

FINAL REPORT: Incorporating E-bikes into safe cycling in Vancouver

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Executive Summary

Part of the strategic plan of the Active Transportation Unit (City of Vancouver) is the promotion of cycling, which aligns with many of the Healthy City's goals to improve the health and wellness of all (Vancouver, 2018). Ideally, cycling would be safe and comfortable, the intention of the All Ages and Abilities Guidelines for cycling routes (City of Vancouver, 2018). This research focuses on e-cyclists, one group among many diverse users, with the intention of exploring their current experiences on bike routes and their perceptions of what will make them safer, more comfortable and more accessible. Seven research interviews on this topic were conducted using both closed and open ended questions as well as likert-type scales. Further discussions on relevant issues were encouraged. The data was collected and analysed, quantitatively using tables and charts to display the ranking of preferences or concerns, and qualitatively using the several common themes that emerged from questions and discussions.

Our results showed that the majority of our research group used e-cycling for commuting or other purposeful riding. While most had access to alternative methods of transportation, such as motor vehicles and transit, reasons of speed, reduced commute time, relative ease of effort, older age, disability, and the many current environmental concerns made e-bikes appealing to our participants. By necessity, the e-cyclists used all types of bike routes. Those with protection (physical barriers, if possible) from traffic, paved smooth surfaces, wider lanes, separation from pedestrians, and continuous (or with the fewest transitions between different route types) were widely favoured. Safety was generally a greater concern than comfort, as evidenced by the fact that dangerous intersections and roundabouts, speed of traffic, "unsafe" parts of the route, and traffic rules not followed were highlighted as the primary concerns when cycling. The main themes that arose centred around route design, motor vehicle traffic and education. Participants felt that cycling routes should be continuous and consistently designed (within and between municipalities). Several suggestions of street designs were suggested where there is a clear direction of movement, excellent visibility and a focus on protection for vulnerable road users. Passing other route users safely was very important to our group. Further, it was generally felt that passing room was not allocated for cyclists or ignored by others. While there were suggestions of lower speed limits on routes used by cyclists and cars, there was also evidence to show that e-cyclists wanted higher speed limits on the routes they use. This would allow them to be much faster than walking speed and benefit from the speed potential of an e-bike. Other traffic concerns revolved mainly around the the MVA which was perceived as outdated, with current rules neither adhered or enforced. Education of both cyclists and drivers was seen as an extremely important part of this dialogue. Either through voluntary campaigns or mandatory testing, awareness of consistent and logical rules was considered paramount. The report's recommendations are : (1) Separate cyclists from motor vehicles and pedestrians; (2) Aim for continuous routes with consistent, thoughtful design; (3) Recognise that a minimum of two different route designs will be necessary to safely include all cyclists; (4) Education for cyclists and drivers must keep pace with current changes.

Introduction and Literature Review

The term e-bike for “electric bike” encompasses more than just a bicycle with a battery. The spectrum of e-bikes is broad; it can include bicycle style e-bikes and scooter style e-bikes, which include motorized wheelchairs or mobility scooters. E-bikes often have three main components: a battery, controller and a motor (Fishman & Cherry 2016). The Insurance Corporation of British Columbia (ICBC) distinguishes motor-assisted cycles from limited speed motorcycles. Although they resemble one another, there are different rules of the road that apply to these cycles. For the purpose of this review, we will be focusing on motor assisted cycles which have an electric motor of 500 watts or less and bicycle style pedals. Similarly to bicycles, e-bike users are required to wear a bike helmet but do not need to have a special licence. The goal of this report is to identify e-cyclists in the community to discover their views around the safety and comfort of current bike routes, exploring the challenges and apprehensions that currently exist for this cycling group. Due to the wide range of reasons one may choose an e-bike, the in depth interviews allowed us to gain insight into the current perceptions and suggestions for the future. By addressing issues that are present, we have formulated several recommendations in order to make e-cycling safer, more accessible and more comfortable in Vancouver.

There are a number of motivating factors that have driven the recent increase in e-bike use. According to studies of e-bike users in North America and Austria, the majority of users tend to be older than the general population (Fishman & Cherry, 2016). One of the main reasons people prefer to use e-bikes over regular bikes is because they are faster and reduce physical exertion, the latter being a potential reason for individuals from older populations favouring e-bikes. While individuals are still able to exercise, e-bikes require a lower intensity effort (Fishman & Cherry, 2016). Testimonies from e-bike users (and our own study participants) have claimed that the use of an e-bike has greatly reduced commute time (Shore, 2016). Additionally, e-bikes are preferred over motor vehicles due to their reduced negative impact on the environment. Unlike cars using gasoline to operate, e-bikes use electricity, thus, reducing emission rates (Fishman & Cherry, 2016). Again, this rationale was born out in our discussions with e-bike riders.

From our own city’s point of view, the incorporation of e-bikes into the traffic systems of Vancouver will assist many of the Vancouver Healthy City Strategies Goals; particularly Goals 6, 8, 11 and 12 (Vancouver, 2018). E-bike integration will promote Goal 6 of “Being and Feeling Safe and Included” by addressing the current issues around e-bike safety and comfort with the intention of improving users’ sense of safety and that of others on bike routes. More importantly, integration of e-bikes into Vancouver traffic systems will improve the sense of belonging of those who would like to participate in cycling as a mode of transportation, but may have health or physical limitations that are currently preventing them from doing so. Persons with disabilities often face exclusion which can lead to social isolation (D’Eloia & Price, 2018; 2016). Our findings included an example of the use of an e-bike due to limited mobility, allowing the participant and child to engage in active transportation which would not be possible using a conventional bicycle. A second goal that e-bike incorporation addresses is Goal 8 “Active Living and Getting Outside” (Vancouver, 2018). This goal primarily discusses getting outside to parks and other green areas. Our findings showed that the use of e-bikes to reach parks and beaches was important to our participants so improving accessibility of e-cycling will assist in reaching this goal.

