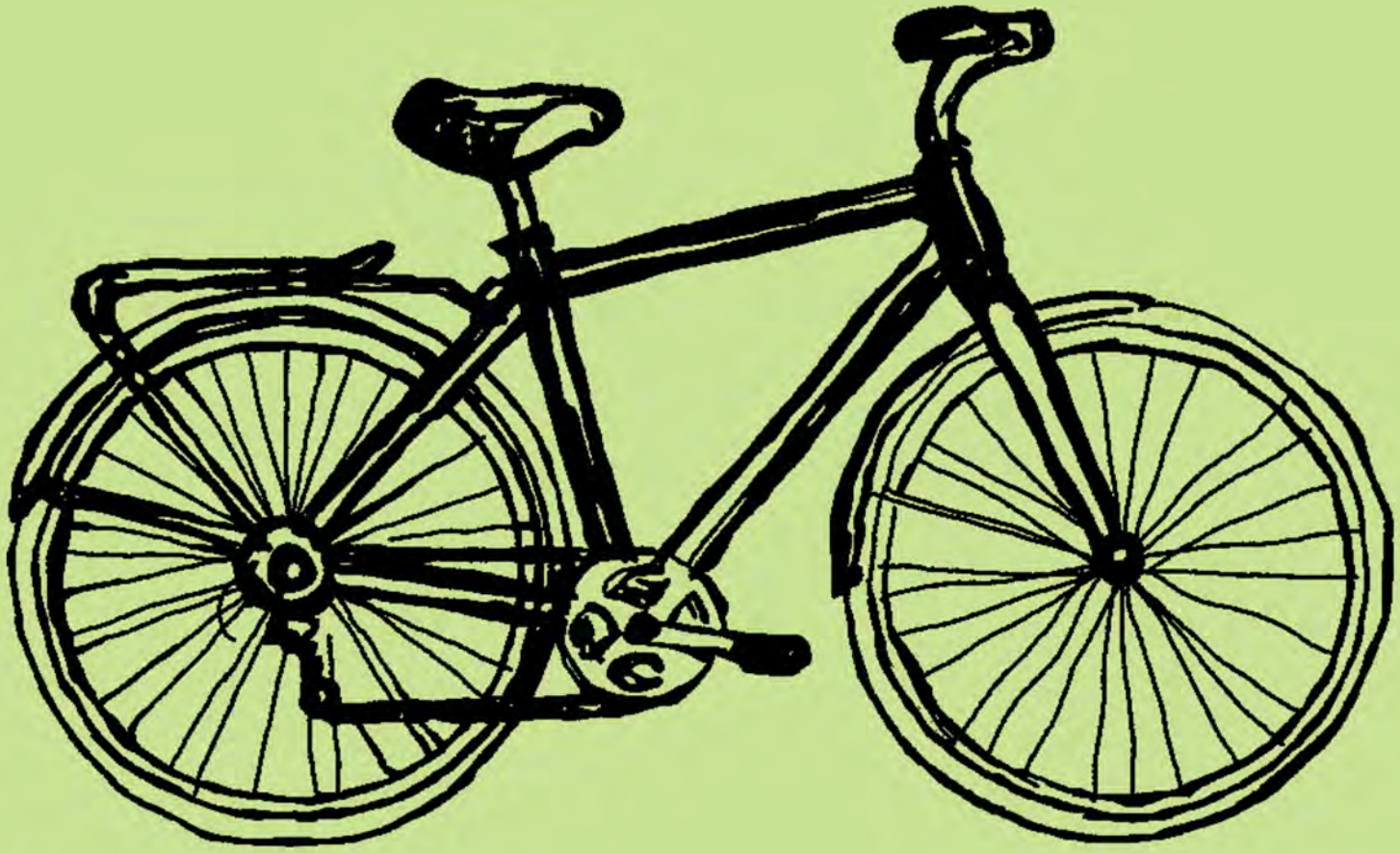
Elevating Seattle's Understanding of Safety Perception & Cycle Tracks



Shoshana Reist
Senior Capstone
June 2018
cep

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Abstract

It has been proven that cycle tracks are the safest form of bike infrastructure in terms of car-bike collisions (observed safety), however this study explores how various buffers in cycle tracks differ and rank in terms of perceived safety. Safety perception is measured by an online survey that asks respondents to rank how comfortable they would be using various cycle track buffers on a Likert scale of "Very Uncomfortable" to "Very Comfortable". The eventual goal of the survey was to produce a ranking of buffers in order to create a recommendation for the Seattle Department of Transportation to implement more of these types of cycle tracks, as there is a correlation between higher safety perception and increased comfort with ridership.

