

Bike Lanes
Helping To Decrease The Dependence

New Mexico
SuperComputing Challenge
Final Report
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Team #22
Down To Earth School

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Executive Summary:

There are many automobiles used all around the world and the number of automobiles used in the United States, alone, has increased greatly (“Motor Vehicles”). Because of this dependence on motor vehicles combined with other carbon dioxide emitting activities, about 17.6 tons of CO₂ is released by each person in the US (“CO₂ Emissions”).

Our downtown area is very dependent on automobiles, which is not only bad for the environment, but the economy and society as a whole. Downtown Silver City is centered around Bullard Street. Cars parked on both sides of the street cause the driving space to be narrow and leave little room for bicyclists or pedestrians.

Many solutions have been created to lessen society’s carbon dioxide emission rates from automobiles but none of which have decreased the dependence on automobiles, which holds hidden costs. One of these solutions, that has not been played out in many places, is building protected bike lanes. This project will observe how bike lanes might decrease our dependence on automobiles and how might they affect society and the way things are done, specifically in our downtown area. We hypothesize that parking restrictions and protected bike lanes on Bullard Street, even as little as one day a week would: 1. cause traffic to be smoother, 2. make more people inclined to bicycle and walk, 3. create more money for the businesses downtown. These factors together would lead to further growth.

We have created an agent-based, computational model of Bullard Street. The model has different breeds of agents – representing the cars, bicyclist, and pedestrians, each with their own variables – interacting with each other and their surroundings on Bullard Street. Using the model, we can analyze the effects of different amounts of automobile, bicycle, and pedestrian traffic. If the results collected from the model convey that parking restrictions, allowing more bicyclists safe passage, would benefit the downtown community, we will seek assistance in orchestrating an event to test these effects in a real-world setting.

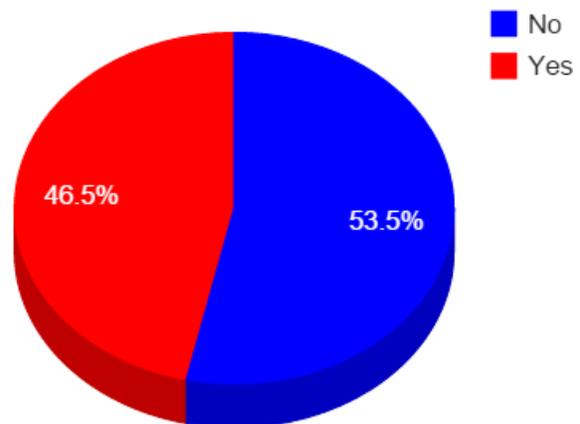
Introduction/Research:

_____In late July of last year there were approximately 1.2 billion automobiles in use in the world (Voelcker). The dependence on automobiles around the world continues to increase and is increasing at a great rate in the United States and worldwide. The number of cars produced in the world each year has been increasing steadily (“Cars Produced”). The approximate number of cars produced around the world this year - 2015 - has surpassed 15 million and that number continues to grow each day (“Cars Produced”). The world population between 2009 and 2010 increased by approximately 81,461,549 people (“Total Population”), while the number of automobiles during that time frame increased by approximately 47,772,598 (“Cars Produced”). The number of people in the United States between 2010 and 2011 increased by approximately 2.4 million, though the number of automobiles during that time frame increased approximately 2.84 million (“Motor Vehicles”).

Downtown Silver City is based around Bullard Street. The downtown area is very dependent on automobiles and cars park on both sides of the street. Few people in Silver City bicycle and, because of parking on Bullard Street, the driving space is narrow and leaves little room for bicyclists. From surveys taken, asking downtown business

owners and pedestrians on Bullard Street, data has shown that many people believe that biking on Bullard Street is dangerous and should be avoided. Though, there were the few people that

