IMT 570 B Research Report - Bicycling in Seattle

Executive Summary

The goal of our research was to address the issues of transportation in Seattle and we utilized the opportunity to investigate the problem statement of "What are the factors that inhibit bicycle commuting in Seattle?". Based on the analysis of our secondary data sources, we identified five key categories through which we could measure our problem statement with prospective users. We conducted 9 interviews and rolled out an online survey that recorded 42 responses. The analysis of our qualitative and quantitative methods validated our initial findings and we were able to form the following problem statements in each of the categories.

Category	Description	Problem Statement
Infrastructure	It includes protected bicycle lanes, dedicated parking spots, support in buses/light rail/other modes as well as shared bicycling facilities in the city.	Do shared bikes increase bicycle adoption?
Safety	It includes the safety of the rider as well as the safety of the bicycle equipment	Are Seattle's car/vehicle drivers aware of driving styles that affect safety of bicycle commuters?
Community Support	It included the community awareness related to bicycle riders in the city as well as a socially active bicycling community.	Is there an association between community awareness and safety of bicycle commuters?
Personal Reasons	It includes personal motivation that drives people to bicycle, like, fitness, care for environment, ease of travel, being able to afford and maintain a bicycle.	Can community engagement increase bicycle adoption?
Environment	It includes external environmental factors such as the weather, terrain and distance of commute, quality of air, road and traffic conditions.	What are the factors that will allow regular bicycle commuters to continue in unpredictable weather?

Our recommendations are directed to the Seattle Department of Transportation (SDOT) to invest in further research in each of the categories and problem statements to identify and address the core issues that are negatively affecting people, preventing them from taking up bicycling as a mode of

commute in Seattle. Further research can benefit the city into executing well informed policies and prioritizing the investment of public funds allocated for development of bicycling infrastructure and facilities that can improve the stagnant adoption of bicycle commute in the city. Even a small increase in the number of bicycle commuters will have a significant impact in reducing the traffic and thereby mitigate some of the issues surrounding transportation in the city.

Introduction

Background

During the last decade Seattle has seen the highest population growth in United States of America. The city is expected to add more than 120,000 new people and 115,000 new jobs in the next 20 years.[1] The transportation infrastructure of the city, however, has not been able to keep up with the growing demands of the population. The situation has also been aggravated by the fact that certain key transportation infrastructure such as the Alaskan Way Viaduct is being scheduled to be closed down as early as January 2019 and the light rail infrastructure that is supposed to accommodate the majority of the transportation woes of the city is expected to take its time and would be completed in at least the next 25 years. [2] Seattle Department of Transportation (SDOT) has even coined the term, “Period of maximum constraints” (2018-2021) to acknowledge that the transportation infrastructure of the city will be pushed to the limits in the next 3 years, and they have officially quoted on their blog, “Yes, ironically, things will get tougher before they get better”.[3]

With this background in mind we explored the option of bicycle commuting in our research because Seattle has been considered a bicycle friendly city for quite some time. On October 10, 2018, SDOT posted on its blog, the recent results from the survey by the *Bicycling Magazine*, where Seattle was ranked as the best city for bicycling in USA.[4] At the same time around a month back, seattle times analysed the census records of the city and reported that the number of people commuting to work by a bicycle hit a 10 year low in 2017. [5] The report was also corroborated by the findings of the 2017 Commute Mode survey that showed the overall aggregate mode share of bicycling commute has been stagnant at 3% for the last 7 years. [6] So why is it that on one hand the city of Seattle is ranked the best city for cycling in the country and yet it is not able to increase its bicycle commutership in the last decade? In order to address this gap, we explored the following problem statement in our research.

Problem Statement

What are the factors that inhibit bicycle commuting in Seattle?

Research Objectives

The research methodologies and analysis adopted by different media outlets, and public and private organisations to arrive at the above conclusions may differ and there may or may not exist any causality in between them. Our aim is to explore the available literature and additional open data sources within the public domain to ascertain the factors that inhibit bicycle commuting in Seattle. We further intend to undertake quantitative and qualitative research in order to validate our assumptions.