Introduction

My inspiration for this project arose while I was traveling abroad alone in Northern Europe this past summer and was biking as my main mode of transportation. Upon my return to Seattle, I noticed that I had never seriously considered biking in the city. I realized this was due to my negative perception of bike safety. There was a campaign last year that Seattle Neighborhood Greenways had implemented that planted cutouts of people's silhouettes on intersections. These cutouts symbolized the locations where both pedestrians and bikers had been hit by cars. This campaign, along with my mostly negative miscellaneous biking experiences in Seattle, is the reason why I perceived Seattle to be generally unsafe to bike in. I concluded that my higher perception of safety while biking in Europe was due to the increased presence of bike lanes that had some kind of physical separation between cars and bicyclists.

I later found that these types of bicycle lanes are officially called 'cycle tracks' by the National Association of City Transportation Officials (NACTO). NACTO defines cycle tracks as "bikeways that are at street level and use a variety of methods for physical protection from passing traffic" (Urban Bikeway Design Guide 29). Cycle tracks are also commonly referred to as 'protected bike lanes', as the definition by PeopleForBikes.org is quite similar to that of NACTO's: "protected bike lanes… are like sidewalks for bikes… they use planters, curbs, parked cars, or posts to separate bike and auto traffic". For the sake of this project, I will be calling these bicycle lanes with physical protection 'cycle tracks'. This is a vague term – the physical protection can be anything from planters, to a cement curb, to flex posts. I thought that this kind of bike infrastructure seemed safer than other kinds of bike lanes, but surely safety perception must differ depending on what kind of buffer is implemented.

The Seattle Department of Transportation (SDOT) has a document called the *Bicycle Master Plan* which outlines the city's goals and aspirations for the future of Seattle's bicycle network. The plan includes the following goal – to "increas[e] [the] amount. . . of bicycle riding in Seattle for all trip purposes". However, when SDOT conducted the *Bicycle Participation Phone Survey* in 2013, they found that "don't feel safe" was the primary reason those with bicycles do not bike more. It seemed to me that there was a disconnect between the city wanting people to bike more, but the people who live here not feeling safe enough to do so. According to my research, cycle tracks are the safest form of bike infrastructure in terms of both perceived and observed risk. Not only do people feel the safest when using them, there is also collision data to back up the fact that there are the fewest vehicle-bicycle collisions on cycle track infrastructure. The implementation of cycle tracks seemed to be the potential solution to overcoming this obstacle of low safety perception and ultimately increasing ridership.

I was able to find a lot of information about cycle tracks and their relationship with high safety perception – according to McNeil et al., "bike lanes with the addition of an extra buffered space can increase the perceived safety and comfort of bicycling for both current and potential bicyclists, which in turn would make people more likely to ride a bicycle for transportation" (15). However, I found that there was not a lot of information available about what kind of buffer used in cycle track infrastructure was the best. As I stated before, what sets cycle tracks apart from other kinds of bicycle lanes is the physical separation that protects the bicyclist. That physical separation (or buffer) can be anything from a planter, to a raised curb, to a parked car. I wondered how safety perception surely must differ among these different types of buffers. This is what my project goal was – to figure out what kind of cycle track buffer has the highest safety perception among respondents and ultimately recommend that the Seattle Department of Transportation implement more. In the *Bicycle Master Plan*, SDOT states that they aspire to "encourage and accommodate more people to ride a bicycle". Therefore, it would be in SDOT's best interest to implement bike infrastructure that makes people feel the most safe, as it has been found that in Seattle "concern about safety was the reason 35% of destination riders [and 28% of recreational riders] said they don't ride more often" (EMC Research).

Literature Review

Safety and Cycle Tracks

In the context of my project, “safety perception” can be thought of as the degree to which an individual perceives to be averse from collisions. There is a difference between perceived and observed safety, however “perceived safety increasingly plays an important role in proactive safety planning, because it provides critical information for understanding individuals’ travel behaviors and identifying potentially high crash-risk areas (Cho et al. 692).

The importance of perceived safety has been demonstrated through the plethora of research that has been done on the subject. For example, in *Safety impacts of bicycle infrastructure: A critical review,* the authors argue that in order “for biking to be a viable, healthy mode, travelers choosing the mode should be able to do so without either the fear or reality of excessive danger associated with their choice” (DiGioia et al. 105). This study provides evidence that if the Seattle Department of Transportation wants to increase bicycle ridership, they must address the serious issue of perceived lack of safety in the current bicycle infrastructure. There has also been a lot of research conducted about observed risk – in *Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study,* it was found that compared to twenty other forms of bicycle infrastructure, cycle tracks had the lowest injury risk” (Teschke et al. 2340). According to NACTO, “compared with bicycling on a reference street (a comparable street without dedicated bicycle facilities) . . . these cycle tracks had a 28% lower injury rate”. I was able to conclude that cycle tracks are the safest form of bicycle infrastructure due to the overwhelming evidence of their supremacy in terms of both perceived and observed risk.