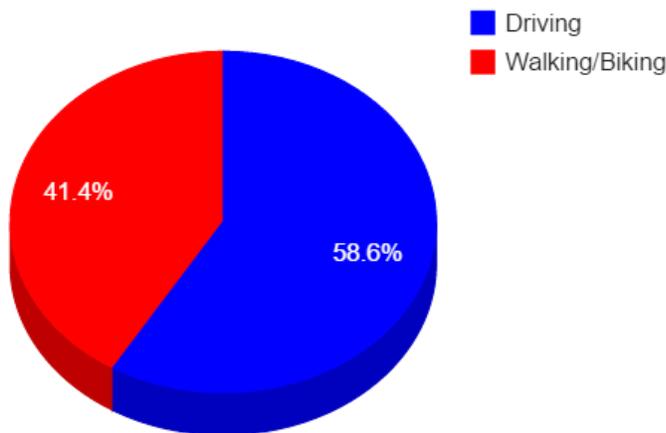
People who bicycle



answered that biking on Bullard Street is not a problem and that they are comfortable doing so. However a study shows that only around 18% of bicyclists feel comfortable biking on major roads that have no bike lane (Sztabinski). The same study shows that a larger portion, 53%, of cyclist feel comfortable cycling on major roads with a bike lane (Sztabinski). This is unhealthy for the downtown economy because few people are going to bicycle on Bullard street due to an absence of bike lanes and because people who bike spend more money on retail sales than people who only drive (Schiller).

The increase in automobile use contributes to the increase of the Carbon Dioxide emission rate. Between 2009 and 2010, the amount of Carbon Dioxide emitted by each person, in the United States, increased by 0.3 tons, which equals approximately a 92,610,000 ton increase (“CO2 Emissions”). Though the total approximate amount of CO2 release by the US in 2010 was

Types of Transportation for Trips Less Than 1 Mile



5,433,120,000 metric tons (“CO2 Emissions”).

Problem Statement:

The amount of Carbon Dioxide in the atmosphere is causing many harmful problems not only to humans but to the environment and ecosystem as well

(“Carbon Dioxide”). This project will target the specific problem of the overuse of automobiles’ contribution to an increasing Carbon Dioxide emission rate. The decreased use of automobiles will help cities in the following ways: economically, environmentally, and socially.

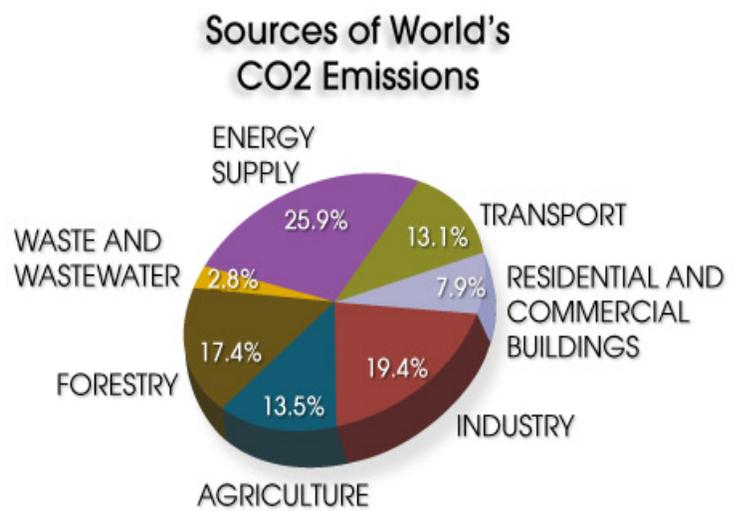
Transportation around the world accounts for approximately 13.1% of the world's total carbon dioxide emission ("Carbon Dioxide"). Thus with fewer cars the amount of carbon dioxide released due to automobiles would decrease as well.

Solutions to this problem have been created but none of which are effective enough. Some of these include: fuel efficient vehicles (Mello), more public transportation (Macaig), and even electric vehicles (Shahan), though these solutions are not solving the root of the problem.

Though all of the mentioned solutions are reducing carbon dioxide emission, they all need fossil fuels to be functional and efficient.

One solution that has been proven to help is the construction of protected bike lanes, though few places have taken to this solution. The places that have built protected bike trails have seen a large positive affect.

Bicycles help, not only the environment but, the economy and the social well being of a city . A few ways that bikes help the environment include: they do not emit CO2 and they use less material to make which allows the use of fewer fossil fuels to produce them. Another way that they help is that they do not damage the land and habitat like motor vehicles might, destroying living environments for wildlife.



Bicycles are not only better for the environment than motor vehicle but the economy as well. Studies from cities where protected bike lanes have been built show a positive effect on the economy of that area (Andersen, 29).

Bike lanes themselves also help in many ways. Research shows that a house's value increases by 11% every half a mile closer it is to a bike lane (Schiller).

Physical Problem/Method:

Downtown Silver City is the main tourist attraction of the town though, the dependence on automobiles of the downtown area makes it not as successful as possible. The increase of the dependence on bicycles will decrease the dependence on automobiles. We believe that a way to increase the bicycle dependence is to build bike lanes on Bullard Street in place of parking, and that the increase dependence on bikes will also help the downtown community in other ways as well.

