Human-electric hybrid vehicles: Implications of new non-auto mobility options for street design and policy in the Vancouver region

Prepared for TransLink

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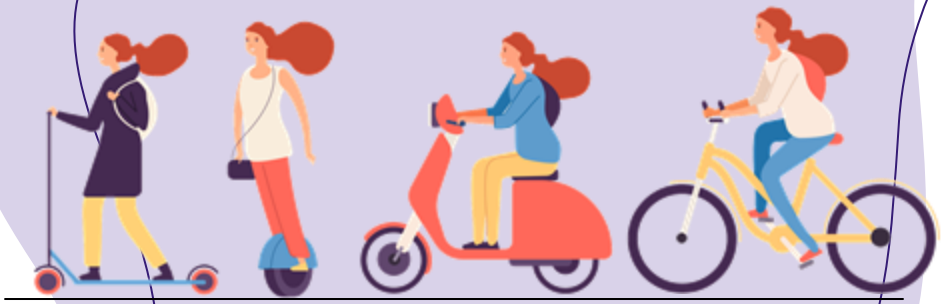
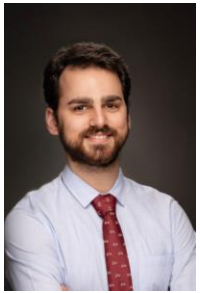
May 2022



MEET THE TEAM

research on active transportation

react



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CONTENTS

10th Avenue, Vancouver

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INTRODUCTION

CONTEXT

- The focus of urban transportation has shifted towards more multi-modal systems.
- Technological and commercial developments have increased the availability and popularity of low-power vehicles such as electric bicycles, scooters, and skateboards.
- These new mobility options create opportunities to address enduring challenges related to traffic congestion, air pollution, climate change, public health, and energy consumption.

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CHALLENGES

- New mobility devices come in a variety of sizes and designs, presenting new challenges to transport system design.
- Pedestrian-bicycle interactions in shared spaces are already seen as a comfort and safety issue.
- It is paramount that we capture the potential benefits of more diverse travel options while mitigating the risks of a wider variety of vehicles within constrained city street spaces.

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OBJECTIVES

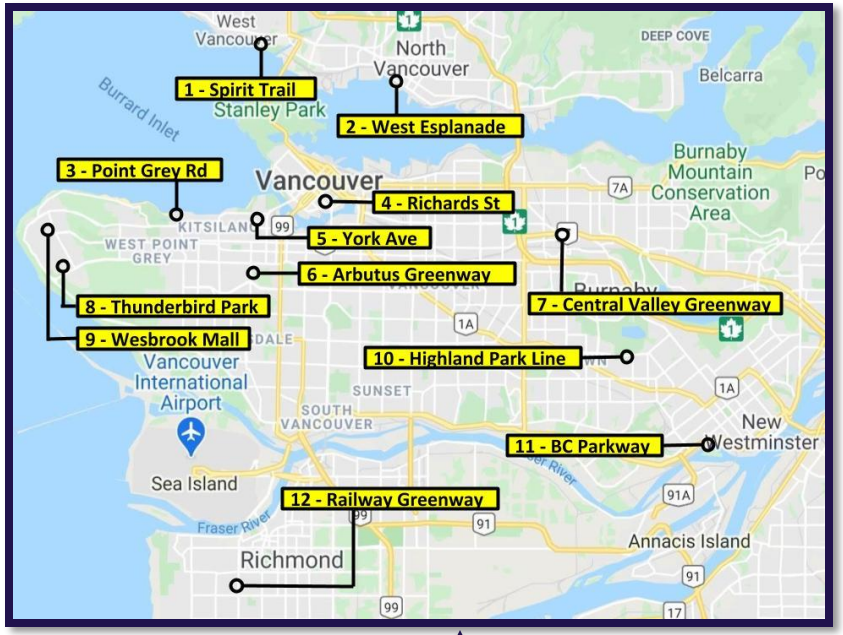
- How will new mobility options impact speeds on non-auto facilities and interactions among non-auto travellers?
- How are speed and comfort on off-street paths influenced by electric-assist and various microenvironment factors?
- What transportation system policies, plans, and designs are needed to mitigate conflicts among non-auto modes?
- Is the Vancouver region ready to accommodate these new modes with existing infrastructure and policies?