Our research area is relevant because SDOT is in the process of investing over 75 million US dollars in a plan to improve the bicycle infrastructure in the city of Seattle through its Bicycle Master Plan (BMP) 2017-21.[7] As per the master plan, bicycle network implementing facilities such as off-street trials, protected bicycle lanes and neighborhood greenways, are expected to increase ridership, safety and connectivity in coming years. Hence, it would be important to validate the areas of infrastructure and facilities that the BMP should prioritise in order to be successful with its mission to encourage and accomodate more people to ride a bicycle for “of all ages and abilities”. [8]

The objective of our research study is to address the problem statement and identify the gaps that exists in between the various conclusions drawn by different studies on bicycle commuter ship in the city of seattle. On the basis of our analysis, we intend to draw inferences that can be used to make validated recommendations to the SDOT on the current implementation of its ongoing Bicycle Master Plan.

Approach and Methodology

Sample Selection

The scope of our research was limited to the population at University of Washington(UW). For our participation selection, we used the stratified sampling method.

Stratified sampling is a divide and conquer sampling strategy. The population is divided into groups called strata (David Diez, 2012). [9] We chose two stratas to group similar cases together like stratum of students at UW and stratum of non-students at UW. A second sampling method of simple random sampling was employed within each stratum. The stratified sampling in conjunction with random sampling method helped us get a stable, reliable and diverse estimate for each subpopulation that is

representative of the whole population. We then used the "Snowball Approach" while initiating our first contact from the participants within the University of Washington.

The limitations of stratified sampling is that we can't classify every member of the population into a subgroup. Finding an exhaustive and definitive list of an entire population can be challenging. Also overlapping can be an issue if there are subjects that fall into multiple subgroups.

Due to the challenges associated with stratified sampling, we will not use it for a full-scale study. We will use random sampling method for participation selection in this case. The challenges associated with random sampling method is that we need to have a large sample size which is time consuming. The second important limitation of random sampling is that it may not give us a good estimate of the diverse population.

Data Collection Procedures

The primary data for our research was collected by using surveys and interviews.

1. Online Survey: We rolled out an online survey within the University of Washington. The choice of using an online survey is because it can be easily transmitted to a wider audience through email/social media and personal contacts. The survey provided quantitative insights into the diverse nature of issues, problems and areas of concerns of the participants which we used further to explore deep into the qualitative analysis during the interview sessions. We were able to get 42 responses through the survey.

2. Interviews: We interviewed 2 people in-person and 7 people over the phone from both the stratums. For interviews, we developed protocols to ensure all interviews are run and conducted smoothly in standardized procedures. The questions from the verbal protocol and prompt areas were executed in the form of semi-structured interviews. We explored new and innovative ways of conducting semi-structured interviews, for example using skype, telephonic interview or in person chat, instead of structured interviews, so that the conversation can be more flexible. Natural conversations may also allow new issues to be raised and for us to focus on. We then used thematic analysis to quantify our data from the interview session and explore correlations that could be used to validate our primary data analysis.

For secondary data, we analysed the following sources,

1. Reports from Government Agencies
    a. Commute Mode Split Survey 2017 - This study was conducted for Commute Seattle(a partnership between the Downtown Seattle Association, King County Metro, Sound Transit, and the Seattle Department of Transportation) on behalf of SDOT to understand how the behaviour of commuters travelling to Downtown Seattle have shifted over time.

   b. Bicycle Master Plan 2017-2021 - The implementation plan for developing the bicycle infrastructure in the city and published by the Seattle Department of Transportation.
2. Reports from Bicycle Magazine
   a. Where We Ride (2016) report[10] that publishes growth in number of cyclists commuting to work over a period of time from 1990 to 2016. The cities with better numbers compared to Seattle are a good starting point to start looking for improvements and changes that can be recommended to the latter.
   b. PlacesForBikes[11] is a program that ranks cities around the US, that aims to help build and connect great places to ride. To identify the extent to which a city is bike-friendly, it looks at broad factors like ridership, safety, network, reach and acceleration.
3. Reports from Local Media & Advocacy groups
   a. Articles from the Seattle Times.
   b. Articles from Seattle Bike Blog Advocacy group.