Computational Model:

_____The agent-based computational model built for this project simulates the activity and environment of Bullard Street. There will be different breeds of agents that represent the automobiles, bicycles, and pedestrians, each with their own variables. A few variables include: the route that each agent is traveling, the speed at which the agent moves, the aggressiveness of each agent, and the amount of money each agent spends in the downtown stores. The agents interact with each other as in the real world. The agents that represent the pedestrians have a random probability of "entering" a downtown business. When the agent does enter the

business another procedure is called. This procedure asks the business agent into which the pedestrian entered to choose a random number and if the number is in a certain range, the business increases the number of purchases made by one. Though the pedestrian is making the purchase, it was less complicated for the business to increase its own purchases. The pedestrians also have a random probability of getting into a parked car and driving away and vice versa. The agents representing bike ride through downtown and have a random chance of parking. The pedestrians that got off the bikes have a greater chance of entering a store and making a purchase. This shows the fact that people who bicycle spend more money but because there is no money in the model, they make more purchases instead.

The model can be used to show the effects of different amounts of automobile, bike and pedestrian traffic. The data gathered from the model is the number of purchases in each store, each separately as well as an average. This is the data that determines the effect of the amount of each breed in that trial; the more purchases made in each store shows a healthier economy and downtown.

Verification and Validation:

The model has variables that are and can be changed to be realistic such as the amount of automobile, bicycle, and pedestrian traffic, though there are things that could be changed to model the real world more accurately. The probability of a person entering a business or making a purchase is set as a slider thus allowing it to be set to an accurate number though for the trials, the probability was chosen at random. If it were to be more accurate, that probability would be a specific percentage derived from data. The probability of purchases could be made

more accurate with the help of business owners. When we continue this project next year, using money instead of purchases would be more accurate thus giving us more accurate results.

Results and Conclusion:

_____We hope that, when finished, the model will show that the increase of bike traffic will increase and be better for the economy. If this is the analysis of the results that we get, the results will show higher purchases from the businesses when there are a larger number of agents representing bicycles. If the model outputs these results, we will then take the results to the Silver City Town Council and attempt to make parking restrictions on Bullard Street and build bike lanes in their place, even if just for one day a week.

Significant Achievement:

_____Our significant achievement was working with the community and proposing a solution that many people agreed with and that may be very beneficial to the community. If the event of restricting parking on Bullard Street for a day does happen and is beneficial that will be our most significant achievement.

Teamwork:

Our team is a team of two, Simone Hill the programmer and Analyse Waldron the researcher. Simone was also given the jobs of being the team leader, and the lead presenter. Analyse is responsible for being the lead powerpoint designer and poster designer. We split the responsibilities of the technical writer and graphic designer.

Acknowledgements:

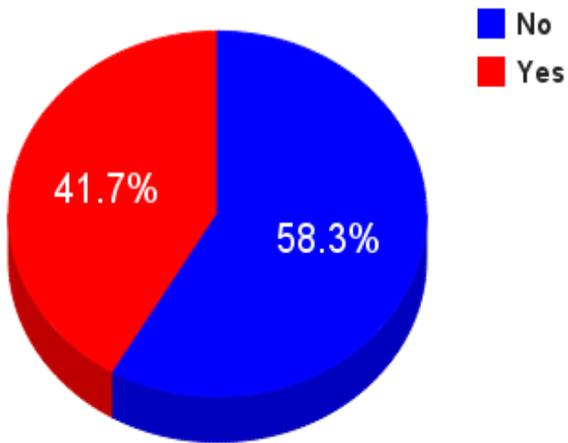
_____Team 50 would like to thank everyone who has helped us with our challenge. Thank you to Celia, David, Patty, and, Josephine. The Supercomputing consult team. We enjoy our Monday morning messages. To Jed Crandall who reviewed our project and gave us very helpful feedback we thank you. To all of the volunteers who reviewed the interim reports we thank you for all of your effort. For the two judges, Mia Kalish and Tanya Rivers who evaluated our presentation at WNMU, your feedback was very useful. To the downtown businesses of Silver City we thank you. We would like to give a special thanks to our amazing mentors Maia Chaney and Shanon Muehlhausen.