Goal 11 of “Getting Around” is the one where e-bike promotion potentially has the greatest impact. According to the Vancouver Healthy City Strategy, methods of healthy transportation including cycling (Vancouver, 2018) and, on average, our respondents cited commuting as the most common purpose of their e-bike trips. For this reason, our study centred around whether e-bikes are being integrated into Vancouver’s transport systems, with particular interest in bicycle safety, current laws and infrastructure being built for this specific mode of transport. Finally, Goal 12, “Environments to Thrive In” discusses the right to healthy and equitable access to livable environments (Vancouver, 2018). Our results demonstrated that sustainability and accessibility of healthy transport methods was greatly valued by the e-bike community. Participants expressed concern for the increasing population density and motor vehicle use and were motivated to be part of creating a healthy and thriving environment for all.

However, despite its advantages, with the idea of increasing e-bike use in Vancouver it is important to address the potential impact on the City’s transportation plans. There is a need to investigate whether e-bikes are being integrated into the current systems through the design of infrastructure, traffic laws and motor vehicle and cyclist education. Since there is a spectrum of e-bike designs, from bicycle-style e-bikes (BSEBs) to scooter-style e-bikes (SSEBs), it is difficult to place them into one category. The greatest concern with this relatively new method of transportation is safety. Of paramount importance should be the determination of the appropriate lanes of travel for e-bikes which are currently used in all six types of “cycling routes” Vancouver as defined by the City of Vancouver (Appendix 1D). The primary purpose of our current research is to provide an insight of how the current and future bike routes can be made safer and more comfortable for e-bike users. This data, although with data from other roads, bike route users and pedestrians can be used to assist the City of Vancouver adapting policies and designs to meet the new challenges of e-cycling.

Methods

Procedure

Seven participants who use e-bikes (either owned or borrowed) were identified. They were approached by one group member either by phone, email or in person and invited to take part in our research project by participating in a 15-20 minute interview. At this time, any questions or concerns were discussed with the participants. Participants were then provided, by email or in person, with a copy of the UBC consent form (Appendix 1C) and the City of Vancouver’s “Transportation Design Guidelines: All Ages and Abilities Cycling Routes” (Appendix 1D). This allowed them to understand the nature of the research project and familiarise themselves with the different types of cycling routes that currently exist or are being proposed. In person interview times were then set at a time and place of the participants choosing. Five of the seven interviews were completed verbally and in person (most were recorded). Two participants, due to illness /unavailability chose to fill out the answers, add their own comments, sign the consent and return the forms by email. Participants were thanked for their participation and the data analysed thematically for the research report and poster presentation.

Recruitment of volunteers

Although e-bike use is increasing, the bikes are not yet widely available and used in Vancouver. While our initial plan was to focus on users of e-bikes with disabilities, it was concluded, after some debate, that doing so would focus only on a segment of a relatively small

user group. Since it was felt that the concerns related to comfort and safety were likely similar for all e-bike users, it was decided not to limit our study to those with disabilities only. For these reasons, we added no parameters of age, experience, minimum amount of use, disability etc in choosing our sample population. Of the seven participants, four were identified as “key” participants as they were members of the HUB cycling network. They had a vast knowledge of cycling rules, habits, infrastructure and the cycling community. They were considered to have the potential to represent the opinions of others in the e-bike community which was important, given the small sample size. The remaining volunteers were individuals who used e-bikes for practical or recreational purposes, and either owned or had rented an e-bike. The fairly detailed interviews addressed a variety of potential issues and concerns with the hope of gathering data representative of all types of e-bike users. Recruitment of volunteers was difficult and time consuming as we had no direct link to the “e-bike community”. We found our volunteers by talking to staff at bike stores, using cycling contacts in the community, posting a flyer (Appendix 11E) and other requests on social messaging sites, and by word of mouth.

Interview process

The length of the interviews varied between 15 - 60 minutes, 60 being at the respondent's request). Each interview followed the same format (Appendix 1A) as the questions on our draft interview guide had proved to be clear and unambiguous. We aimed to gather some quantitative data with short questions and limited response options as well as more in depth, qualitative data to allow us to address concerns that may not have been previously considered. Therefore, simple response questions, such as “is an e-bike your own form of transportation?”, questions with likert-type scales and open ended questions were included. The initial part of the interview was comprised of the more structured/ easier to answer questions to help participants feel comfortable. The second part focused on qualitative data, open ended questions and encouraged discussion led by the participants as well as examples of issues raised. Four of the seven interviews were also recorded with the consent of the participants.

Data Analysis

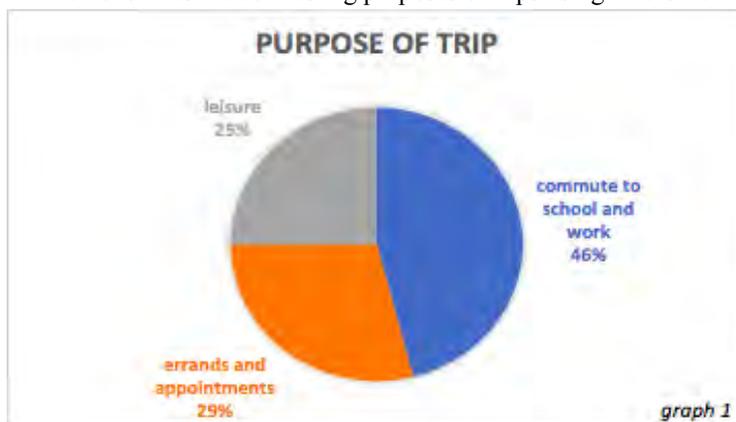
Interviews and consent forms were collected in one digital location. All data was summarized into two documents, quantitative and qualitative data. Quantitative data was analysed mainly to rank preferences of relative importance of suggested items. As there were only 7 interviews administered, data from these did not need to be coded and extrapolated. The quantitative data was therefore simply organized using descriptive statistics. Analysis of qualitative data, as well as answers to questions and discussions that arose during the interview, was done by deriving emerging themes from the data. The results and analyses of the data were then used to compile a final report, an executive summary and a presentation poster to communicate our findings.