Validity and Reliability

As for any internal or external validity concerns (trustworthiness and credibility) related to data collection, we took measures to avoid any bias in our survey or research questions. We piloted our survey with a closed group of initial users and gathered their feedback on leading/confusing questions. We introduced logic in our survey to accommodate the different kind of bicycle users within the population at University of Washington and the people we interviewed were people we knew in some capacity and their answers were reliable. Hence the data we collected can be considered credible within the margin for error.

As for the validity concerns related to a full-scale study, we will have to make sure that our survey and interview questions are valid and reliable in terms of internal validity concerns. For external validity concerns, we have to make sure that the survey and interviews are taken by people who are relevant to the research. There will arise the need for better methods to keep track of all surveys and interviews conducted. Snowball approach is a good way to make sure that the people who are taking our survey or interview will be reliable. More individuals will need to be involved in the overall analysis of collected primary data, and this calls for tighter regulation of access to collected data. Also, for a larger study, more personally identifiable data might be required to be collected, and this will in turn increase the need to mask and protect certain details of respondents from individuals that lack the need to know (i.e. restrict to individuals with the need to know only).

Ethical Considerations

Our research followed strict ethical guidelines as mentioned below,

- Minimizing bias and informed consent of people taking part in surveys and interviews

Verbal consent was sought prior to recording the interaction every time (in case of interviews). The interviews were conducted in a semi-structured manner, allowing interview subjects room to think and

express their views; questions were designed so as to not lead the subjects into thinking about specific factors in a positive or negative manner.

- Convey implications of the research to the participants

Every interview subject was orally informed about the purpose of this research. Similarly, intended use of collected data was informed to survey respondents prior to asking any pertinent questions.

- Maintaining confidentiality of the participants' data

No names were recorded as part of the survey questionnaire. Similarly, no IP addresses were recorded for further analysis. Emails and other such contact information was only used for mentioned purposes, and it was not shared with anyone outside the research group. Age, income and education related data was collected owing to its relevance to this study, and was used to understand demographics of responders.

- Secure management of collected data

All data collected was stored on cloud storage, in a secure drive created just for the sake of this research project. Access to the drive was restricted to the research team/group exclusively.

- Selection of participants

Efforts were made to ensure diversity amongst survey participants, and the invitation to participate was posted in/sent via Whatsapp groups, Slack channels, emails and text messages.

- Legal usage of secondary data sources

Secondary sources of data (e.g. datasets from SDOT) were used responsibly, for analyzing the current scenario and identifying future scope for research.

- Deriving conclusions based on collected data

Ethical research is not just about collecting and managing data responsibly, it is also about analyzing, drawing conclusions and suggesting recommendations as objectively as possible. Thorough discussions were held, keeping these in mind, before publishing this report. Also, interview subjects were offered the option to receive a transcript of the interview, to allow them the chance to clarify any and all inputs provided.

- Citations

Giving credit where it is due, is crucial for any researcher. We are mindful of this, and have cited any and all resources that were used over the period of this study.

Findings and Analysis

Qualitative Analysis (Thematic analysis of interviews)

In order to know more about our interviewees' past experiences, we aimed to create a fluid discussion instead of receiving straightforward answers. To achieve this, we conducted semi-structured interviews by providing open-ended questions. Despite choosing this kind of interview which is more flexible, we designed an interview protocol which includes time slots to manage the interview time and prompts to ensure the interview did not go off topic and beyond time. We limited each interview time to 15 minutes, and overall, we interviewed 9 people, including 6 students and 3 non students at University of Washington.

Sample interview protocol

00:00-00:01	Thank you for your participation. We believe that your input will be valuable to this research and will help us in our professional practice. If it is acceptable for recording, we will now turn on the recorder.
00:01-00:04	Please describe how long have you been biking and how long have you been biking to school?
00:04-00:12	What factors would encourage you to bike the most? Are there any obstacle when biking to school? What are they? Prompts No bike trails, no parking space in school, bad weather etc.
00:12-00:15	Are there anything you want to talk about but we haven't mentioned?

Interview findings

In general:

To generate the findings, we went through each interviewee's transcript and extracted 51 keywords. These keywords are categorized into 5 themes, which are safety, infrastructure, community awareness, personal issues, and the environment. From the statistical data below, we can see the theme "safety" seemed to be mentioned the most, while the "environment" appeared to be the least. Furthermore, after counting the times each keyword is mentioned, we found the keyword "bike-lane", "bike-stolen", and "convenience" appeared the most, with 8 times, 6 times, and 6 times respectively.