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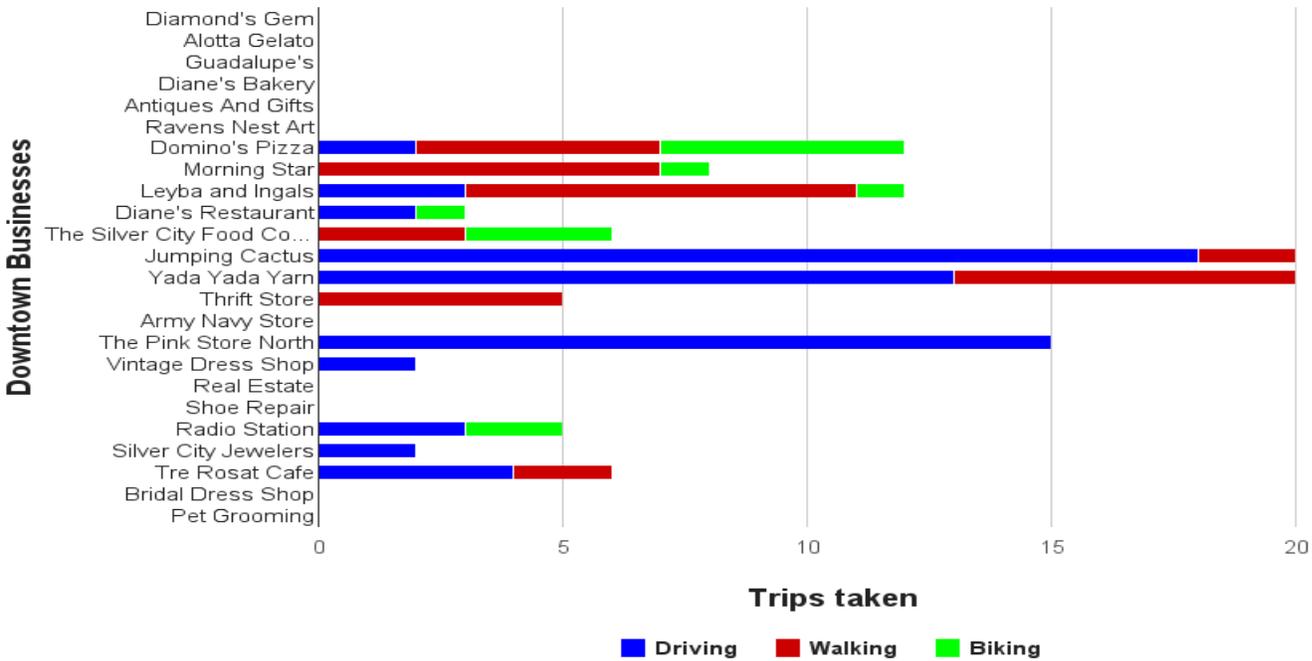
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Appendix A: Business Owners

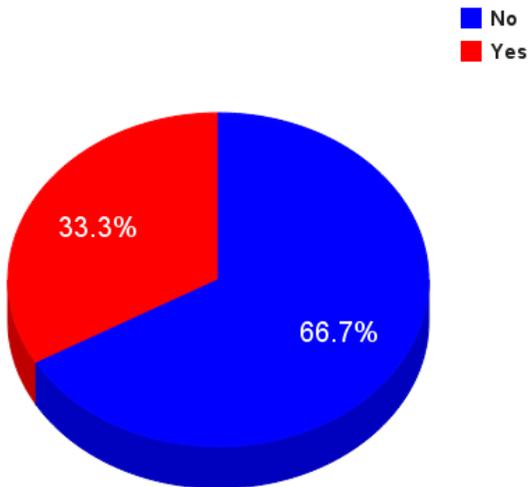
Do you bicycle?



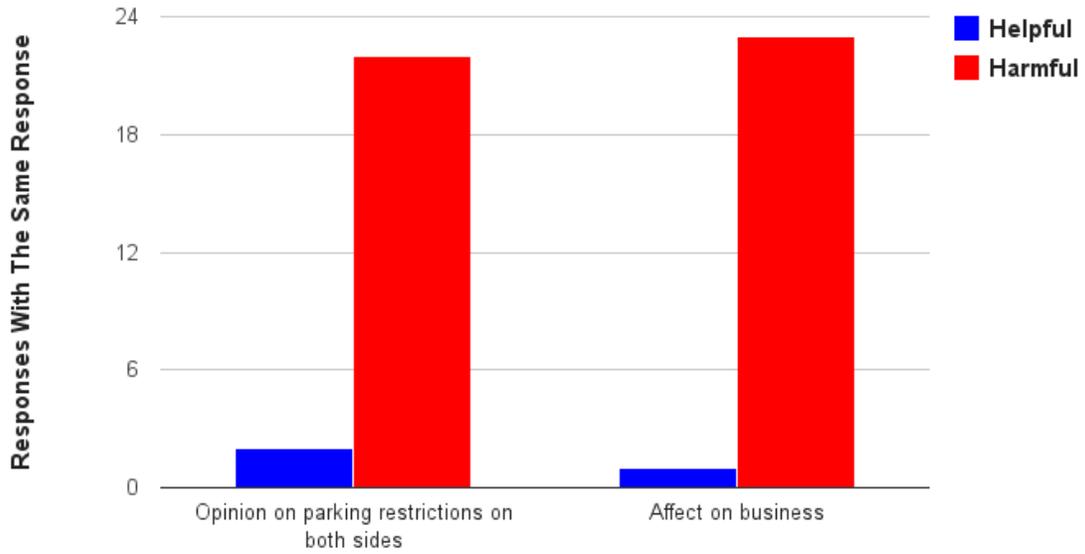
On average, how many trips do you take, each week, that are less than a mile?



