009 (Brechtel, 2009; "Decatur Streetscape Project Begins," 2009.) A one-way bicycle

lane was added to Edgewood Ave., and it was completed in early 2014 ("Bike Lanes, Cycletracks, and Sharrows," n.d.). The bike lane was built for bicyclists to be able to bike on the opposite side of the streetcar track on Edgewood Ave. The intersection of Decatur St. and Piedmont Ave. had the highest average number of bikers over time of any intersection, while the Edgewood Ave. and Piedmont Ave. intersection had the lowest average number of bikers over time. During the Fall 2009 bike counts, the Decatur Street and Piedmont Avenue intersection could either be under construction or just finished with construction. The construction could have limited the access to the area; however, the physical changes could have made bicycling easier and increased the number of bicyclists. The first bike count with the one-way bike lane in the Edgewood Ave. and Piedmont Ave. intersection was conducted in the Fall 2014 bike counts; therefore, in following semesters, there could be an increase in bikers at the intersection. Third, to better serve the students, an evaluation of the Touch the Earth Bike Share program was conducted, and recommendations for improvements were discussed. A large number of participants in September 2014 could be because the evaluation was just launched, so the Touch the Earth staff probably remembered to ask the renter if he or she wanted to participate in the survey. The weather becoming colder is another explanation for fewer bicycle rentals in later months. During the week of Thanksgiving, in November, Georgia State University has a weeklong holiday. In December, classes ended on December 8, 2014, giving students little time to rent bikes. Seniors rented bikes more than any other student class. A possible reason

could be that seniors learned about and used the bike share program during semesters before the survey was conducted. These students also know more students around campus who could have given them information about the program. Seniors might have felt more comfortable bicycling around GSU and Atlanta since the school and city are more familiar to them. Lastly, a modified version of Roger Geller's Four Types of Cyclists was used to examine the comfort level of the participants. Geller's scale was created exclusively for Portland, Oregon; however, a recent study found that the largest 50 US metropolitan cities had a similar breakdown to Portland in 2006 and 2013 (Jaffe, 2016). The Interested but Concerned category had the highest percentage of respondents followed by No Way No How, and the Strong and Fearless category had the lowest percentage of respondents (Jaffe, 2016). In contrast, the data from Georgia State shows that more respondents indicated they were Enthused and Confident than Comfortable but Cautious. However, When the Apprehensive but Interested category is combined with the Comfortable but Cautious category, the total number of respondents are equal to Enthused and Confident as shown in Appendix 11.2. For a general comparison, Dill and McNeil (2013) found that within the 18-34 age group in the Portland, Oregon area, the highest response percentage was in the Interested, but concerned category (Dill & McNeil, 2013). When compared to 50 metropolitan statistical areas (MSAs), the millennial age group (specified by being born in 1981 and after) also had the highest percentage of respondents in the Interested but Concerned category (Dill & McNeil, 2016). Although no one stated that he or she might not bike again, some

participants used the Touch the Earth bikes to try biking even if not on campus. Touch the Earth Bike Share could be used to help students and others who are thinking about trying bicycling. While more females matriculate at Georgia State University, bicycling demographics from Portland, Oregon, and the 50 MSAs show that men are more comfortable and likely to bike than females. Both the gender of participants evaluated in the Touch the Earth evaluation and the gender recorded during the bike count show this gender gap (Dill & McNeil, 2013, 2016; "Georgia State University," n.d.). Finally, recommendations and supporting empirical evidence were examined to increase bicycling to, from, and around Georgia State University. By encouraging Georgia State University to invest in alternative transportation, bicycling infrastructure, and becoming more a more bicycle friendly will help increase bicycling, especially by females, on campus. With the addition of Turner Field, GSU has great potential to become a Bicycle Friendly University. To qualify for this designation, funding for a bike program manager or bicycle advisory committee is essential to helping implement all these recommendations.

8 Study Strengths and Limitations

The research contains valuable information to increase bicycling. Nonetheless, the research has some limitations. Only student addresses were requested; therefore, a comparison between students and staff, faculty, and administrators could not be made. Only 89% of all the students (68% of all participants) gave their address to be used in the geographic analysis. The matching geocode of all student addresses

is 87%. The student locations were all self-reported on the survey; therefore, this data is subject to errors due to unusual situations, such as mid-semester moves and misreporting.

Bike count data were collected over five semesters, and by many volunteers, adding variability in the results. Bicyclists were counted as they were moving down the road; therefore, the data about gender and age had to be determined subjectively, and some data about gender and age are missing. Depending on the route, some bicyclists could have been counted multiple times in a single 2-hour period. The methodology could not prevent the counting of single cyclist multiple times during a session. The final issue is that some semesters had more, less, and different locations making true comparisons only possible for those locations that were taken for all semesters.

The Touch the Earth Bike Share program evaluation gathered valuable information on who is using the bicycles, why the bicycles are being rented, where the bicycles are taken to be used, what the program does that is working, and what needs improvement. The limitations of this evaluation include using self-reported data; therefore, it is subject to biases and human errors. The sample size is also a limitation. The survey participation rate was low (14%), resulting in a small sample size. The evaluation was conducted only over one semester, and the survey was completed voluntarily by students. Students also had the opportunity to decline participation. The Touch the Earth staff also had to ask and give the evaluation to the students after the completion of the rental. With only a 14% participation rate and some participants doing the evaluation more

than once, the responses are probably not generalizable to all the students who rented bikes; however, the evaluation does give a snapshot of the issues, and students suggestions and complaints were similar.