Frequencies of themes from interview transcripts

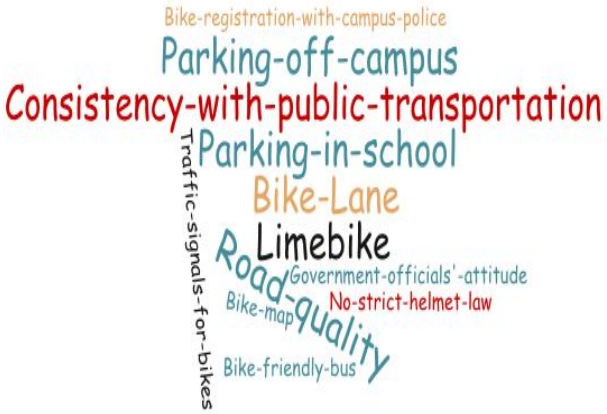
Safety	41
Infrastructure	31
Community Awareness	34
Personal Issues	33
Environment	12

Thematic analysis of safety

In the theme "safety", the keyword mentioned the most is bike-lanes. People said that there are physical barriers on the lanes, impeding their ways and causing dangers. Also, the bike lanes are inconsistent, disappearing suddenly and leaving bicyclists having to ride on the main traffic roads. What's more, the bike lanes are not protected from the cars and not separated from the sidewalk.

Road quality is also a big concern. There are bumps and glass shards on the road, and interviewees complained that these problems are especially serious in Seattle. Speaking of bikes' safety, people said that the bikes thefts are so rampant these days in the city. An interviewee told us she only bikes to UW, since the places off campus have so many thefts that she could never leave the bike out of her sights. Another interviewee told us his bikes have been stolen for twice, even he locked them properly.

Thematic analysis of infrastructure



Besides the bike lanes and road quality that has been mentioned above, when it comes to biking infrastructure, people said that parking can cause big problems. However, parking in school is kind of easy, while parking off-campus is much more difficult.

People also talked about bikes' consistency with public transportation. While some people speak favorably about the bike-friendly buses, others complained that it is hard to load the bikes onto the bus. What makes things worse is it is kind of awkward and embarrassed when the whole bus of people are

waiting for and watching them loading bikes. When this happens for times, an interviewee totally gave up making good use of the bike-friendly buses.

Another keyword that has been frequently mentioned is the Lime Bikes. People agreed that Lime Bikes are actually a very nice infrastructure to encourage the citizens to bike. Nevertheless, they are too costly and did not offer helmets to riders, people are not parking them properly, the riders are not skilled and experienced, and with the electricity options, the riders are sometimes riding at a very fast speed.

Thematic analysis of community

Speaking of the community, people said that the community's common habit of biking, biking events, bike clubs, and bike challenges are encouraging them to bike regularly. Some participants volunteer in biking organizations and this allows them to keep their biking habits for years.

When it comes to community awareness, interviewees mentioned that besides the bike-stealing problems should be solved, drivers should respect the bicyclists' rights on the road by sharing the lanes with them and following the traffic rules. On the other hand, riders should also be aware of not using phones when biking, always wearing the helmets, and learning as well as understanding the traffic symbols and rules.

Thematic analysis of personal issues

People ride bikes because it is cheap. They don't need to pay parking fees or insurance fees for biking. Also, the affordability is a big concern, and purchasing bikes is always cheaper than buying other vehicles such as cars and motorcycles. What's more, people bike for fitness. An interviewee mentioned that if biking regularly, he doesn't need to work out at gym separately. Some interviewees said that biking is their hobby and they bike simply for senses of fulfillment and happiness. Other interviewees mentioned convenience, saying that they no longer need to wait for buses or be worried about missing buses. Biking seemed to make their lives go easier and faster.

Thematic analysis of the environment

Interviewees complained a lot about the terrains and weather in Seattle. The rainy weather and the endless uphills in Seattle are huge discomforts for both riders and bikes. They may ruin the bikes and cause an increase in the maintenance and repair fees. The environment's problems, though seeming to be the hardest to overcome, are badly discouraging Seattle's citizens to bike.