Results

E-bike riders are an eclectic group of cyclists, representing the age groups of bike riders in general, choosing e-cycling as a form of transportation or leisure activity for a variety of reasons. Many appreciated the ecological advantages as compared to cars and felt that they left “less of a carbon footprint”. Sustainability was also a concern for some, ranging from stress on our natural resources to moving people more efficiently in a city always increasing in density. Others always saw health and social advantages as e-bikes can encourage people to continue cycling as they get older, introduce non-cyclists to the sport in a non-threatening way (especially those who are afraid of hills) and provide more options for those with limited mobility, chronic conditions or enable the active transport a child with a disability.

Trips ranged from fewer than once a week (or season dependent) to 12 , the average (mean) length of a trip being 51 minutes, and the most common range between 30- to 60 minutes. 4 of the 7 participants also owned motor vehicles, while 2 participants also used transit and only 1 participant used an e-bike as their only mode of transportation. The majority of trips were for commuting to and from work or school (46 %). Errands, groceries and appointments accounted for a further 29% of trips while leisure and other uses (meetings, volunteering etc.) made up the final 25%. It was clear from our data that the majority of e-riders engage in purposeful riding as an alternative mode of transportation to accomplish necessary daily tasks rather than cycling as a leisure activity, although several from the sample did this.

Graph 1: Demonstrates the contrasting purposes of trips using an e-bike.



By necessity, e-cyclists generally used all 6 types of bike routes described in the All Ages and Abilities Cycling Routes -Vancouver (2017) (*Appendix 1 D*) ; (*Appendix 2, Table 1*).

Of those 5 routes, preferred cycling routes (most to least preferred) in shown in *Table 2*:

1. Protected bike lane
2. Off-street pathway = Painted, buffered bike lane
3. Local street bike way

4. Painted bike lane
5. Major street (shared use lane)

Table 3 shows the results of how participants ranked the importance of the following factors when choosing a route (most to least important):

1. Protection from traffic
2. Route is continuous
3. Paved smooth surface
4. Width of lane
5. Maintenance/cleaning of route
6. Clear signage
7. Adequate lighting/ “bike only” signals

All participants agreed that a paved smooth surface; protection from traffic (an actual physical barrier); a route that it was continuous; and a lane of sufficient width was “very important or important” to them when they attempted to choose a safe and comfortable route. Maintenance/ cleaning of the route was important or very important to 86% of participants. Clear signage and “bike only” signals were valued as somewhat to very important by 86% and 71% of participants respectively thought adequate lighting was the least important consideration overall when selecting a safe route.

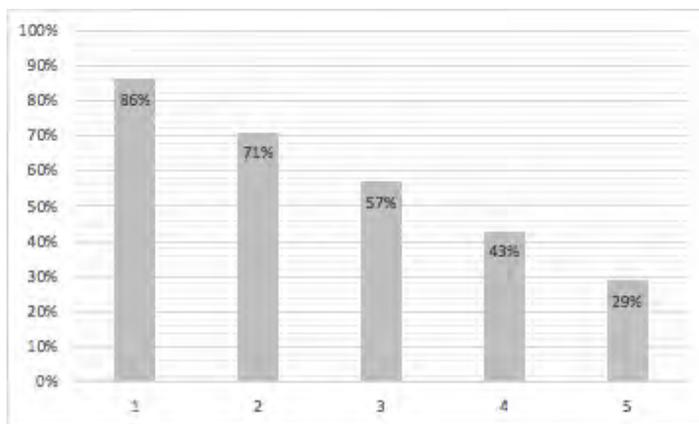
Our findings showed that comfort levels of sharing the road with other users depended very much on how the e-cyclist categorized him/herself as a rider. While 57% of participants felt somewhat unsafe or uncomfortable sharing their route with cars, there were notable exceptions among the cyclists who had more experience, tended to commute and felt confident about keeping up with the speed of traffic. Trucks and buses were less popular road mates, with 71% e-cyclists feeling very unsafe or uncomfortable riding alongside trucks and only slightly less unsafe or uncomfortable beside buses. Cycling commuters, cycling families, pedestrians, scooters and skateboards were generally well received by e-cyclists if they shared the routes and although they might be inconvenienced, they did not feel themselves, generally, to be unsafe or uncomfortable around those route users. Like cars, road cyclists divided the group, some e-cyclists feeling quite unsafe around them and others feeling very safe. Again, this depending on the type of cycling the e-cyclist generally engaged in (leisure v commuting), if they also used a road bike, as well as their desired riding speed and experience.

Table 4 sets out the barriers that e-cyclists perceived as discouraging them from cycling or cycling more (most to least important):

1. Dangerous intersections/roundabouts Speed of traffic Traffic rules not followed by motor vehicles	86% agree this is a barrier
2. Volume of traffic Part of the route is unsafe	71% agree this is a barrier
3. Too many transitions between different types of cycling routes/lack of connecting infrastructure	57 % agree this is a barrier
4. Hills/ gradients Lack of secure bike storage Too many traffic lights Uncertainty about traffic rules Traffic rules not followed by other cyclists	43% agree this is a barrier
5. Inconsistent traffic rules Rules not followed by pedestrians	29% agree this is a barrier

Graph 2: Demonstrates the percentage of participants that agree on certain barriers to e-bike accessibility and safety.

Barriers



While e-cyclists are not a homogenous group, there were a number of themes that consistently emerged in the research results. Since the more structured part of our interview focused on bike route design to enhance comfort and safety, our findings did demonstrate the clear preferences of e-cyclists around design that they believed would enhance their overall cycling experience. The more open ended questions revealed further themes, centered around traffic issues; education; and e-cycling/cycling promotion in general.

Bike route design

The most important factor for e-cyclists was that bike routes were protected from traffic, ideally by a physical barrier, especially on bridges which were perceived as more dangerous to cyclists. White painted, buffered lanes were somewhat acceptable, painted lanes without buffering were perceived as less safe, especially those lanes that were situated between the door zone of parked cars and moving traffic. The importance of separating bikes from pedestrians was also considered paramount. While local street or off street pathway might be appealing aesthetically and less busy with motor vehicle traffic, the idea of mixing pedestrians and bikes was perceived as making both groups vulnerable. E-cyclists would like a speed limit that is high enough to make this type of transportation useful and efficient hence much faster than walking speed. However, on shared paths, the potential for accident and injury, sudden stopping, attempting to pass both other cyclists and pedestrians mean it feels frustrating and hazardous for cyclists.