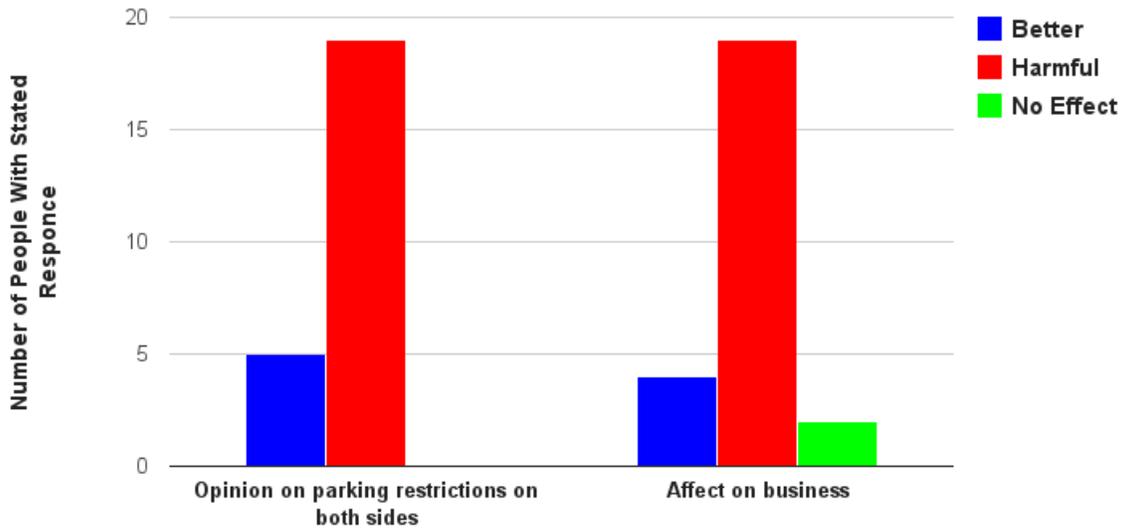
Have you bicycled on Bullard Street?



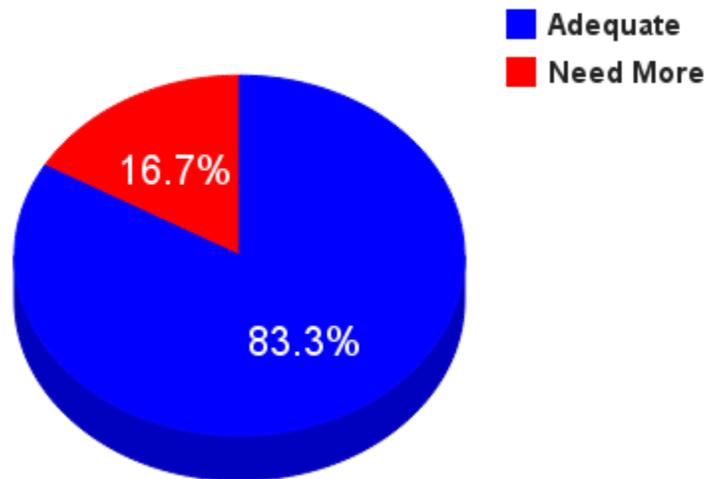
Parking restrictions on both sides of Bullard Street