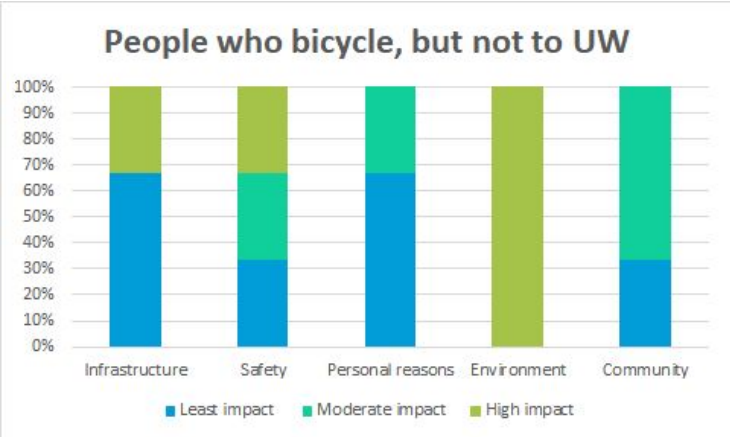
Quantitative Analysis

Scope: Based on 42 survey responses.

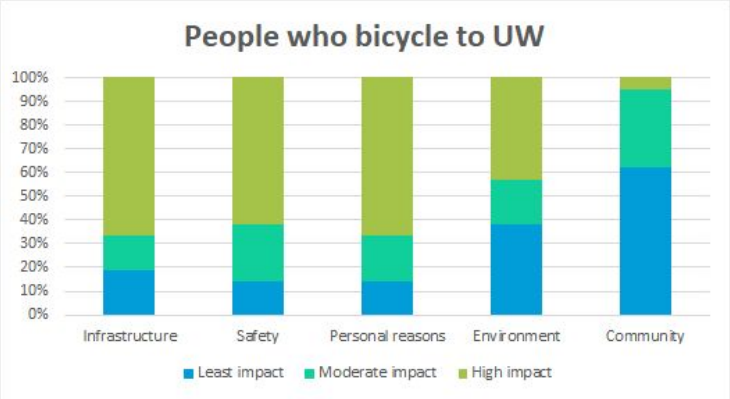
Analysis: Our quantitative analysis indicates the following

1. People who bicycle, but not to UW are highly impacted by Environment, followed by Infrastructure & Safety.
2. People who bicycle to UW are highly impacted by Personal reasons, Environment, followed by Infrastructure & Safety.
3. People who don't bicycle at all, but want to bicycle to UW are highly impacted by Infrastructure and Personal reasons followed by Safety.

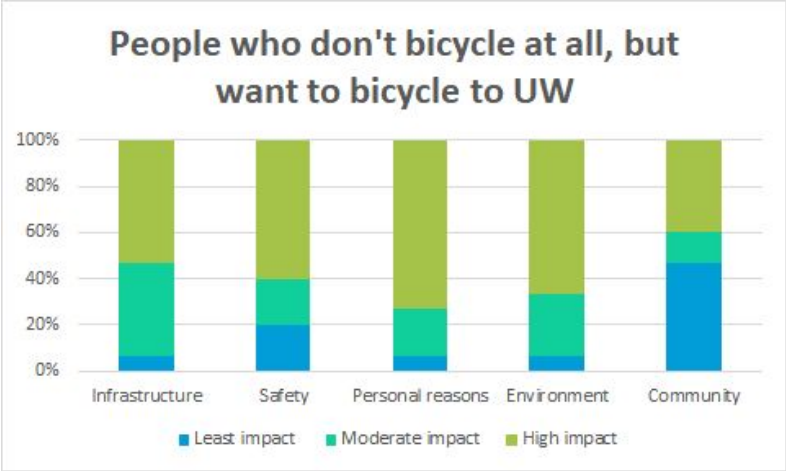
In our overall analysis, we concluded that the three factors of Infrastructure, Safety and Personal Reasons are the most important reasons that affect people when they consider bicycling as a commute option. Any issues within these categories is bound to inhibit users from bicycling to University of Washington. These findings corroborates with the outcome of the thematic analysis conducted from interviews.