Passing other road users was seen as a source of stress and lanes that were wide enough to allow cars to pass safely or bikes to pass each other (unidirectional) were seen as essential. On bi-directional bike routes (off street pathways etc.), again, width to pass cyclists in both directions was important, reflecting the acknowledgement that cyclists often travel at very different speeds. In one interview, width was an important factor to enable the participant to carry their child in a carriage. The final issue that was discussed almost unanimously was the lack of continuity of bike routes between different types of routes as well as between municipalities. An example of where there are no obvious connections between bike routes is the Stanley Park causeway to Coal Harbour Seawall. Another highlighted issue is when one cycling trip meant changing among several different types of routes with varying rules, especially during transitions. More continuous infrastructure was desired by all.

Several respondents suggested particular street designs, such as Vision Zero (Making Our Streets Safer, n.d.) or “Dutch designed” intersections (The Way Dutch Streets Accommodate A Mix Of Cyclists And Cars Is Nothing Short Of Brilliant, 2017) that provide a clear direction of movement, increased visibility and protection for vulnerable road users. Our findings showed that a consistent and easy to understand bike route design as well as ensuring the routes were cleaned and maintained was very important for increasing comfort and safety. Additional measures such as dedicated bike signals activated by the presence of cyclists, flashing green lights and green paint at exits and swing lanes to warn drivers about the presence of cyclists were helpful, although not essential.

Traffic

The second general theme that became apparent was issues around motor vehicle traffic. Apart from the unanimous desire to be physically separated from traffic, when this was not feasible, concerns were raised about the lack of enforcement of existing traffic regulations (both for cars and bikes), the outdated Motor Vehicle Act and its inability to reflect the issues of vulnerable road users. It was felt that current traffic rules were inconsistent with changing

infrastructure and the increasing number of cyclists at different speeds and capability levels. Speed of traffic was a concern and the establishment of a 30k/h limit on residential streets and 40k/h on main shared car/bike routes was suggested. Participants noted that a safe passing distance of cyclists of 1.5m was not always observed by motor vehicles; other road users did not always yield to cyclists on designated “bike routes”; and that e-cyclists were often forced into riding into the dangerous door zone of parked cars or take up the traffic lane. Further, all of these scenarios put cyclists at risk of frustrating drivers. An additional interesting finding was that the participants seemed more concerned with motor vehicles disobeying traffic rules than other cyclists or pedestrians (*table 4*).

Education

Logically, following those concerns, the issue of education emerged, which was felt was long overdue for both cyclists and motor vehicle users. Having a clear cycling infrastructure was considered only to be part of the solution for safety and comfort. If the rules were not understood by all or consistently followed or enforced, even well designed routes posed a danger for e-cyclists. Participants’ comments ranged from suggestions of a requirement that drivers took a mandatory driving test at every license renewal (including a road test if necessary); to campaigns aimed at educating drivers regarding bike routes, cycling rules, safe distance, yields etc. It was clear that our results demonstrated the strong belief that drivers’ education needed to reflect current community of cyclists with different needs not only before passing a road test but throughout their driving careers, as changes will undoubtedly be ongoing. The education of all cyclists was seen as an equally important issue so drivers would feel confident that the former were competent and aware of the rules. A suggestion was even made that cyclists receive a license and registration dependent upon their understanding of the rules of the road. Most felt, however, that compulsory bike programs for children 10 and up; ongoing education campaigns for cyclists as to the rules associated with bike routes ; defensive riding; enforced helmet use; and safety measures that could be taken by the individual (riding in a group, use of a bell, visible clothing, making eye contact with drivers) would be extremely beneficial. In some ways, lack of education and awareness of any consistent rules was the missing piece in the safety puzzle both from the point of view of cyclists and drivers.

The final theme that was important to e-cyclists were issues around cycling promotion in general and e-bikes in particular. While valuable information, this was not directly part of our research goal so the findings are included in *Appendix 3*.

Discussion

Our research helped us achieve our overall goal of learning how a sample group of e-cyclists perceived current bike routes with regard to comfort and safety, as well as establishing which design aspects added to or decreased their sense of comfort and safety. Although “comfort” and “safety” are two separate concepts, our findings showed that they generally

intersected for e-cyclists. The concerns expressed were mainly over safety and even those that increased “comfort” such as a smooth, paved surfaces, were perceived to also improve safety. There were a number of factors that added to e-cycling comfort and overall positive experience that participants considered already existed, at least in parts, of Greater Vancouver. Those included good maps of bike lanes; areas with large numbers of cyclists; bike paths along scenic routes and to beaches; cycling routes that wound through interesting neighborhoods so the “real city” could be seen and experienced. Union Adanac Corridor which extends through Vancouver and connects with Burnaby's Francis Union Bikeway and the Pacific Spirit Trail in North/West Vancouver were cited as examples of continuous routes with clear signage that felt both safe and comfortable. E-cyclists generally wanted both speed and safety in route design (fewer lights and intersections, bike signals activated by cyclists). This may differ from cyclists overall, especially those for whom AAA cycling routes are designed, reflecting both the ability of e-cyclists to ride at the speed of traffic and their primary goal of commuting or other purposeful riding.

The study encountered several challenges both anticipated and unanticipated as we moved into the interview part of our project. We were aware that it may be difficult to connect with e-cyclists for interviews as they do not represent a large part of the cycling community. While several ideas were considered as to how to attract participants, such as distributing flyers or visiting bike routes to approach e-cyclists in person, in the end, we used our current connections to cycling in general to reach our target group. The process of having our project approved, locating participants, explaining the project and securing consent took longer than expected and left us with a fairly short time period in which to set up and conduct our interviews. Thus, as we had foreseen, the relatively small number of seven interviews were conducted, which was, however, within our initial goal of five to ten participants. While we attempted to meet with all our participants in person, adverse circumstances and time constraints meant that two of our sample group chose to submit their responses by email. Despite this limitation, the quality of the feedback was high, in so far as all the questions were fully answered as well as in depth comments and future suggestions provided.