There are very few sources stating concern about cycle tracks, as they are the generally accepted best practice, however I wanted to include some skepticism about their installation. It may be a concern that with cycle tracks, because “bicyclists are not traveling directly alongside automobiles, motorists may not be aware of their presence, leading to increased vulnerability at intersections” (Alta Planning + Design 4). There is also apprehension because of the incompatibility of regular street sweeping trucks and “conflicts with pedestrians and boarding or deboarding bus passengers” (Alta Planning + Design 4). Streets that are not originally designed for cycle track infrastructure may also need to reconfigure irrigation systems. These are inconveniences in my opinion that could be easily worked around, however are important points to consider.

Overall, it is easily found that cycle tracks have the lowest perceived and observed risk, which is why I chose an exploration of different types of cycle track buffers as my project’s focus. It was really easy for me to find literature on this subject, however I felt that there was a gap in the research I was finding. Along with the Seattle Department of Transportation, one of my main goals was to find a way to increase ridership in Seattle, so I wanted to do a study that catered to what I think are some evident issues in the current bike infrastructure and help provide some answers as to how to fix it.

Seattle’s Bike History and Current Infrastructure

In 2016, Zillow named Seattle the best bike city in the United States – “the city of Seattle has seven miles of protected bike lanes and it takes about 27 minutes for the average cyclist to get to work” (Lee). Zillow determined this hierarchy of best bike cities by the following four criteria: cyclists per 1,000 commuters, median commute time via bike, mentions of bike storage per 1,000 rental listings, and miles of protected bike lanes. This high ranking perplexed me – I could never imagine biking regularly in Seattle. Through my miscellaneous experiences biking in the city, I concluded that the available bike infrastructure was not sufficient in making me feel safe while riding. I was not the only one feeling this way - I want to reiterate that in SDOT’s 2013 *Bicycle Participation Phone Survey* that I mentioned earlier, it was found that “‘don’t feel safe’ surpassed weather as the most common reason those with access to a working bicycle don’t ride more often”. How could Seattle be the number one biking city in America while failing to address this issue of safety perception?

Another concern I had with this Zillow study is that it used the umbrella term ‘protected bike lane’. A ‘protected bike lane’ (also referred to as a ‘cycle track’ by The National Association of City Transportation Officials) is a “physically separated cycle track that . . . may [be] configured as a protected cycle track at street level with a parking lane or other barrier between the cycle track and the motor vehicle travel lane” (Urban Bikeway Design Guide 41). A problem with using the general term ‘protected bike lane’ is that it does not specify what the buffer is. As I stated previously, this buffer between the cycle track and motor vehicle travel lane can vary significantly. Quantifying Seattle’s bike-friendliness based on a term that, in my opinion is too vague, is a major flaw in Zillow’s methods. This motivated me in my investigation of various cycle track buffers.

Lack of Cohesion in Bicycle Infrastructure

I read a couple of articles written by local residents to get a more personal look into what attitudes Seattleites had towards Seattle biking. I found an article titled *Why I Started Cycling Less in Seattle*. The author, Josh Cohen, expresses his frustrations with biking in the city because there is a lack of connectivity between stretches of bike infrastructure. Cohen points out that when SDOT was installing the bike infrastructure that currently exists, they "prioritized whiter, wealthier neighborhoods north of downtown". He recently moved to Hillman City, which does not have as much bike infrastructure as the north-central parts of Seattle, and any long-distance bike ride he takes fluctuates between neighborhoods that have infrastructure to areas that have nothing at all. He mentions that this lack of connectivity is obvious on SDOT's *Seattle Bike Map*, which I have a copy of, so I took a look. He was right – as you look very far south or very far north (areas that are mostly lower-income than central Seattle), the infrastructure and quality of infrastructure starts to disappear. Even within areas that do have separated bikeways, I would not necessarily consider these areas a bike infrastructure network.

In the study *Quantifying Bicycle Network Connectivity,* the authors Lowry and Loh propose that "the presence and quality of bicycle facilities has a significant impact on bicycling behavior, especially network connectivity" (S135). Yes, encouraging the installation of more cycle tracks is the goal of this project, however, Cohen points out that good bike infrastructure without a cohesive bike infrastructure network is ultimately inadequate – the installation of bike infrastructure needs to be a citywide movement. I thought that this was important to mention because it is another factor that contributes to general feelings of unsafety.