Two way bike lane replacing one side of Bullard Street

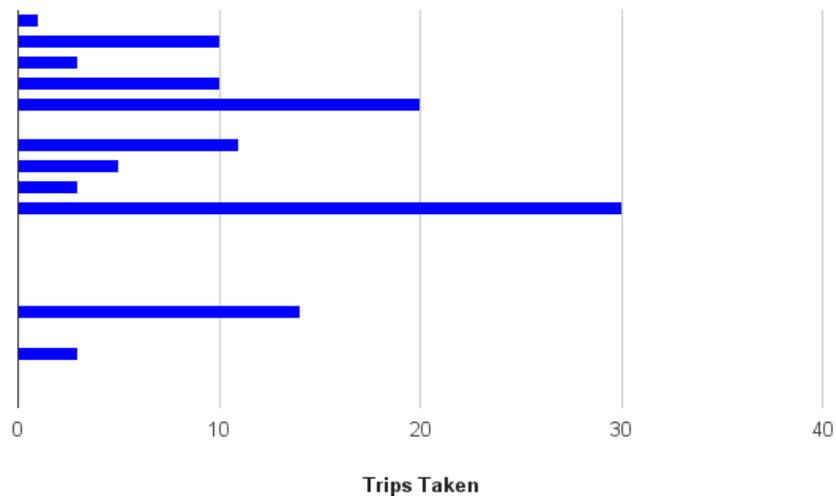


What is your opinion on the stoplights on Bullard Street?

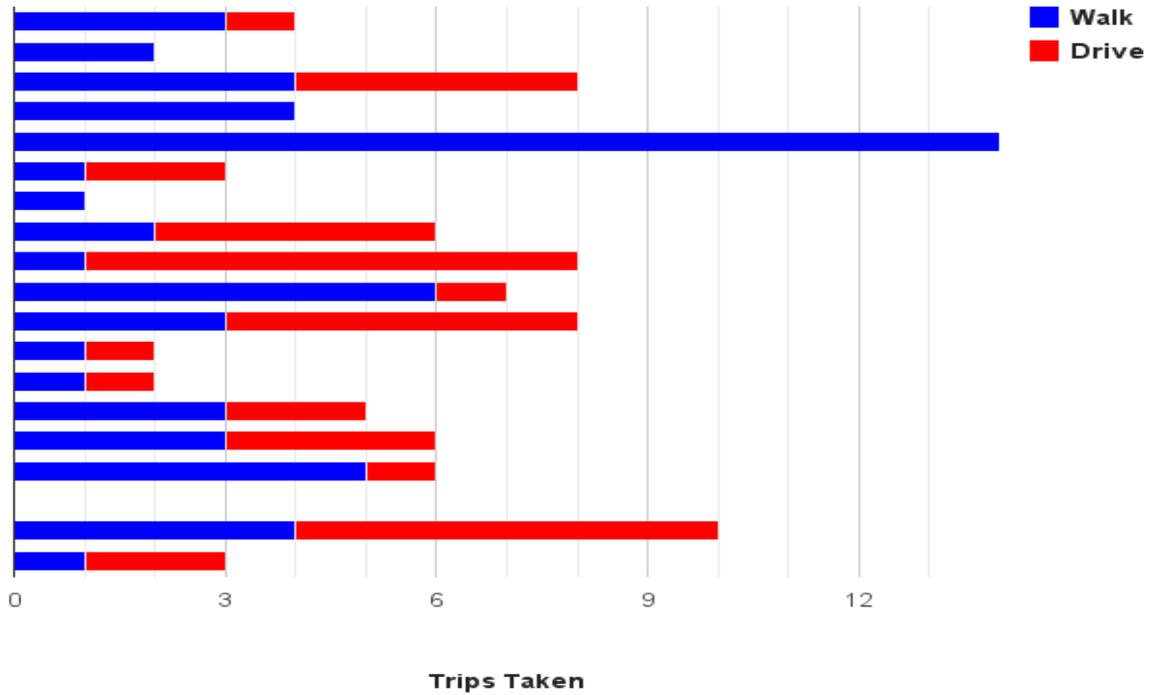


Appendix B: Pedestrians

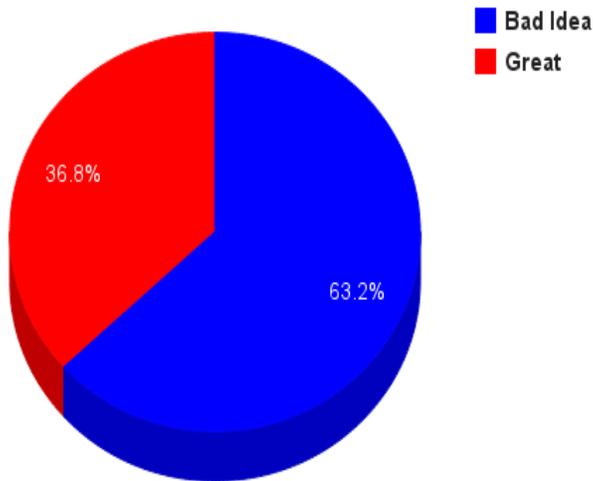
On average how many trips do you take that are less than a mile?