The subject of comfort and safety for e-cyclists is a broad one and we understood at the outset that discussions around current and future bike route design would only represent one aspect of improving e-cyclist's experience in this regard. It was, however, the one that directly aligned with our project goal. We had not fully anticipated the difficulty in isolating only route design among the other issues and concerns of cycling in Vancouver that e-cyclists faced. The open ended questions and qualitative nature of our research led to other themes emerging: those that were suggested as additional solutions to comfort and safety issues (enforcement of rules, changing current laws, education campaigns etc.); as well discussions (less relevant to our project goal, but important to the goals of Vancouver Healthy City Strategy) of the many benefits and desired promotion of e-bikes and the barriers faced by e-cyclists in areas quite separate from bike route design (as discussed in Appendix 3).

Although we found that e-cyclists shared many of the same desires and concerns of other groups of cyclists, we did find that they had some quite specific needs which were less likely to

be appropriate met in the design of the AAA cycling routes. By design, the AAA routes are extremely inclusive thereby, by necessity, catering to the slowest, least experienced and least capable riders, potentially giving them priority over faster cyclists on some of the more scenic and desirable routes. While it had been foreseen that there are many different types of cyclists with different needs, we had not anticipated that some routes may simply be inappropriate for certain types of riders such as e-cyclists, commuters, or road cyclists. It may even be appropriate to designate or characterize certain routes with signage to as to suggested riders to limit the conflicts and improve safety for all cyclists and other users of the routes.

Ideally, more quickly and efficiently locating and securing the participation of our target population would have potentially allowed us the opportunity to conduct more interviews, increasing the richness of our data. This study was intentionally designed to be relatively narrow in scope, focusing specifically on bike route design so our interview questions could have been more streamlined to deal with this topic only. We designed an interview that suggested additional solutions to comfort and safety for riding and allowed for discussion that was not strictly relevant to the project's main goal. Alternatively, with more time, we could have designed a more comprehensive study including all aspects of e-cycling in the city from promotion to awareness and education campaigns for both cyclists and drivers, bike route design and appropriate designation for recommended use, current MVA laws, as well as barriers currently faced by e-cyclists. Future research into the aforementioned areas would be useful. Ideally, our project findings could be connected with other research and to other agencies in provincial and municipal governments so, for example, education and awareness campaigns could be run in tandem with new route design and construction. This might allow for less confusion on the part of motor vehicle drivers, cyclists and pedestrians about the rules and regulations pertaining to the ever evolving cycling networks.

Recommendations

While this project specifically dealt with e-bikes, we must take into account that the changes to the traffic blueprint and other policies will have an effect on other road users such as other cyclists, cars, buses, taxis and pedestrians. When compiling our data and providing recommendations, we must be cognizant of the fact that potential solutions may have unintended, yet detrimental effects on other road users.

With that caveat, our recommendations for improving the comfort and safety of e-cyclists are:
In bike route design:

1. ***Separate (by physical barrier if possible) bikes from both motor vehicles and pedestrians.*** In situations where a barrier is not possible, use buffering, painted lines and clear signage so all users are aware exactly where they should be cycling/walking.
2. ***Aim to design continuous routes if possible.*** In situations where this is not possible, ensure there are very clear transitions appropriate for cyclists between routes, especially if there are route transitions at intersections, bridges or roundabouts. For example, an off road cycle path that suddenly joins a main road at a busy intersection (Eg. Cornwall and Cypress) may pose a risk to unaware motor vehicle drivers. In this example, the danger

occurs when cyclists who enter the intersection westbound encounter both west bound cars turning right and left onto Cypress.

3. ***Recognize that no cycling route will feel safe and comfortable for all cyclists.*** There are too many different types of cyclists for a “one size fits all approach”. E-cyclists have particular requirements. However, these are generally more similar to commuters on conventional bikes and road cyclists than those on another form of transportation. This means that different route designs should be considered for this combined group which may be incompatible with current AAA bike route design.
4. ***Education about rules, bike route design and safety is paramount both for motor vehicle drivers and for all cyclists.*** This could be achieved several ways from bike courses in elementary schools; driver’s education classes; additional requirements to obtain a driver’s license; mandatory testing; media/social media educational campaigns. This is the crucial missing piece in the comfort and safety puzzle. Both cyclists and drivers are unsure what they should be doing or what others should be doing, leading to the critical problem of unpredictable behavior and a potentially very dangerous situation.

Appendix 1 Materials Used

Interview Questions E-bike Cycling Questionnaire:

E-bike Cycling in Vancouver :Interview

Cycling Habits

1. What type of vehicle do you own? (*E-bike, electric scooter, etc.*)

2. How often do you ride per week, on average? (*Number of trips*)

3. How long does your average trip take? _____ minutes

4. How many trips are for...
 - Commuting (to work or school)? _____
 - Groceries, errands? _____
 - Leisure? _____

 - Other (specify)

5. Is this vehicle your only mode of transportation? _____

6. Do you use cycling routes? If so, what type? (*Check all that apply*)
 - Major street (shared use lane)

 - Painted bicycle lane

 - Painted buffered bike lane

 - Local street bikeway

Protected bike lane

Off-street pathway

Cycling and route preferences

7. Which of the cycling routes do you prefer? *(Rate 1 to 6, most preferred to least)*

Major street (shared use lane)

Painted bicycle lane

Painted buffered bike lane

Local street bikeway

Protected bike lane

Off-street pathway

8. Which of the following are important to you when you choose a cycling route?

**Very
important**

**Not at all
important**

5 4 3 2 1

Clear signage					
Maintenance/cleaning					
Width of lane					
Separate-bike signals					
Adequate lighting					
Paved smooth surface					
Route is continuous					
Protection from traffic					