Social and Political Conceptions of Biking in Denmark vs. the United States

"Risk perceptions . . . [are] heavily influenced by social and cultural conditions", according to Meghan Winters et al. As I mentioned previously, a main inspiration for my project was my solo trip to Europe in the summer of 2017. It was specifically cities like Copenhagen and Amsterdam that left a lasting impression on me in terms of their efficient bicycle infrastructure. For the purposes of this project, I will be focusing on Denmark as a case study. *In Cycling for Everyone: Lessons from Europe*, authors Pucher and Buehler examine why it is that Northern European countries have been significantly more successful in making bicycling a part of modern life. Firstly, they suggest that bicycling in Northern European countries is a more casual and socially acceptable activity, whereas in the United States "cycling remains a marginal mode [of transportation] . . . because it is widely viewed as requiring special equipment and training, physical fitness, and the courage and willingness to battle with motor vehicles" (Buehler and Pucher 2-3). This social stigma is less prominent in Northern European countries and is not such an inhibiting obstacle. For example, "in Denmark, there is a strong tradition for people from all strata of society to cycle. Most Danes associate the bicycle with positive values [such] as freedom and health" (Ruby). This is a social conception that was built over time with help from Danish branding campaigns that came from a concern of the "many traffic accidents and the growing pollution problem" that Denmark was facing in the 1960's (Ruby).

James Longhurst, author of *Bike Battles: A History of Sharing the American Road*, proposes that the role of the bicycle has a complicated history in the United States, dating back to the 19th century. Longhurst describes that bicycles prospered in the late 1890's, but by the 20th century they dropped in popularity. This was largely due to a decrease in price and increase in accessibility, a combination that would seem to increase ridership overall, but the past exclusive and luxurious nature of bicycling was what attracted people. This therefore ensued "the elimination of the bicycle as a luxury, followed by the gradual falling off of popularity in the middle classes, and finally by the working classes" (Robert E. Sessions). A more positive social conception towards bicycling never was established in the United States.

There also seems to be a difference between the United States government and Danish government in attitudes towards biking. Perhaps Denmark has been more successful in increasing ridership because the Danish government has prioritized making safe, affordable, and accessible biking available in a way that the United States never has. For example, in 2013, the Danish government set aside about 3.59 billion dollars for the Ministry of Transport Affairs (Finance Act 2013). On the other hand, using *A New Foundation For American Greatness* (the U.S. government's budget for the fiscal year of 2018) as a representation of American values in biking, Trump proposed to decrease the Department of Transportation's budget by 12.7% (Krieg and Mullery). The new administration also completely cut the Transportation Investment Generating Economic Recovery program (TIGER), which allows the Department of Transportation "to invest in road, rail, transit and port projects that promise to achieve national objectives" (About TIGER Grants). This includes bicycle plans, bicycle lanes on roads, bicycle parking, and bicycle racks on transit – all of which contribute to increased accessibility to bicycling (Pedestrian and Biking). Through these cuts in the Department of Transportation's funding, it is clear that building United States' bike infrastructure is not high on Trump's agenda.

One of the concluding statements of the Pucher and Buehler article is “perhaps the most important reason for the higher levels of cycling in Northern Europe . . . is that cycling is much safer there than in the USA”. Ultimately, the issue of a lack of ridership in the United States comes back to safety. If the U.S. government does not allocate funding towards bicycle projects, the infrastructure quality will not significantly increase in the near future. Lack of governmental aid in a sense may feed the American social stigma of biking being unsafe because “bicycling injury rates are higher in countries where cycling for transportation is less common” (Teschke et al. 2336).

The significance of comparing Denmark to the United States is to demonstrate how the social attitudes and political contexts of both countries have significant consequences in terms of the progress of bicycle infrastructure. If a large goal of my project is to get more people biking, then it is important to consider the context in which I am trying to evoke change. The United States has historically had a more negative social stigma around biking and the government does not necessarily prioritize biking in its funding. The U.S. federal government has demonstrated its lack of financial support for bicycling infrastructure projects.

Cars and the Unsustainable Environment

From the environmental perspective, an increase of bikes on the road hopefully means less reliance on cars. The consequences of a society that is reliant on cars have become increasingly evident as humans observe more and more environmental results of climate change. According to the Environmental Protection Agency (EPA), transportation is responsible for 27% of total U.S. greenhouse gas emissions, “making it the second largest contributor of U.S greenhouse gas emissions”. Of that 27%, “the largest sources of transportation-related greenhouse gas emissions include passenger cars” (Sources of Greenhouse Gas Emissions). The EPA even suggests biking as an opportunity to reduce transportation emissions on their website. Using 2015 United Nations data on road transportation, which includes cars, light duty trucks, heavy-duty trucks, buses, and motorcycles, I found that the carbon dioxide emitted between the United States and Denmark was 1466.32 metric tonnes and 11.56 metric tonnes respectively (Greenhouse Gas Inventory Data).