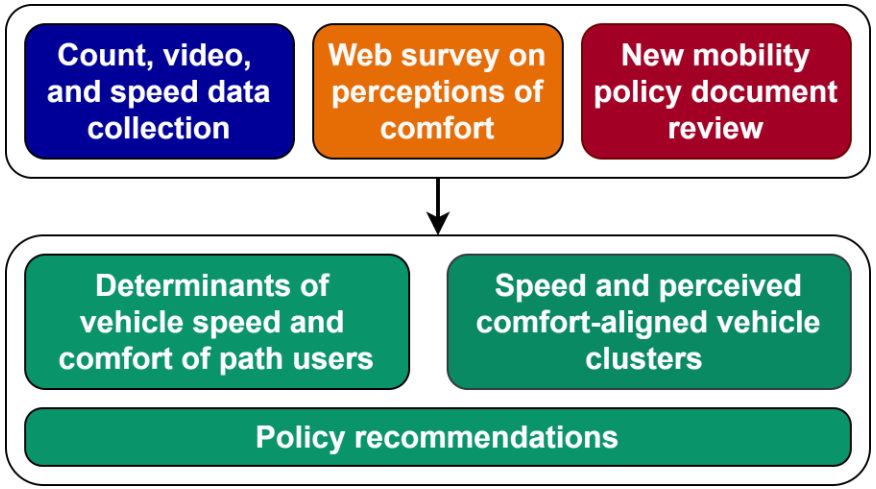

Point grey road, Vancouver

02

METHODOLOGY

METHODOLOGY





Data collected at **12 locations** across Metro Vancouver over 4 seasons: **mode shares** and **speed profiles** of all types of vehicles used in off-street paths, and path users' **comfort** in sharing those paths with each vehicle type. Reviewed local, regional, provincial, and federal transportation **policy, planning, and design** documents related to emerging vehicles.