Criteria/Buckets	Least impact	Moderate impact	High impact
Infrastructure	2	0	1
Safety	1	1	1
Personal reasons	2	1	0
Environment	0	0	3
Community	1	2	0



Criteria/Buckets	Least impact	Moderate impact	High impact
Infrastructure	1	6	8
Safety	3	3	9
Personal reasons	1	3	11
Environment	1	4	10
Community	7	2	6



Criteria/Buckets	Least impact	Moderate impact	High impact
Infrastructure	4	3	14
Safety	3	5	13
Personal reasons	3	4	14
Environment	8	4	9
Community	13	7	1

Demographic Analysis: Based on an analysis of the survey conducted, the mean and median ages of respondents are 31 and 29.5 respectively. This implies that a large portion of participants are relatively young in terms of age, and might not consider physical limitations (muscle ache, pain in joints, fatigue, respiratory issues, etc.) as hindrances prior to considering bicycling as a commute option. Next, a majority of the survey respondents were students (67%); and other individuals like teaching and non-teaching staff at the UW made up the rest. From an educational perspective, this set of respondents is very well educated: with almost half of them sporting undergraduate (43%) and advanced degrees (48%). A small percentage is taken up by Ph.D holders and individuals with some sort of college education (but no degrees conferred). Talking about income, about 52% respondents reported their annual household income to be higher than $50000, hinting that they are fairly well to do. However, an equal number of respondents (24%) either reported income lesser than $50000, or

declined to share this information. Finally, the group of respondents exhibits a good diversity in terms of gender : 52% male, 43% female and the rest declined to share this information.

Number of people	Education Type
20	Masters
18	Bachelors
2	Doctors
2	Some form of college education

Number of people	Professional status
28	Student at UW
4	Professor/ Instructor/Faculty at UW
7	Non-teaching employee/staff at UW
3	Others/Do not wish to answer

Number of people	Gender
18	Female
22	Male
2	Do not wish to answer

Number of people	Annual household income (range)
10	Less than 50000
22	More than 50000
10	Did not wish to answer

Limitations

Due to the constraints of time and budget, we acknowledge that our research was limited by following factors.

1. We acknowledge that our representation pool in University of Washington (sample size was small with only 42 survey respondents and 9 interviews) may lack the diversity that we may need, in order to generalize our analysis/findings for the city of Seattle.
2. Our research also excluded the following population in Seattle,
    a. People with any physical disabilities/mental issues that may inhibit their bicycling commute.
    b. People who cannot afford a bicycle and its maintenance/repair and hence outside the scope of our research.

Recommendations

The analysis of our exploratory research suggested that further research should be considered in the key areas mentioned below to better understand and isolate interventions or issues that can have the maximum impact in addressing our problem statement.

Infrastructure - Do shared bikes increase bicycle adoption in Seattle?

As part of our findings, people considered shared bikes as an infrastructure within the city. The opinion was divided among our interviews, if shared bikes were useful in increasing bicycle adoption or rather becoming an inhibiting factor. The underlying assumption of our interviews was that even though shared bikes provided opportunity for new riders to pick up bicycling, but at the same time it provided an unsafe environment for inexperienced riders. Additionally, it created a safety concern of riders because the share bikes, like lime bikes, do not offer helmets to its riders. Hence, we recommend that

further research be carried out on the problem statement of "Do shared bikes increase bicycle adoption in Seattle?"

Safety - Are Seattle's car/vehicle drivers aware of driving styles that affect safety of bicycle commuters?

As part of our qualitative findings, bicycle commuters commented upon their perception of drivers and their driving styles, especially at intersections where there is a concept of "Free Right on Red" and bicycle commuters always take the lane closest to the walking path. Hence, bicycle riders feel unsafe around unaware drivers. Hence, we recommend further research with the above problem statement to further explore the perception of drivers, driving styles and if driving tests include necessary training to ensure safety of bicycle riders.

Personal Reasons - Can community engagement increase bicycle adoption?

Our interview respondents gave positive indications towards factors like an active community of biking clubs in the city, the number of bicyclists visible on streets, etc. in motivating people to switch to this commute option. We recommend that this research problem to be studied together with research problem in the category of community support.