All of this carbon dioxide that is emitted from transportation ends up in the atmosphere, our ocean, and our land. Carbon dioxide is “the most important gas for controlling the Earth’s temperature”, and as carbon dioxide levels rise, it causes the planet to increase in overall temperature (The Carbon Cycle). Higher temperatures lead to melting glaciers, which leads to rising sea levels. Carbon dioxide also ends up dissolving in the ocean creating “carbonic acid, which increases the acidity of the water” – this process is called ocean acidification (The Carbon Cycle). Increasing populations require more food, and farmland is replacing forest, “which store much more carbon. . . than crops”. In 2008, it was found that “deforestation accounted for about 12% of all human carbon dioxide emissions” (The Carbon Cycle). As the world’s population continues to grow, our highways will become more congested than they already are, and the overall carbon dioxide emitted from vehicles will increase. Although this is a very brief account of why increasing carbon dioxide is bad for the environment, I hope it can demonstrate why the increase in reliance on vehicles paints a dangerous future.

However, in a research article called *‘Peak Car’ – Themes and Issues*, Goodwin and Van Dender propose that the future may not have to be so dim. Since the 1970’s, social scientists in the United Kingdom have been speculating that “there would be an upper limit or saturation level to car ownership and use… the rate at which car ownership and traffic approached the eventual saturation was thought to be influenced by incomes and by prices” (Goodwin and Van Dender 245). This ‘peak car’ forecast of “an ultimate saturation level of around 400-450 cars per 1000 population would occur in the first decade of the twenty-first century” (Goodwin and Van Dender 245). Although this did not necessarily happen, Goodwin and Van Dender did find some promising trends. The first is that young people are driving less – they “have made the largest negative contribution to the recent development of car travel” (Goodwin and Van Dender 250). As these young adults age and replace the middle aged adults of today, perhaps we will see a change in the current use of cars. They also presented the idea that as metropolitan cities become bigger and overcrowded, it will make traveling by car increasingly inefficient and people will be forced to find other means of transportation.

Methods Research

I had to do a lot of research about surveying, as academic and scientific surveying is a lot more intricate than I had previously anticipated. I am also considering trying to get this research published, so I wanted to make sure that my surveying techniques were professional and accurate. I based the methods off of a study done at Portland State University called *The Influence of Bike Lane Buffer Types on Perceived Comfort and Safety of Bicyclists and Potential Bicyclists*. The survey was self-administered, which means that it is a “survey

that collects data without the use of a telephone or in-person interviewer" (Thayer-Hart et al. 11). The survey included both closed and open-ended questions. Closed questions "provide a list of acceptable responses", whereas open-ended questions "allow respondents to answer in their own words" (Thayer-Hart et al. 9). For example, when asking respondents about safety perception, I asked the closed question, "How comfortable would you feel bicycling on a high-capacity urban street with two lanes of traffic in each direction, with traffic speeds of 35 miles per hour, with the following types of separation from traffic". I gave respondents the option to answer on a Likert scale from "Very Uncomfortable" to "Very Comfortable". A Likert scale is "an ordered scale from which respondents choose one option that best aligns with their view" (Losby and Wetmore 4). "For questions that only ask about one dimension", so in this case how comfortable they would be, "five fully labeled categories are usually sufficient" (Thayer-Hart et al. 10). Towards the end of the survey, there is an open-ended question about other significant factors that affect respondents' perception of bike safety.

Methods

The goal of my methods was to produce a ranking of high to low safety perceptions of the various types of cycle track buffers I selected to study through an online survey. The different types of buffers I examined were:

- Painted 2-3 foot buffer
- Painted 2-3 foot buffer and plastic flexposts
- Raised concrete curb
- Raised concrete curb and parked cars
- 2-3 foot tree buffer
- Planters separating the bikeway

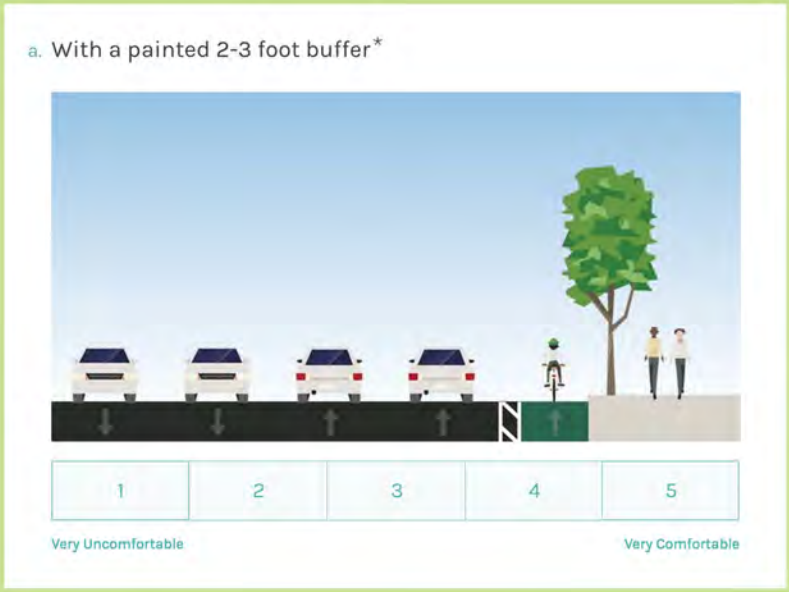
The first month and a half of winter quarter I did a lot of research planning the survey. I found that even the language of questions as well as the order of questions could possibly invoke bias and affect the data. I created the online survey using Typeform.com as my platform of choice. I made sure to test the survey before its distribution, gathering opinions and feedback from my peers. In late February, the survey went live and I circulated the link to bike blogs, organizations, and shops as well as my urban planning community/network.