METHODOLOGY

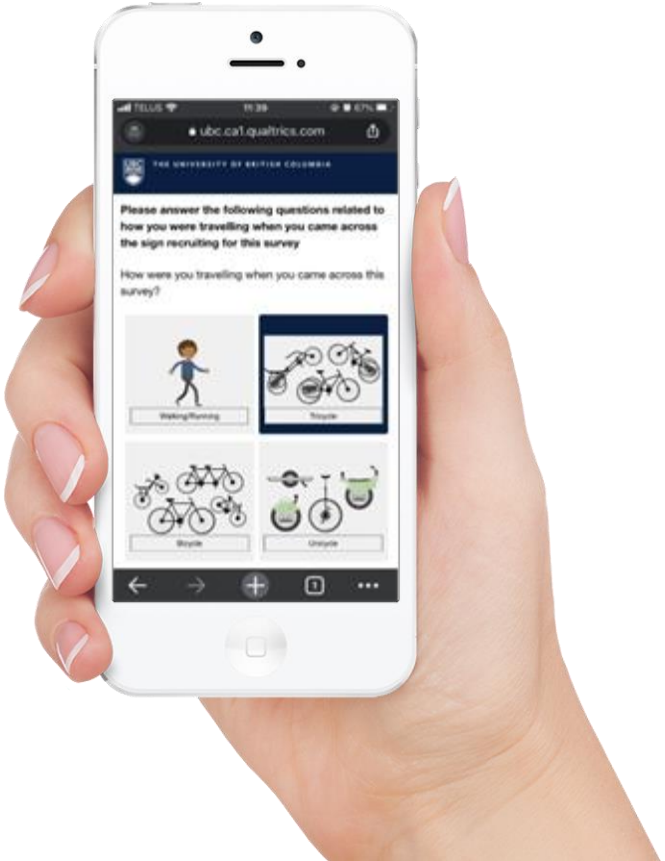
Count, video, and speed data collection

25,282 vehicles with their speed were recorded and classified

METHODOLOGY

Web survey on perceptions of comfort

- Advertised at the 12 locations
- Total of 1,103 cleaned survey responses

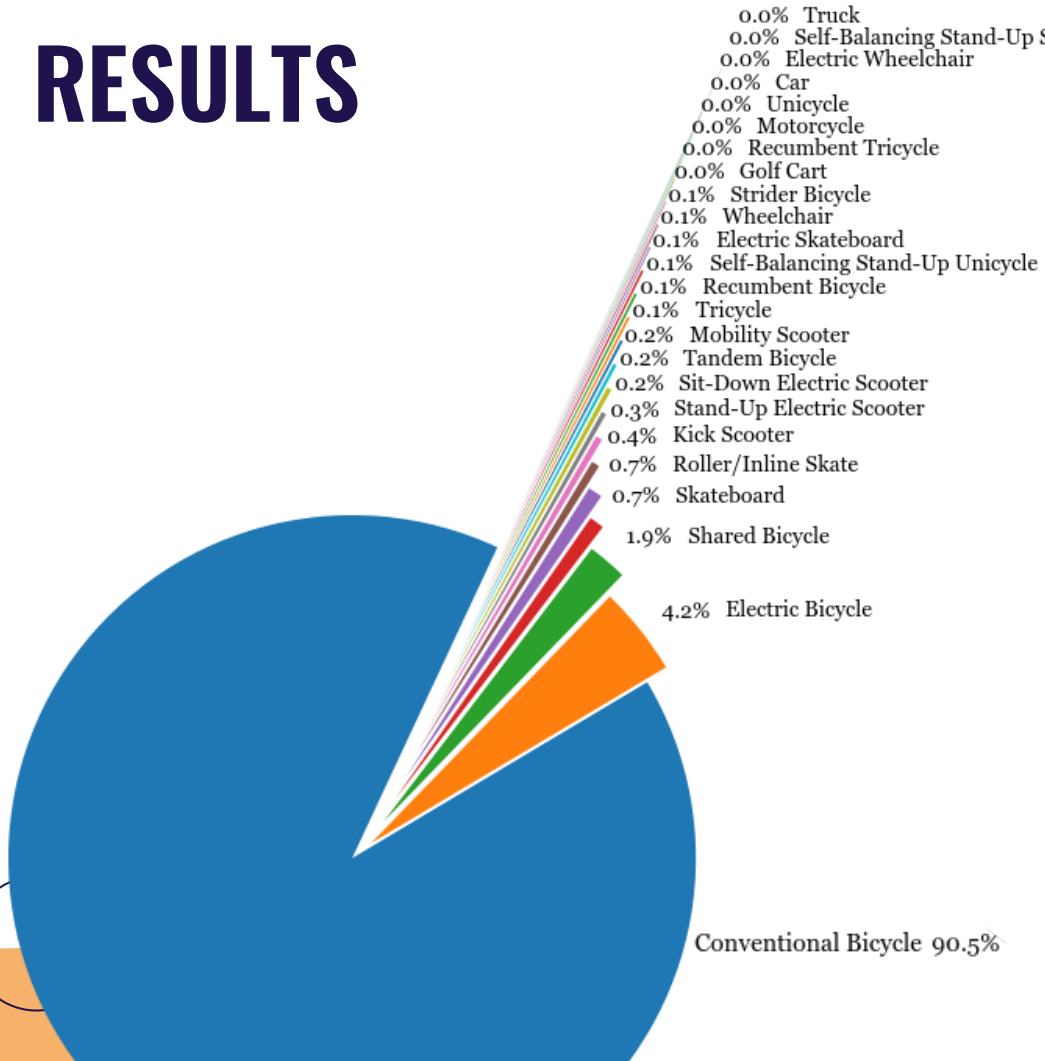



Kelowna, BC

03

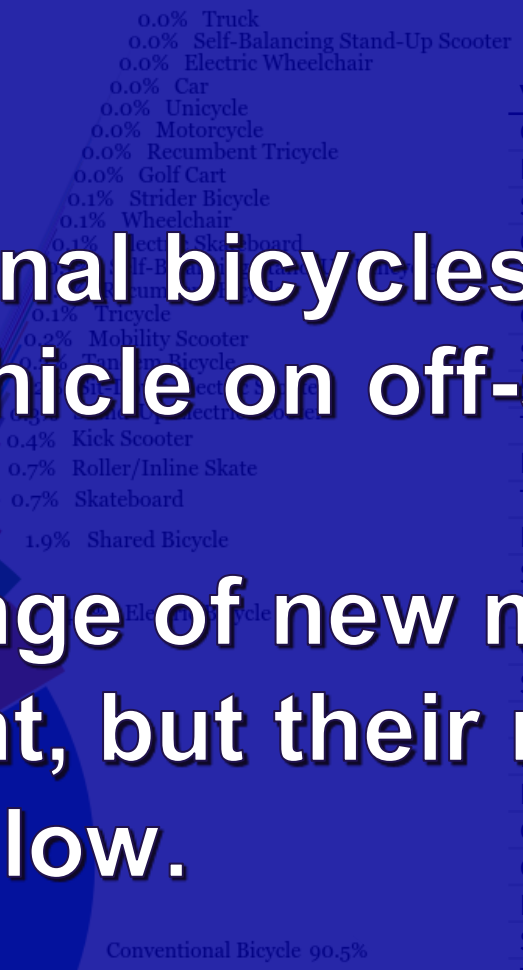
RESULTS AND FINDINGS

RESULTS



Vehicle Type	Count
Conventional Bicycle	22,885
Electric Bicycle	1,062
Shared Bicycle	472
Conventional Skateboard	177
Roller/Inline Skate	171
Conventional Kick Scooter	96
Stand-Up Electric Scooter	78
Sit-Down Electric Scooter	56
Tandem Bicycle (E/non-E)	55
Mobility Scooter	40
Tricycle (E/non-E)	33
Recumbent Bicycle (E/non-E)	28
Self-Balancing Stand-Up Unicycle	28
Electric Skateboard	26
Conventional Wheelchair	17
Strider Bicycle	16
Golf Cart	12
Recumbent Tricycle (E/non-E)	8
Motorcycle	7
Conventional Unicycle	5
Car	5
Electric Wheelchair	2
Self-Balancing Stand-Up Scooter	2
Truck	1
Total	25,282