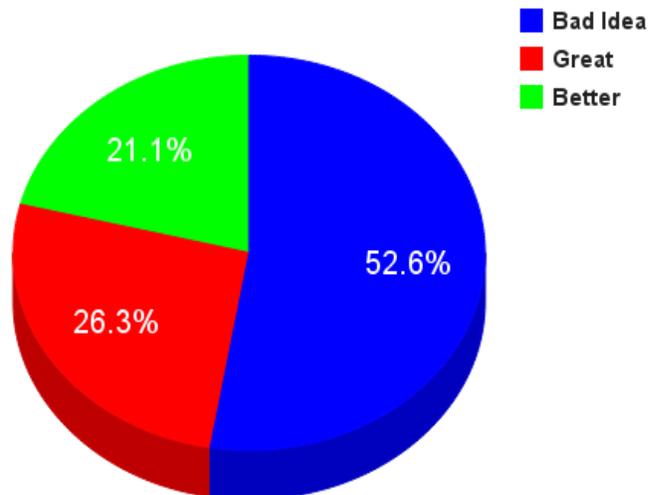
On average, how many trips do you take, each week, downtown?



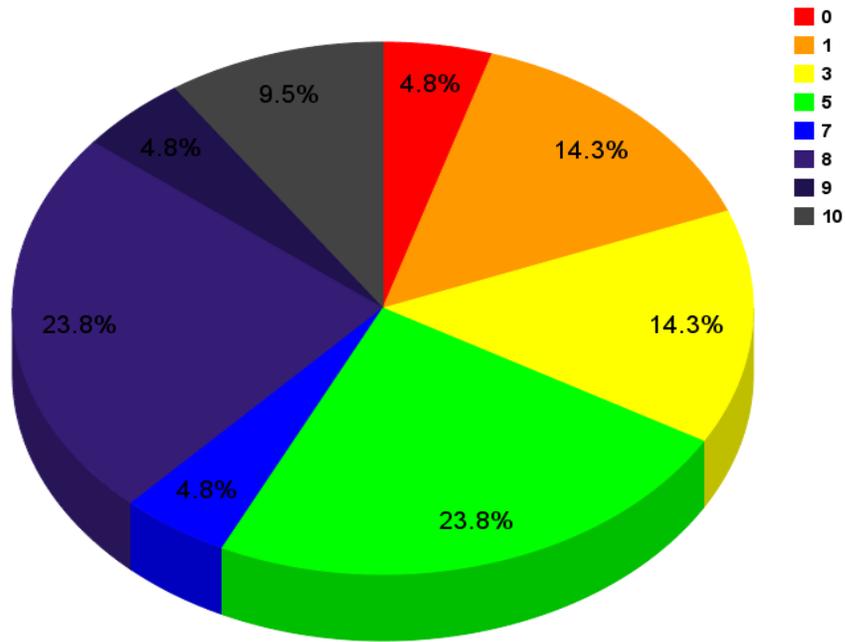
Opinion if bike lanes replace both sides of parking on Bullard Street



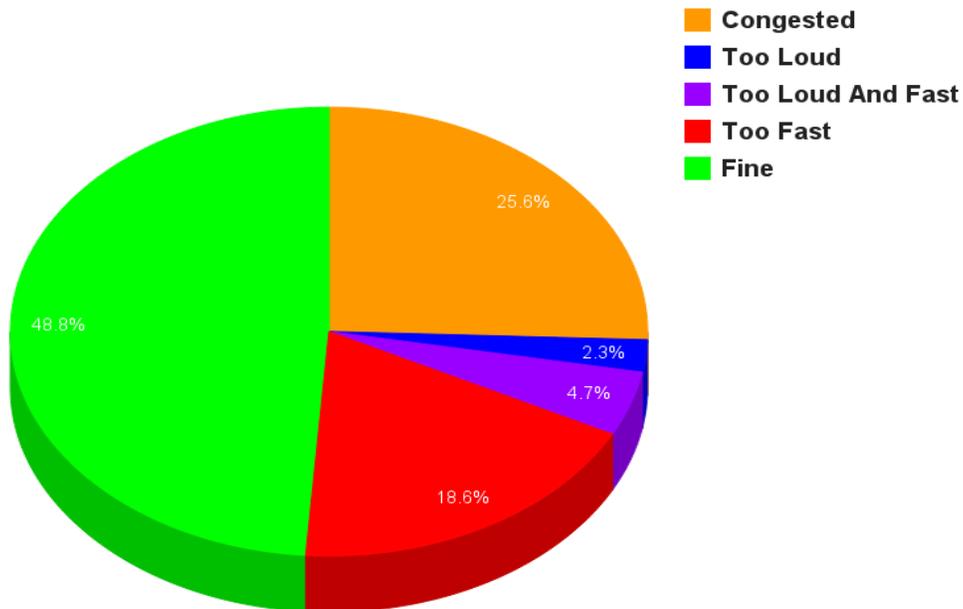
Opinion if a two-way bike lane replaced only one side of Bullard Street