Screenshots of tweets promoting my online survey from both Bike Works, a non-profit bicycle shop in Seattle, and Cascade Bicycle Club, a statewide, non-profit, bicycle organization.

The survey begins by asking respondents for demographic information, including their age range, gender identity, and what neighborhood they live in. This information isn't extremely necessary for answering my question of what type of cycle track buffer is ranked highest in terms of safety perception, however I thought it was easy demographic information to gather to study further trends in my data. Next, I asked respondents about their safety perception of the six selected cycle track buffers. For each different cycle track buffer I asked, "How comfortable would you feel bicycling on a high-capacity urban street with two lanes of traffic in each direction, with traffic speeds of 35 miles per hour, with the following types of separation from traffic:" I had respondents rank on a Likert scale of 1 to 5, 1 indicating "Very Uncomfortable" and 5 indicating "Very Comfortable".

Each cycle track buffer had a corresponding graphic to avoid difference in respondents' interpretations of the cycle track buffer titles. This portion of my survey was inspired by the McNeil et al. study *The Influence of Bike Lane Buffer Types on Perceived Comfort and Safety of Bicyclists and Potential Bicyclists*, which was conducted at Portland State University.

This is what the safety perception questions looked like in the online survey. The question followed each title of buffer with its corresponding graphic. The order of the buffers was randomized for each respondent to avoid response bias, specifically question order bias. Next, I included questions regarding respondents' biking habits and activity. I asked whether or not the respondents owned bikes, how often the respondents bike, how long their average bike ride is, and to name any other factors that contribute to making them feel unsafe while bicycling. My goal for the survey responses was 200 – that was the amount of responses I felt comfortable drawing conclusions from. I hypothesized that parked car buffers would have the highest safety perception. The collage of graphics below show the six different cycle track buffers that I had respondents rank with their corresponding graphics.



Source: Typeform

Painted 2-3 foot buffer

Planters separating the bikeway

Painted 2-3 foot buffer and plastic flexposts

Raised concrete curb

Raised concrete curb and parked cars

2-3 foot tree buffer

Source: Streetmix

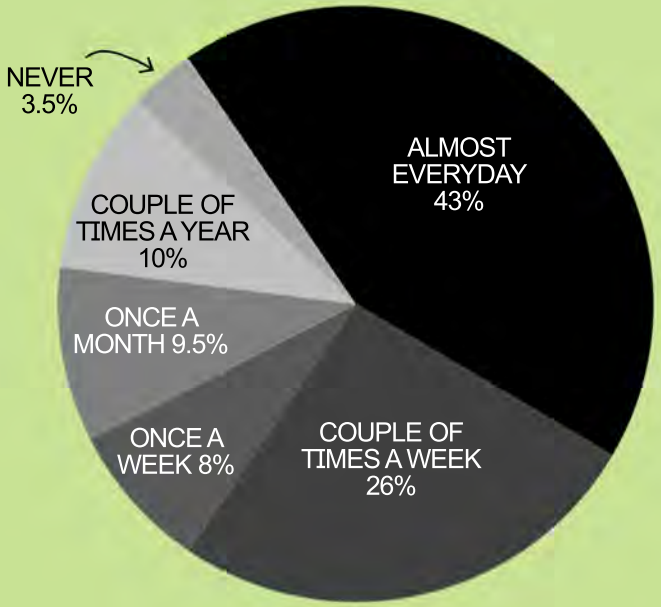
Results

Most respondents (35%) were between the ages of 25 and 34.The age range of 25-44 years old made up for more than half of the respondents, so most of the respondents were relatively young. The majority of respondents coming from this age range was fairly expected as it is the age range where individuals are the most active, healthy, and independent. It was also the most responsive age range in SDOT's 2013 *Bicycle Participation Phone Survey*. The gender ratio was fairly balanced with 54% of respondents idenitifying as male