RESULTS



Vehicle Type	Count
Conventional Bicycle	22,885
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Shared Bicycle	472
Conventional Skateboard	177
Roller/Inline Skate	[illegible]
Conventional Kick Scooter	96
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Electric Skateboard	[illegible]
Tandem Bicycle (E/non-E)	55
Mobility Scooter	40
Tricycle (E/non-E)	33
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Recumbent Tricycle (E/non-E)	[illegible]
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Truck	1
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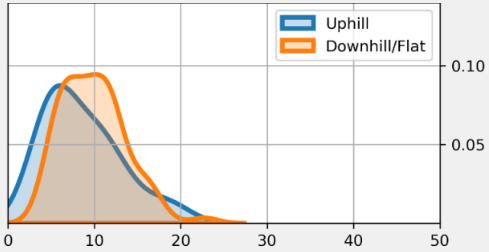
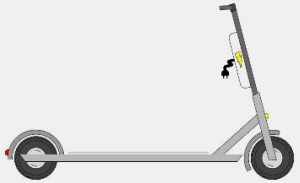
Conventional bicycles are still the dominant vehicle on off-street paths.

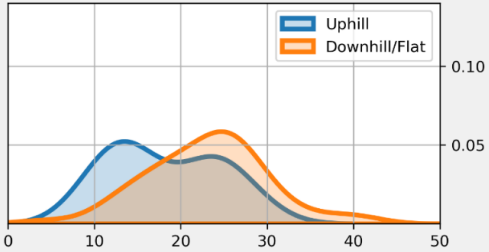
A wide range of new mobility devices are present, but their mode share is extremely low.