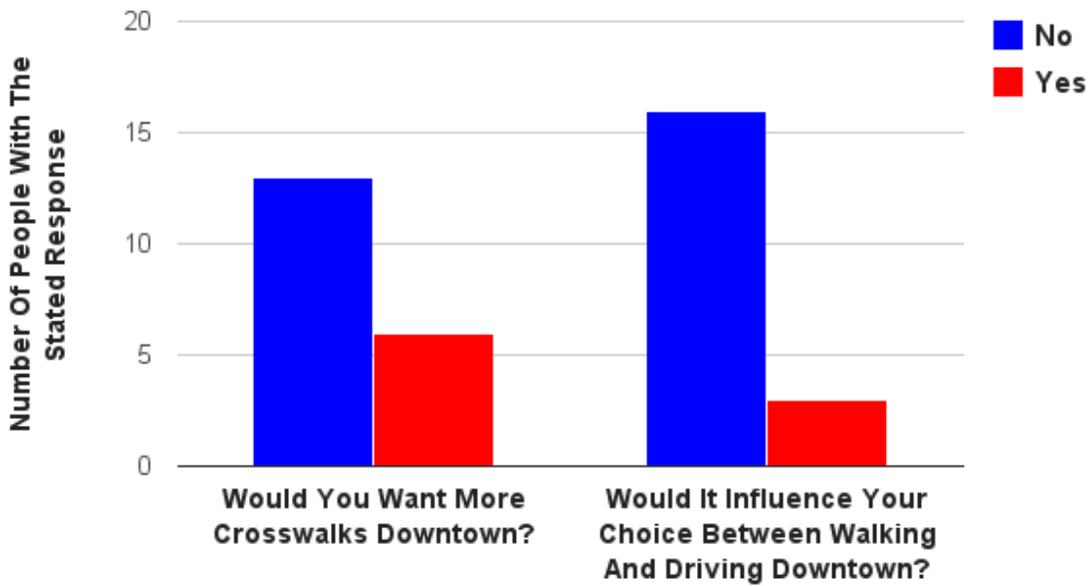
Out of ten times, how many times do you use the crosswalks downtown?



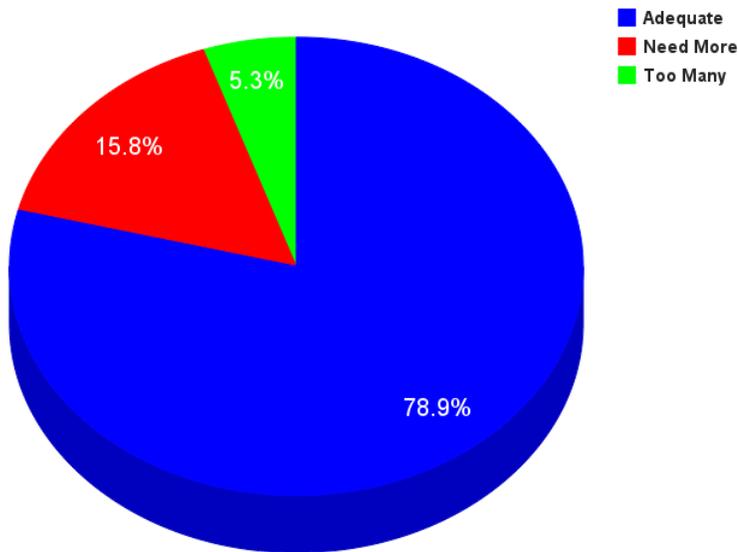
Opinion on Traffic on Bullard Street



Crosswalks On Bullard Street



Opinion on stoplights on Bullard Street



Do you bicycle?