Community Support - Is there an association between community awareness and safety of bicycle commuters?

A recurrent theme in the interviews, was the glass shards in many areas of seattle that were affecting the safety of bicycle commuters. Bicyclists complained that the community was generally insensitive or were not aware of the problems faced by bicycle commuters when dumping their glass waste on the roads. Such glass shards can be dangerous - causing tyres to burst and leading to injury. Hence we recommend the research problem to address the issues around the awareness of the community about how their everyday actions can affect bicyclists and their regular commutes.

Environment - What are the factors that will allow regular bicycle commuters to continue in unpredictable weather?

In Seattle, environment plays a important role in inhibiting regular bicycle commuter. The dreary weather, coupled with frequent rains and hilly terrain are constant influences and affect the decision of regular bicyclists. Our interviewees, argued that lack of changing rooms, secured parking spots in the city became a source of inconvenience, even though they wished to bicycle despite the weather. Since the environment will play always externally affect bicycle commuters of all types in seattle, we recommend that adequate measures to be researched that would reduce the inconvenience of regular commuters when faced with inclement weather.

Conclusions

Based on the results of our research and analysis we direct our recommendations to the Seattle Department of Transport (SDOT) to prioritize and invest further research in each of the categories to help identify and address the core issues that are negatively affecting people from taking up cycling as a mode of commute in seattle.

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Appendix

1.1 SURVEY DECLARATION

Research Survey : To explore bicycling as an option to commute to the University of Washington, Seattle.

Introduction.
We are a group of graduate students from the Information School at University of Washington, and the purpose of this study is to understand the factors that influence people's willingness to bicycle to University of Washington.

This survey will take roughly 3 minutes to complete. All data collected will be anonymous and we assure you that it will be handled responsibly. Please feel free to contact us via email (zhwang96@uw.edu) if you encounter any problem with the survey, want to provide us with some feedback, or wish to have a further understanding of our research topic.

We appreciate your participation! Your input is valuable to this study and helps all of us in professional growth.

1.2 SAMPLE SURVEY QUESTIONS

Survey Question	Question Type
Are you interested in bicycling?	Binary - Yes/No
What factors do you consider affect bicycling? (Weather, distance of commute, route of commute(topography), age, gender, income, traffic, infrastructure, safety)	Rating Question on a scale of 1(minimum) to 10(maximum). Factors decided based on our preliminary findings from literature review.
Are there any other factors that you can recommend? (that we may have missed)	Text Box - Optional
Do you currently commute to University of Washington?	Binary - Yes/No
Standard Demographic Questions for age range, ethnicity, education level, household composition, professional or employment status.	Industry standard options with an option of 'I do not prefer to answer'
Would you be interested in taking an in-depth research interview?	Binary - Yes/No
Please recommend your peers and colleagues to take this survey. (An email address/contact where we can reach out to)	Text Box - Optional

1.3 SAMPLE INTERVIEW QUESTIONS

Time	Verbal Protocol & Prompts Areas
00:00-00:02	Thank you for your participation. We believe that your input will be valuable to this research and will help us in our professional practice. Approximate length of interview: three major questions/30 minutes
00:02-00:04	Please describe how often you bike to school and how long have you been biking to school?
00:04-00:08	Question 1: Why did you choose to bike to school? Prompts: Distance, hobby, no public transportation etc.
00:08-00:12	Question 2: Are there any obstacle when biking to school? What are they? Prompts: No bike trails, no parking space in school, bad weather etc.
00:12-00:16	Question 3: What factors would encourage you to bike the most?
00:16-00:22	Question 4: What's your feeling about the current infrastructure (the infrastructure includes parking, biking system etc.)? Question 5: Do you have any expectations?
00:22-00:28	Question 6: Do you know about the Bicycle Master Plan? Prompts: If yes, what's your feeling about the plan? Question 7: Since we would like to know more about the Seattle's or other city's effort on encouraging biking, do you know if there are any other policy or plan relating to it? Hint: Make sure this question won't let participants feel that they are being tested on their knowledge.
00:28-00:30	Any suggestions and feedback? Was anything unclear?