Conventional kick scooter

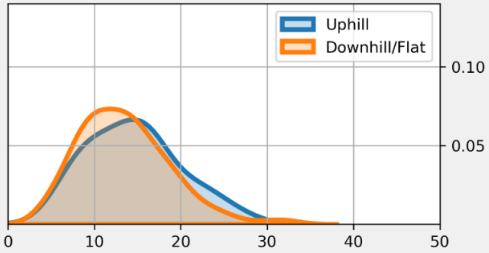


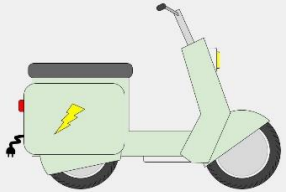


Electric kick scooter

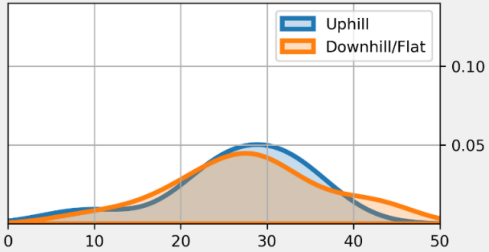


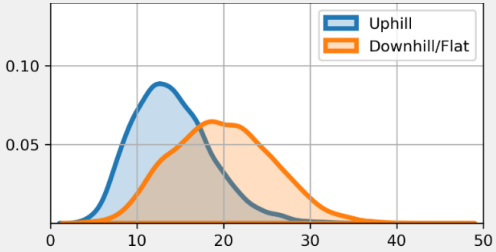
Roller/inline skate



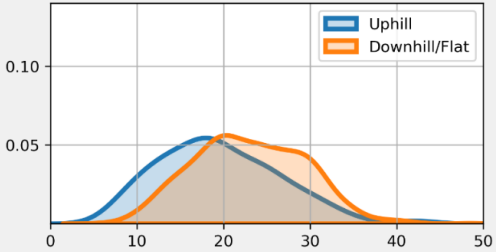


Electric sit-down scooter

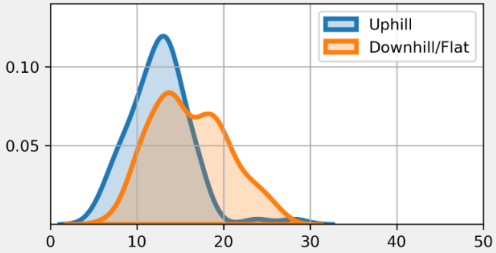




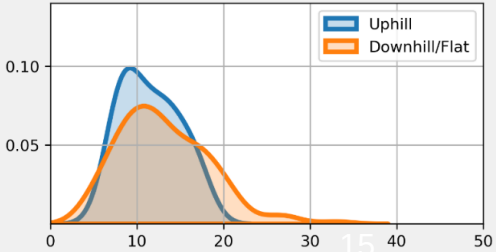