Comfort and Safety

9. Do you usually feel safe when riding in Vancouver? Why? Why not?

10. Do you feel comfortable/safe sharing routes with?

Very comfortable / safe Very uncomfortable / unsafe

5 4 3 2 1

Motor vehicles					
Cars					

Busses					
Trucks					
Other cyclists:					
Road cyclists					
Commuters					
Families cycling					
Skateboarders/scooters					
Pedestrians					

11. Do any of the following discourage you from cycling / using certain routes? (Check all that apply)

Speed of traffic

Volume of traffic

(Dangerous) intersections

Too many transitions between different types of cycling routes

Too many traffic lights

Part of route is unsafe

Inconsistent traffic rules

Traffic rules not followed by

Other cyclists

Motor vehicles

Pedestrians

Uncertainty about traffic rules

Hills / gradients

Lack of secure-bike storage

General

12. What do you currently like about the routes you use?

13. What would like to see more of/less of?

14. What would encourage you to cycle more?

15. What changes could be made to improve your cycling experience or encourage cycling in general?

Other comments/ concerns?

B. Summary of AAA Guidelines given to participants

All Ages and Abilities Guidelines Summary

AAA routes are designed to make cycling safe, convenient, comfortable, and fun for all ages and abilities.

They will provide a “low stress” network of routes for most short trips.

Definitions for current bike routes:

Not suitable for AAA route:

- Major Street Shared Use Lane: Regular street with a bike symbol only painted on it towards the right-hand side.
- Painted Bicycle Lane: Regular street with white lines indicating bike lane and bike symbol painted on it towards the right-hand side.
- Painted, Buffered Bike Lane: Regular street with narrow lane with hatched road markings (to indicate break between bike lane and traffic lane), white lines to indicate bike lane and a painted bike symbol. No physical barrier.

Suitable for AAA route:

- Local Street Bikeway: Local street with bike symbol only painted on it towards the right-hand side.
- Protected Bike Lane: Designated bike lane running parallel to street but with a physical barrier between street and bike lane.
- Off-street Pathway: Designated bike lane that may or may not follow parallel to a street but is quite separate from it.

Guidelines/Rules for AAA routes:

1. Comfort for all cyclists: Quiet streets, protected bike lanes, off street pathways. Low vehicle speeds and physical separation.
2. Motor vehicle volume below 500/day (below 50/peak hour).
3. Motor vehicle speed below 30km/hour median.
4. Roadway and parking interplay: Bike lane width sufficient for 2 people cycling side by side to pass an oncoming cyclist.
5. Bike lane width for comfortable passing (2.5m unidirectional; 3.0m bidirectional).
6. Adequate lighting.
7. Separate spaces for walking and cycling.
8. Smooth and paved travel surfaces.
9. Grades below 3% as much as possible.
10. Thoughtful design of intersections:

To increase visibility, reduce conflicts and provide clear direction

C. Sample consent form given to participants

KIN 464: Health Promotion and Physical Activity

Participant Consent Form for Class-based Projects

Principal Investigator:

Dr. Andrea Bundon (Assistant Professor, School of Kinesiology, Faculty of Education)

Student Group: 11

Jacqueline Clark, Natasha Hoover, Alex Lim, Gracie Mann, Maddi Mondin

The purpose of the class project:

To gather knowledge and expertise from community members on topics related to physical activity, recreation, health promotion and/or active transportation.

Study Procedures:

With your permission, we are asking you to participate in a short interview. Students will record the interview and take note of your responses. With the information gathered, students will critically examine how different individuals understand or engage in health promoting activities or initiatives.

Project outcomes:

The information gathered will be part of a written report for the class project. The written report will be shared with the community partners involved with the project. Summaries of findings may also be posted on the following website.

CityStudio Projects:

<http://www.citystudiovancouver.com/projects/>

No personal information/information that could identify participants will be included in these reports.

Potential benefits of class project:

There are no explicit benefits to you by taking part in this class project. However, participating will provide you with the opportunity to voice your opinion on your experiences with health promoting activities or initiatives in a broad sense and will provide the students with an opportunity to learn from your experiences.

Confidentiality:

Maintaining the confidentiality of the participants involved is paramount, and no names will be used in the reports.

At the completion of the course, all data (i.e. notes, interview transcripts) and signed consent forms will be kept in a locked filing cabinet in Dr. Andrea Bundon's research lab (1924 West Mall) at the University of British Columbia. All data and consent forms will be destroyed 1 year after completion of the course.

Risks:

The risks associated with participating in this research are minimal. There are no known physical, economic, or social risks associated with participation in this study. Although there is a schedule of questions, participants are free to share what they would like, including refusing to answer specific questions. You should know that your participation is completely voluntary and you are free to *withdraw from the interview* and there will not be negative impacts related to your withdrawal. If you withdraw from the study, all of the information you have shared up until that point will be destroyed.

Contact for information about the study:

If you have any questions about this class project, you can contact Andrea Bundon by phone at 604-822-9168 or by email at andrea.bundon@ubc.ca

Research ethics complaints:

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or e-mail RSIL@ors.ubc.ca. or call toll free 1-877-822-8598.

Consent:

Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time. Your signature below indicates that you have received a copy of this consent form for your own records. Your signature indicates that you consent to participate in this study.

Participant signature _____

Date: _____

D. Link to All Ages and Abilities Cycling Routes-Vancouver:

<http://vancouver.ca/files/cov/design-guidelines-for-all-ages-and-abilities-cycling-routes.pdf>

E. Flyer to Attract Participants

Calling all “e-bikers”!

We are looking for individuals who either currently use an e bike or e scooter or who are looking to use one of these transportation methods.

We are students at UBC working towards promoting safe and accessible cycling in Vancouver.