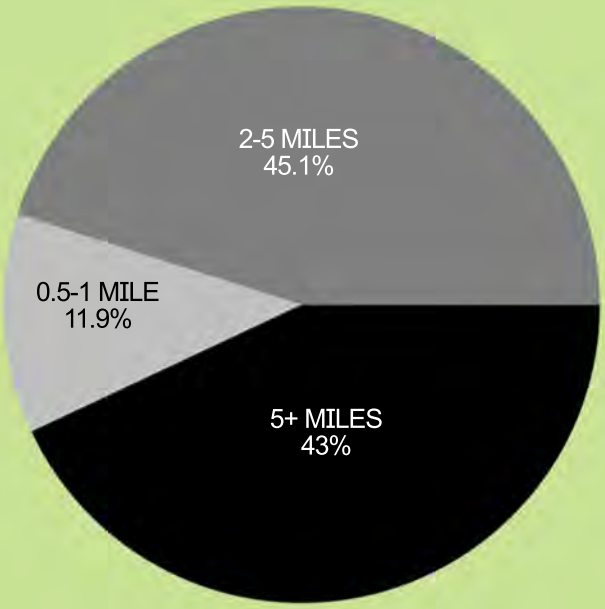
and 45% respondents identifying as female. Only two people identified as non-conforming. The most represented neighborhoods were “Other” at 23%, Capitol Hill at 11%, and both Ballard and University District at 9%.

When asked how often they ride a bike, 43% of respondents said “Everyday” and 26% said “A couple of times a week”. This means that almost 70% of respondents bike at least a couple of times a week. On their average bike ride, 45.1% of respondents reported they bike 2-5 miles, 43% of respondents said 5+ miles, and 11.9% of respondents said 0.5-1 mile. Of 200 respondents, 184 own a bike. This bike activity information allowed me to conclude that the majority of my respondents are experienced bikers that are familar with Seattle’s current bicycle infrastucture because they use it on a pretty frequent basis. Therefore, I am confident that respondents could accurately rank their percieved safety in my survey because they have used these different types of bicycle infrastructure in real life.

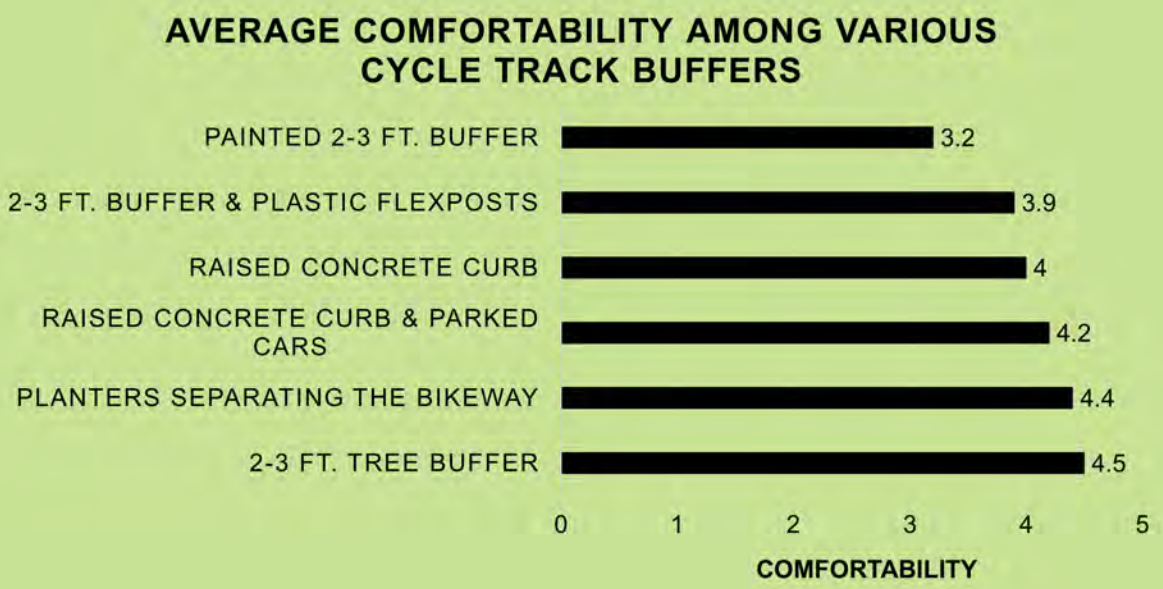
Average Bike Activity



Average Bike Ride Length



Among six different choices, the buffer with the highest rating of comfortability was the 2-3 foot tree buffer rating at an average of 4.5 on the comfortability scale. In second place was planters separating the bikeway at an average comfortability rating of 4.4 and in third place, the raised concrete curb and parked cars with an average comfortability rating of 4.2.