Conventional bicycle

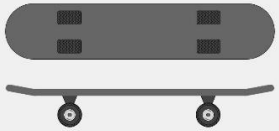


Electric bicycle



Shared bicycle

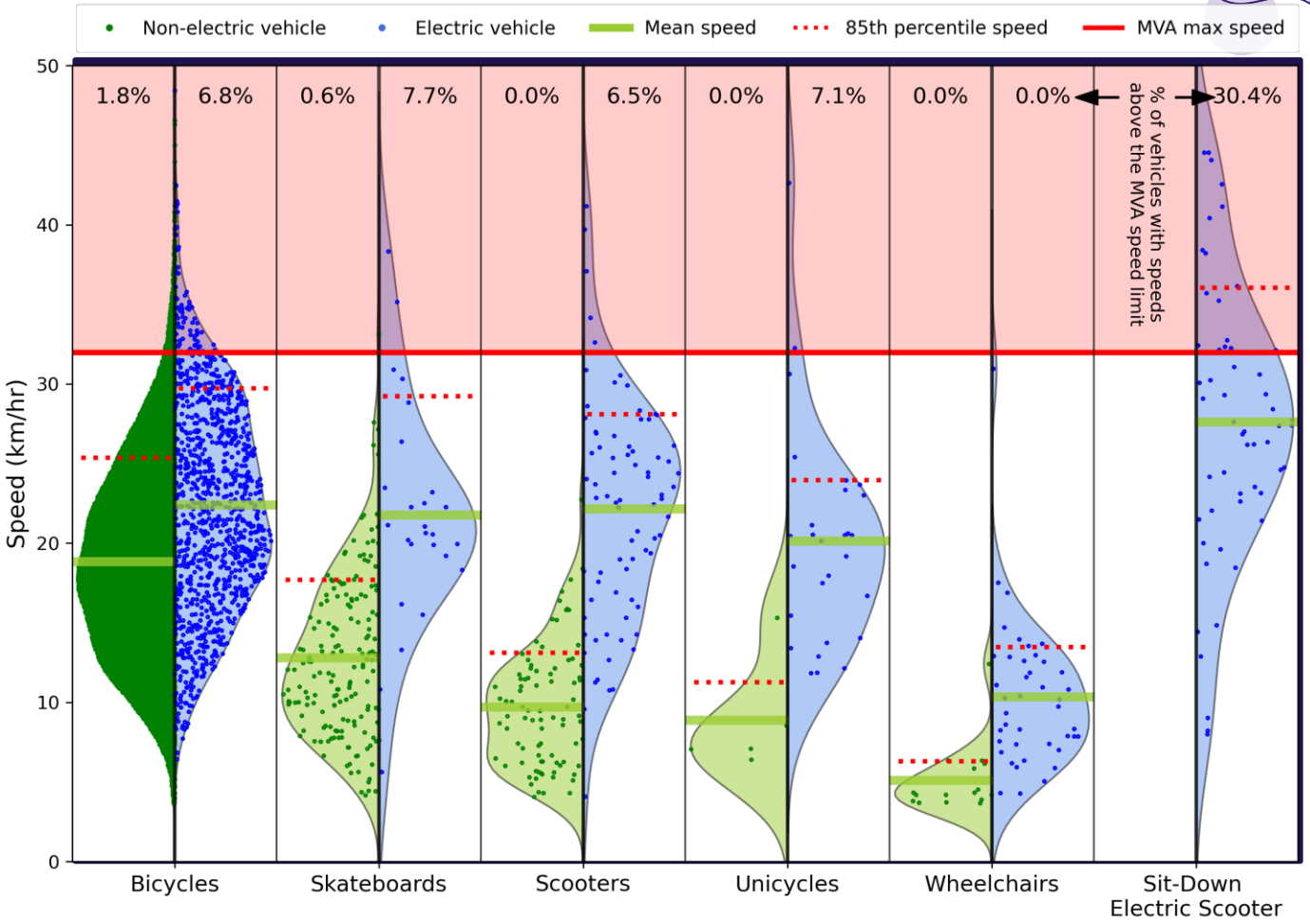




Conventional skateboard

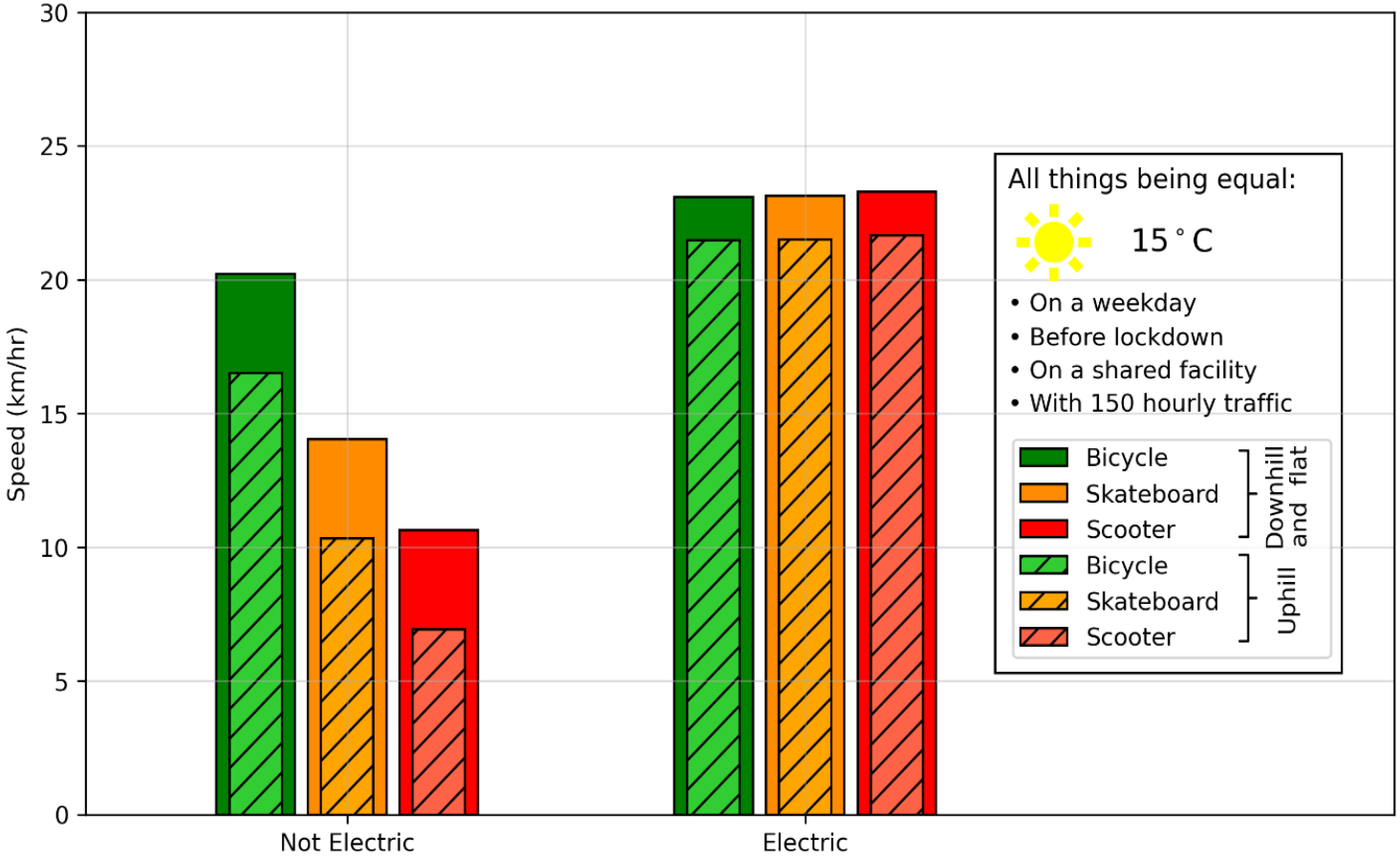
RESULTS

Effects of Electric Assist on Speed



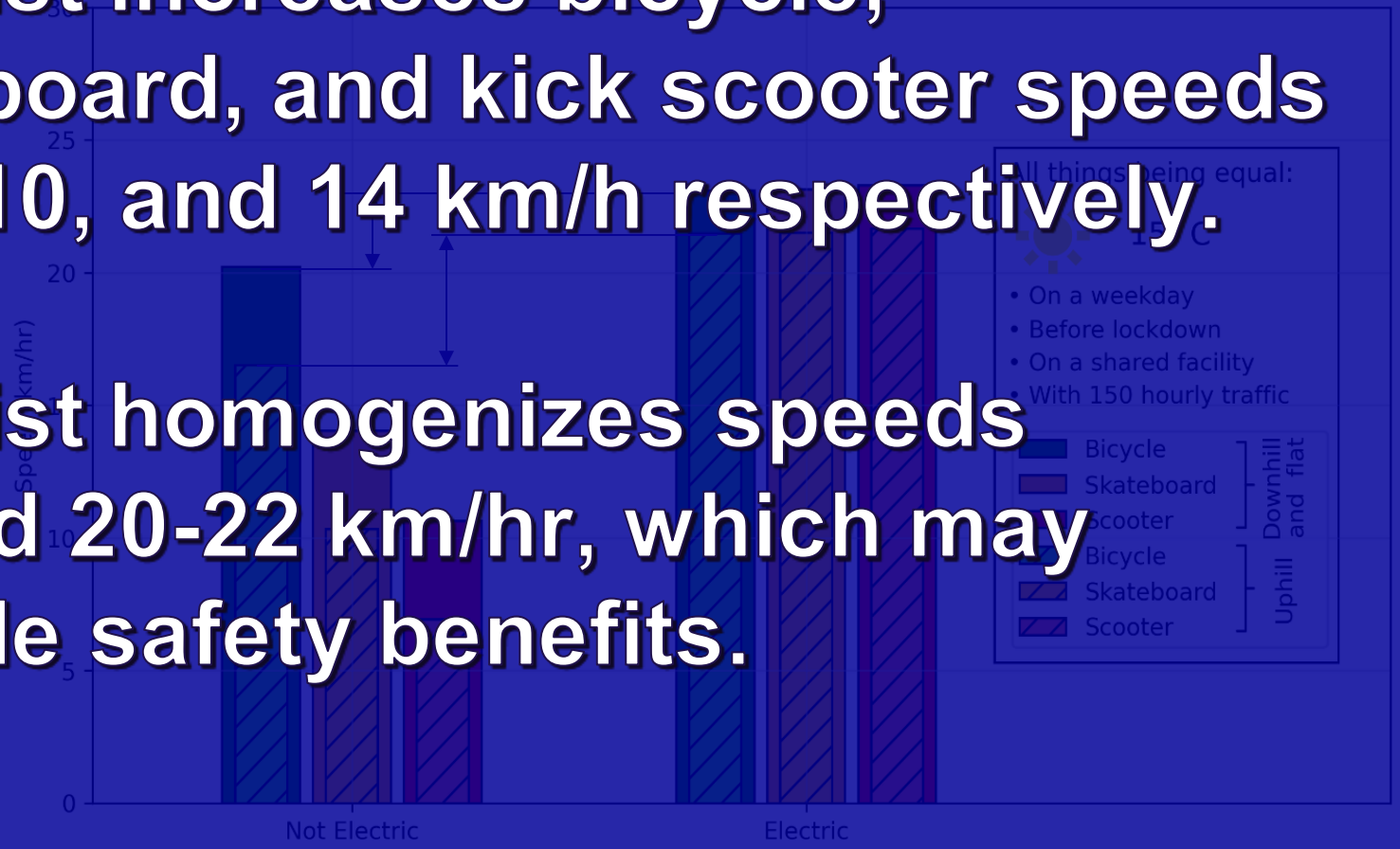
RESULTS

Mixed-effect regression model of speeds for bicycles, scooters, & skateboards