Interested in participating

Contact vancouverebike@gmail.com for more information

Appendix 2

Table 1: Bike lanes currently used by participants

Major street (shared use lane)	86%
Painted bike lane	86%
Painted buffered bike lane	86%
Protected bike lane	86%
Off street pathway	86%
Local street bikeway	71%

Appendix 3 Promotion and Issues pertaining to the e-cycling community

When conducting our research the main points we were focusing on was how to ensure and how to increase the feeling comfort and safety of the e-bike users in order to promote the usage of e-bike users. Upon many of our interviews that were conducted we came across quite a few other concerns that were raised by e-bike users which would help increase their desire to use e-bikes. Along similar lines of safety many people proposed security measures to be taken into place. For example having safe storage for e-bikes on the seabus, secure bike parking at schools, to eliminate the bike theft problem that Vancouver faces, as well as a community campaign to distribute stolen and recovered bikes. One of the major points that was raised was by making e-bikes more financially accessible to everyone, whether that be by lowering rental costs, having discounts/incentives for e-cycling rather than using a car or eliminating PST from e-bikes. The people would also like the government to help out and fund/support the cycling community by doing things such as allowing e-bikes on transit/translink.

Residential streets should have a default speed of 30 km/h. Main routes where bicycles and cars share the road the default speed should be reduced from 50 to 40 km/h. Alternatively, speeds exceeding 50 would attract a fine so it would not be ok to drive 60 km/h as is currently the case.

Other comments/ concerns? As we increase the building density to accommodate more people, we continue to build for more cars. People driving on our roads demand curbside parking to the detriment of the cycling community.

Interview #2

Cycling Habits

A mandatory driver's test with **every** driver's licence renewal -- written and/or road test (if infractions are signs of poor driving habits).

A revised Motor Vehicle Act to reflect the issues of vulnerable road users, i.e. safe passing distance of cyclists of 1.5m, blanket slower speeds on city streets, unless otherwise indicated;

Enforcement of existing traffic regulations, with responsibility totally on the driver to comply 100% - no exceptions allowed in court, like poorly maintained vehicle so 'no fault of driver';

Vision Zero, with state-of-the-art street designs that protect vulnerable road users;

Cycle highways that are parallel to provincial routes in rural areas, but at a safe distance (>5m) from the highway, with separating ditch or jersey barriers

13. What would encourage you to cycle more?

Funding and support from the provincial and federal governments, with an ongoing awareness campaign aimed at motor vehicles.

14. What changes could be made to improve your cycling experience or encourage cycling in general?

Clear signage, dedicated bike signals at intersections that are activated by the presence of a cyclist, i.e., the black tarred circle/line in a traffic lane doesn't consistently recognize the presence of a cyclist

Other comments/ concerns?

Compulsory bike program in schools for every student, aged 10+;

Funding to install secure bike parking in view of the main school entrance;

A community campaign to distribute the stolen & recovered bikes that are stored at police warehouses;

Project 529 Garage computer application to register bikes (1/3 were recovered by 529 members in the first 18 months of the program in Vancouver, 2/3 by police);

Requirement that bike shops record the serial numbers of the bikes they sell, built-in to the cost of the bike or with provincial financial incentives to comply;

1. Comfort for all cyclists:
Quiet streets, protected bike lanes, off street pathways. Low vehicle speeds and physical separation, * **direct and convenient, connecting key community destinations.**
2. Motor vehicle volume below 500/day (below 50/peak hour).
3. Motor vehicle speed below 30km/hour median.
4. Roadway and parking interplay:
Bike lane width sufficient for 2 people cycling side by side to pass an oncoming cyclist.

5. Bike lane width for comfortable passing (2.5m unidirectional; 3.0m bidirectional).
6. Adequate lighting.
7. Separate spaces for walking and cycling.
8. Smooth and paved travel surfaces.
9. Grades below 3% as much as possible.
10. * Thoughtful (? --> **proven to be best**) design of intersections:
e.g., **Dutch-designed Intersection**

Interview #5

Cycling Habits

1. What type of vehicle do you own? (*E-bike, electric scooter, etc.*)

E-bike – same kind as the sf police use

B. Participant Consent Forms (will be given in class hard copy)

C. Master Answers Quantitative Data (7 participants)

- 1. Type of vehicle :* One e-bike (4)
More than one e-bike (1)
Borrowed e-bike (2)

2. *Trips per week* ranged from <1 to 12

3. *Length of trip* : average 51 minutes (usual range was from 30-60 minutes).

4. *Types of trips*: Commuting (work/school) 46% (735 min/week combined)
 Groceries, errands, appointments 29% (473 min/week combined)
 Leisure: 20% (318 min/week combined)
 Other (meetings, volunteering): 5% (80 min/week combined)

5. *E-bike is only mode of transportation*: No (own car) (4)
 No (can use transit) (2)
 Yes (1)

6. Participants used:

- Major street (shared use lane) **86%**
- Painted bike lane **86%**
- Painted, buffered bike lane **86%**
- Protected bike lane **86%**
- Off street pathway **86%**
- Local street bikeway **71%**

7. *Preferred Cycling routes (Most to least preferred)*

1. Protected bike Lane
2. Off-street pathway /Painted buffered bike lane
3. Local street bike way
4. Painted bike lane
5. Major street (shared use lane)

8. *What is important when choosing a route? (Most to least important)*

1. Protection from traffic
2. Route is continuous
3. Paved smooth surface
4. Width of lane
5. Maintenance/cleaning
6. Clear signage
7. Adequate lighting / “Bike only” signals

100% agreed that

- Paved smooth surface
- Route is continuous
- Protection from traffic
- Width of lane

Was “very important /important”

83% agreed that

- maintenance/cleaning

Was “very important/important”

86% agreed that

- Clear signage

Was “very important/important/somewhat important”

71% agreed that

- “Bike only” signals

Were “very important/ important/ somewhat important”

57% agreed that

- Adequate lighting

Was “somewhat important/ not very important”

9. Comfort/safety level sharing the road/route?

57% felt somewhat uncomfortable or somewhat unsafe /uncomfortable or unsafe sharing the route with cars

57% felt uncomfortable or unsafe/very uncomfortable or very unsafe sharing the route with buses

71% felt very uncomfortable or very unsafe sharing the route with trucks

86% felt **very comfortable or very safe/ comfortable or safe /comfortable /somewhat comfortable or safe** sharing the route with cycling commuters, families who were cycling , pedestrians and skateboarders

57% felt **very comfortable or very safe/ comfortable or safe / somewhat comfortable or somewhat safe** sharing the route with road cyclists, scooters

10. *Barriers/ reasons that discourage you from cycling (Most to least important)*

1. Dangerous intersections and roundabouts; Speed of traffic; Traffic rules not followed by motor vehicles **86% agree**
2. Volume of traffic; Part of route is unsafe **71% agree**
3. Too many transitions between different types of cycling routes **57% agree**
4. Hills/gradients; Lack of secure bike storage; Too many traffic lights; Uncertainty about traffic rules; Traffic rules not followed by other cyclists **43% agree**
5. Inconsistent traffic rules; Traffic rules not followed by pedestrians **29% agree**

D. Master Qualitative Answers

(2) etc. denotes the number of respondents who made the same or very similar comment.