As previously stated, I expected that this type of cycle track would have been the most comfortable, however upon further research, I found that cyclists typically associate parked cars with a phenomenon called "dooring". Dooring, when drivers open car doors and hit cyclists, is responsible for a significant amount of car-bicycle collisions. According to the City of Seattle's 2016 *Bicycle and Pedestrian Safety Analysis*, "crashes involving bicyclists and opened doors of parked vehicles. . . are the fourth most common crash type" (9). The painted 2-3 foot buffer was rated the lowest, which was expected because the buffer is paint instead of vertical physical separation, at an average comfortability rating of 3.2 with the 2-3 foot buffer & plastic flexposts and raised concrete curb following closely behind.

I am aware that cycle track infrastructure is much more expensive than other types of bike lane infrastructure such as sharrows – "road markings used to indicate a shared lane environment for bicycles and automobiles" (Urban Bikeway Design Guide 133). It has been estimated that painted sharrow signage costs about $180 per unit (Bushell et al. 30). According to the *Cycle Track Barrier Selection Matrix* by PeopleForBikes.org, striped buffers (referred to as "Painted 2-3 foot buffer" in this study) cost $1.50-3 per foot and $8,000-16,000 per mile and flexposts cost $3-5 per foot and $15,000-30,000 per mile. These types of buffers are cost-effective, but are ranked much lower in terms of safety perception. On the other hand, it has been estimated that parked car buffers cost $15-60 per foot and $80,000-300,000 per mile and planter buffers cost $15-75 per foot and $80,000-400,000 per mile. These two types of cycle track buffers were ranked highly in this study in terms of safety perception, but are much more expensive. There is no estimation of cost for tree buffers available on this matrix or much information in general on the cost of these types of buffers because they are not widely used. The higher costs of cycle tracks is a reasonable source of hestitation – just this past month, the Seattle Department of Transportation completed a cycle track project on 7th Avenue in Downtown Seattle. The cycle track project uses a raised curb buffer and is only 4.5 blocks long, but ultimately costed the city $3.8 million (Lindblom).

The final part of the survey was an open-ended question that asked respondents to name any factors that contribute to making them feel unsafe while biking. I provided a few predetermined reasons such as "high car speeds", "poor infrastructure", and "lack of infrastructure cohesion", as well as gave the option for them to type in their own factors. Respondents were allowed to choose more than one. High car speeds was the most popular factor at 79.5% of respondents agreeing that it contributed to their feeling unsafe. Not far behind was poor infrastructure at 77.5% and lack of infrastructure cohesion at 72.5%. It is clear that all three of these issues are of high importance for most respondents. Among the open-ended answer portion, the most popular answer was the unpredictability of drivers due to texting.

I would like to acknowledge that the 200-person sample I collected cannot be entirely representative of the biking population in Seattle. One of the main intentions of this study was to figure out how to get more non-bikers like myself biking, however the respondents of the online survey were reached through the audiences of Bike Works & the Cascade Bicycle Club (who are mostly bikers) and through my personal urban planning network (people interested in public transportation). All things considered, I wanted my sample to be intentional and I could not find a caluculated and purposeful way to reach the non-biking community.

Conclusions

Ultimately, I recommend that the Seattle Department of Transportation look into implementing more cycle tracks with parked car buffers. I understand that these are amongst one of the most expensive buffers I could recommend to implement, however they are also considered one of the safest. Compared to planter and tree buffers, they require little upkeep/maintenance. As mentioned before, the reconstruction of irrigation/draining is a huge obstacle for the installation of many cycle track buffers that I studied, but is not one for the parked car cycle track. The problem of dooring is definitely someting to consider, however I believe with the right execution of a public campaign which would properly educate the public, I think that the City can decrease the amount of dooring incidents significantly. In my research, it was shown that the increase of bikers on the road makes biking generally safer and it is my hope that this increase would lead to an eventual decrease in vehicle use. If these two things were to happen as a positive consequence of the implementation of better bicycle infrastructure, the issue of dooring would also become less common.

This study occurred at a convenient time – with the City spearheading initiatives like *Vision Zero*, their "plan to end traffic deaths and serious injuries by 2030 through innovative engineering", and the 2016 *Bicycle and Pedestrian Safety Analysis* where they sought to find "where, how... and why crashes happen" – this is the seemingly perfect time to supply the City with valuable information about the safety perception of infrastructure used by its residents. It is my hope that this document is referred to in future bicycle infrastructure implementation considerations in Seattle.

Acknowledgments

Thank you to Megan Herzog, Kelly Hostetler, Brad Shipley, Nico Martinucci, Lisa Hembre, Caitlin Reddy, and Branden Born for their guidance throughout this project. Thank you to Bikeworks and the Cascade Bicycle Club for their support in spreading my survey throughout their respective networks. Finally, thank you to my CEP community for being a support system over the course of the past year.

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