RESULTS

Mixed-effect regress on model of speed for bicycles, scooters, & skateboards

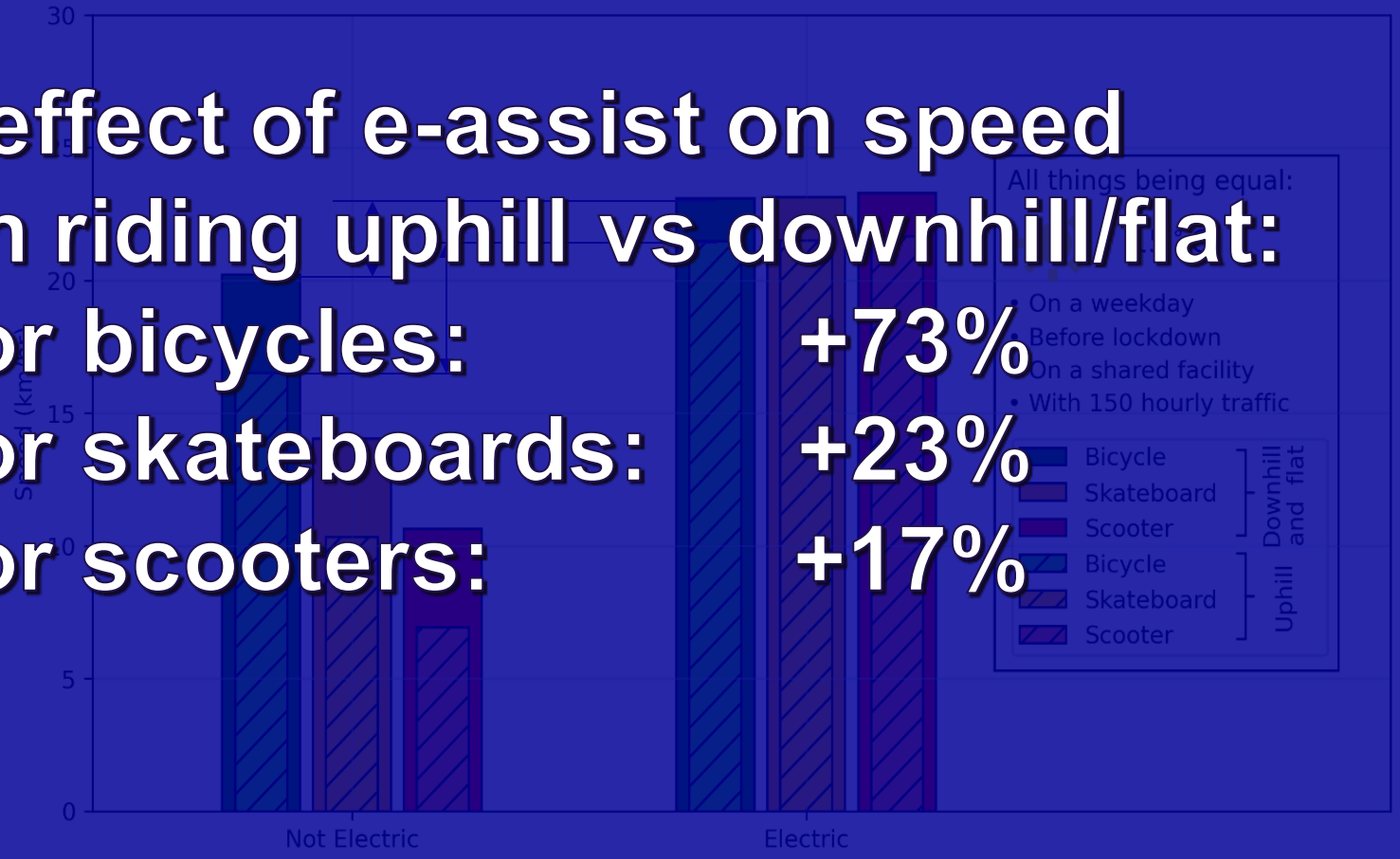


E-assist increases bicycle, skateboard, and kick scooter speeds by 4, 10, and 14 km/h respectively.

E-assist homogenizes speeds around 20-22 km/hr, which may provide safety benefits.

RESULTS

Modelled speed of bicycles, scooters, & skateboards using mixed-effect regression method