9 Conclusions

This capstone provides valuable data on utilitarian bicycling to, from, and around GSU. The results and recommendations in this capstone should be used to complete the Georgia State Bicycle Plan and be integrated with Georgia State's Master Plan to make the campus more bicycle friendly. The Touch the Earth Bike Share evaluation should be given to Carson so that needed changes can be implemented.

Georgia State University has work to do to make the campus more accepting of bicycles. However, time, effort and money invested in this project will motivate more students, faculty, and staff to bike to, from, and around campus, improving their health and changing the way of thinking about transportation in the City of Atlanta. Finally, if Georgia State commits to fulfilling the League of American Bicyclists BFU 5Es, it could obtain Bicycle Friendly University designation.

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11 Appendix

11.1 Post Bike Rental Evaluation

Post Bike Rental Evaluation

I decline to fill out this evaluation form (check if apply): ☐ Date: _____

I. Demographics (check one):

What is your gender?

☐ Female ☐ Male

What is your year classification?

☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior ☐ Graduate Student ☐ Faculty/Staff ☐ Other

Where do you currently live?

☐ Patton Hall ☐ Greek Housing ☐ Piedmont North ☐ University Commons ☐ The Lofts
☐ Off-Campus Downtown Location (e.g. One 12 Courtland) ☐ Off-Campus NOT Downtown Location

II. Bike Ownership and Biking Confidence (check the best fit):

Do you have a bike at the present time?

- ☐ I have a bike, but it is not available or convenient for me to have it on-campus
☐ I have a bike, but I prefer the Touch the Earth bikes
☐ I am using the Touch the Earth bikes before I get my own
☐ I am using the Touch the Earth bike as a loaner while mine is getting fixed/maintained
☐ I prefer to rent than own a bike
☐ Other _____

In terms of your level of comfort and confidence as a bicyclist, how would you categorize yourself?

- ☐ Strong & Fearless - I am willing to ride my bike in any situation. I consider myself a cyclist as part of my identity.
☐ Enthused & Confident - I am confident sharing the road with vehicles, but prefer areas geared to cyclists.
☐ Comfortable, but Cautious - I am comfortable on most roads, but strongly prefer areas geared to cyclists. I will choose another mode depending on the areas.
☐ Apprehensive, but Interested - I have heard a lot about cycling and was curious to try it, but I require areas geared to cyclists (freedom park trail, beltline, piedmont park, etc.).
☐ I May Not Bike Again - Due to weather, physical condition or lack of interest, I am not interested in cycling anymore.

III. Bike Usage through Touch the Earth (check one):

How frequently have you ever rented a bike?

☐ 1st time user ☐ 2-3 times ☐ 4-5 times ☐ 6 or more times

During this visit, for how long did you borrow the bike?

☐ Less than ½ day ☐ ½ day to 1 day ☐ A full day ☐ 1+ days (overnight) ☐ Maximum rental period (3 consecutive business days)

How did you learn about the Touch the Earth Bike Rental Program?

Write in: _____

How did you use the bike from Touch the Earth this time? (check all that apply)

- ☐ Transportation around campus
☐ Transportation from campus to home/work
☐ Recreation/Physical Activity around campus
☐ Recreation/Physical Activity at an off-campus site (for example the beltline, a trail, etc.)
If checked, did you transport the bike in a vehicle (check one)? ☐ Yes ☐ No
☐ Other _____

How satisfied were you with the **bike** you borrowed from Touch the Earth (such as condition, rideability, comfort, etc.) (check one)?

☐ Highly Satisfied ☐ Satisfied ☐ Neutral ☐ Dissatisfied ☐ Highly Dissatisfied

How satisfied were you with the **experience of** borrowing from Touch the Earth (convenience, check-in-checkout, ability of staff to assist you, etc.) (check one)?

☐ Highly Satisfied ☐ Satisfied ☐ Neutral ☐ Dissatisfied ☐ Highly Dissatisfied

Please indicate any specific ways Touch the Earth could improve its bike rental (i.e. location, better bikes/condition, checkout/return, more information etc.)? _____

What was the best thing about your bicycling experience this rental? _____

Suggestions/Other comments: _____

Have you previously filled out this form (check one)? ☐ Yes ☐ No

Thank you for taking our evaluation form. It will greatly help with improvements for the program.

11.2 Confidence Levels and Frequency of Rentals

Confidence Level	Frequency of Rentals			
	1 st Time	2-3 Times	4-5 Times	6 or more Times
Strong and Fearless	1	3	1	5
Enthused and Confident	4	5	2	5
Comfortable, but Cautious	10	2	1	0
Apprehensive, but Interested	3	0	0	0

Table 11.2 Confidence Level of Renters and the Frequency of Rentals

11.3 Bicycle Friendly University Quick Assessment Questions

ENGINEERING

Does Your Campus Have A Well-Connected Bicycling Network? Yes or No

Is Bike Parking Readily Available Throughout The Campus? Yes or No

Is The College Or University Easily Accessible By Bike? Yes or No

EVALUATION

Does Your School Have A Current Comprehensive Bicycle Plan? Yes or No

Does Your College Or University Have A Bicycle Program Manager? Yes or No

ENFORCEMENT

Do Campus Safety/Law Enforcement Officers Receive Training On The Rights And Responsibilities Of All Road Users? Yes or No

Is There A Program On Campus To Prevent Bike Theft? Yes or No

EDUCATION

Does The School Offer Bicycle Education Classes For Students And Staff? Yes or No

ENCOURAGEMENT

Is There An Active Bicycle Advocacy Group At The College Or University? Yes or No

Is There An On-Campus Bike Center For Rentals And Repairs? Yes or No

("BFU Quick Assessment," 2013)