People feel safe because:

City of Vancouver has good maps of bike lanes; everything is accessible.

They have experienced riders

They choose the routes they prefer

(2) Only choose to ride in summer/good weather

They choose to ride where there are lots of other cyclists and feel safety in numbers.

Safety Concerns:

Safety measures are left to the individual: bright clothing; helmet; use of bell; travelling at quieter times, taking much-used routes (safety in numbers); being predictable for moving traffic; openly communicating clearly with other road users (looking directly at drivers); riding defensively; listening for unusual sounds ;

Design of bike paths : 90 degree turns and tourist maps installed on the path (Stanley Park seawall)

Width of lane (when carrying child in trailer)

Poor connections between bike routes:

No obvious designed bike connection between Stanley Park causeway to Coal Harbour Seawall

Traffic Rules

- Inconsistent with the changing infrastructure, increasing numbers /capability levels of cyclists, outdated driver education as per MVA (2)
- On streets that are designated “bike routes” like 10th Avenue, car drivers often don’t give cyclists the right of way.

Traffic Volume

North Shore has limited river/stream crossings and a lot so traffic which is problematic

Traffic and parked cars

- Choice of between riding in door zone of parked cars or taking up the lane for safety and irritating impatient drivers.
- People demand curbside parking for their residences even if they have allocated parking in driveways etc, to the detriment of cycling.
- Painted buffered bike lane BETWEEN parked and moving cars feels less safe than next to sidewalk.

Things LIKED about current routes:

Separated from traffic (5)

Direct

Fast

Clear signage

Separated from pedestrians

Nice scenery / see the real city/interesting neighbourhoods (3)

Can stop off at beaches

Relatively few lights

Relatively few intersections

Dedicated bike signals

Flashing green lights/ green paint at exits or swing lanes to warn drivers that cyclists could be crossing (entrances /exits off Stanley Park causeway

Spirit Trail in West Vancouver

Feels safer than Toronto City Streets

Union Adanc route is continuous , crossing a large portion of the city (signage is good and feels pretty safe)

Maps

Other e-bikes

Want more:

Bike only routes

Dedicated bike signals activated by presence of a cyclist (2)

Investment in infrastructure separating bikes from people and cars (2)

Wider lanes (2)

Want less/fewer:

Sharing routes with cars (Physical not painted buffer)

Sharing routes with pedestrians (have to go so slowly defeats point of having e-bike)

Stop signs

Roundabouts which are very dangerous to cyclists

Routes that are very busy (Stanley Park seawall)

What would encourage you to cycle more?

(3) Safe routes

Fast routes

(3) **Better continuous infrastructure** across municipal boundaries; continuous routes (especially to Burnaby)

Improved safety on bridge crossings ; every bridge should have good barriers.

Safe bike storage (eg at sea bus)

Design speed for bike routes for e-bikes so faster cycling is accommodated to encourage people to ride longer distances by bike. Slow speed limits discourages this.

Funding and support of cycling from provincial and federal governments

Ongoing awareness campaign aimed at educating motor vehicle drivers.

Eliminate bike theft problem in the city.

Cheaper rental costs
More scenic routes for leisure
Discounts/incentives for cycling rather than using a car

Transit issues:

Translink will not allow e-bikes on bike rack and, since January 2011, nor on skytrain during peak hours (except Canada line). Discourages use of e-bikes. (2)

Recommendations:

Consistent bike route design
Easy to understand bike route design
Design speed for bike routes e-bike speed to accommodate all types of bikes
Mandatory driver's test with every renewal
(2) Revised MVA to reflect issues of vulnerable road users (eg safe passing distance of cyclists of 1.5m, blanket lower speeds on city streets unless otherwise indicated); residential streets default speed of 30km/h. Main routes where bikes and cars share should be 40 km/h or exceeding 50 km/h would attract a fine.
Enforcement of existing traffic regulations with responsibility on driver to comply 100%
Vision Zero (https://en.wikipedia.org/wiki/Vision_Zero) with state of the art street designs that protect vulnerable users (2)
Cycle highways that are parallel to provincial routes in rural areas but at a safe distance (>5m from the highway) with separation ditch or barrier.
Licence registration educate riders; more responsibility around cyclists knowing the rules of the road ; consistency in capability and knowledge of cyclists so drivers and be sure cyclists are competent and aware.
(3) Education for cyclists about the rules of the road (drivers often assume cyclists do not have a driver's licence so don't know the rules of the road, often incorrectly); compulsory bike programs in school for every child aged 10+
Funding to install secure bike parking in view of main school entrance.
Community campaign to distribute the stolen and recovered bikes that are stored at police warhorses.
Project 529 Garage computer application to register bikes
Requirement that bike shops record serial numbers of bikes sold built into the cost of the bike or with provincial financial incentives to comply.
Use "Dutch -designed intersections" :increases visibility, reduces conflicts and provides clear direction of movement.
Stricter bike helmet laws so everyone wears one

Why an e-bike:

Cost compared to driving

Less carbon footprint

Encourages people to cycle longer as they get older

Encourages people to cycle if they are afraid of hills

Causes less stress on narrow bike routes as to whether you can keep up (or have to stop on a bridge, for example to be passed by road cyclists)

More options if disability

More options to carry child with disability.

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