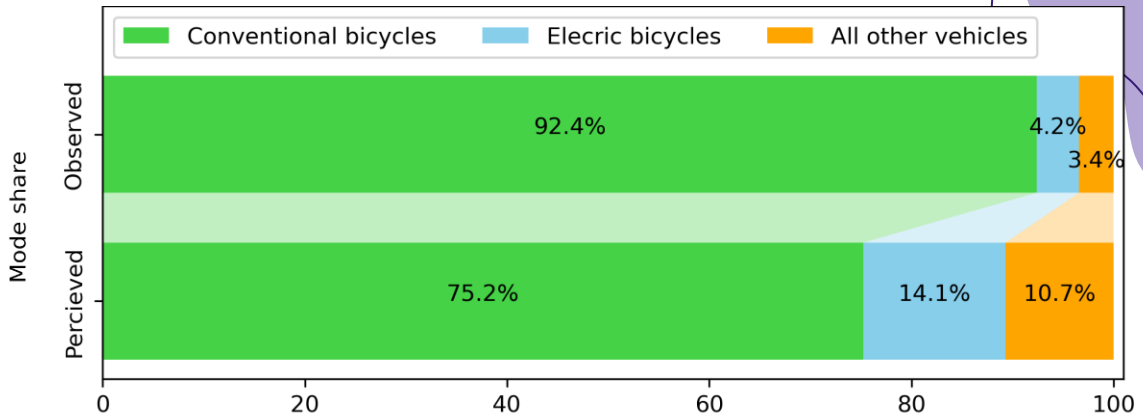
The effect of e-assist on speed when riding uphill vs downhill/flat:

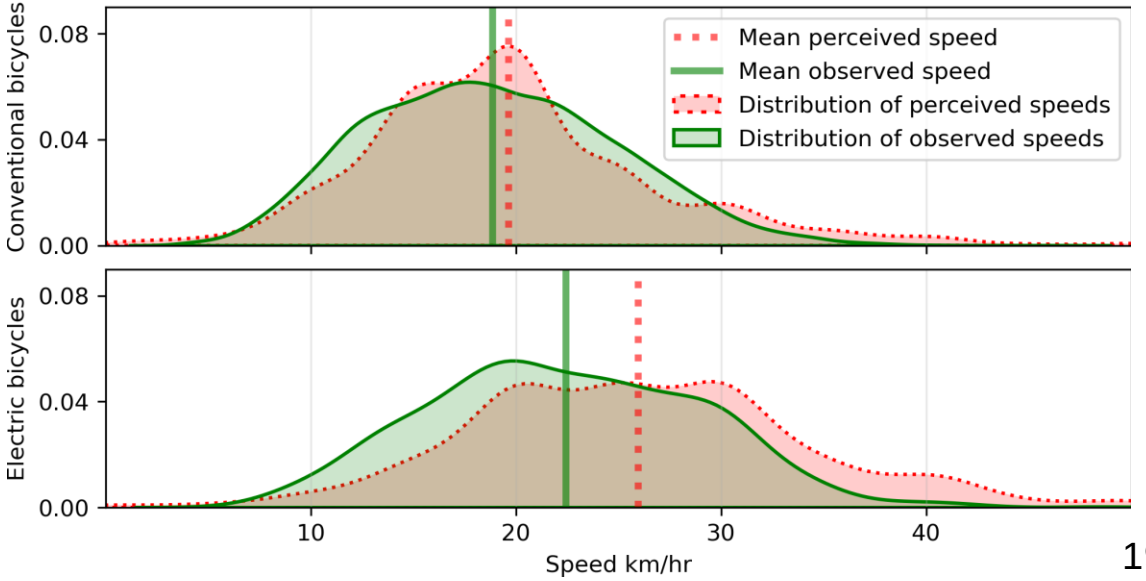
- For bicycles: +73%
- For skateboards: +23%
- For scooters: +17%

RESULTS

- Electric bicycles and other new mobility devices are perceived to be *three times* more prevalent than they actually are.

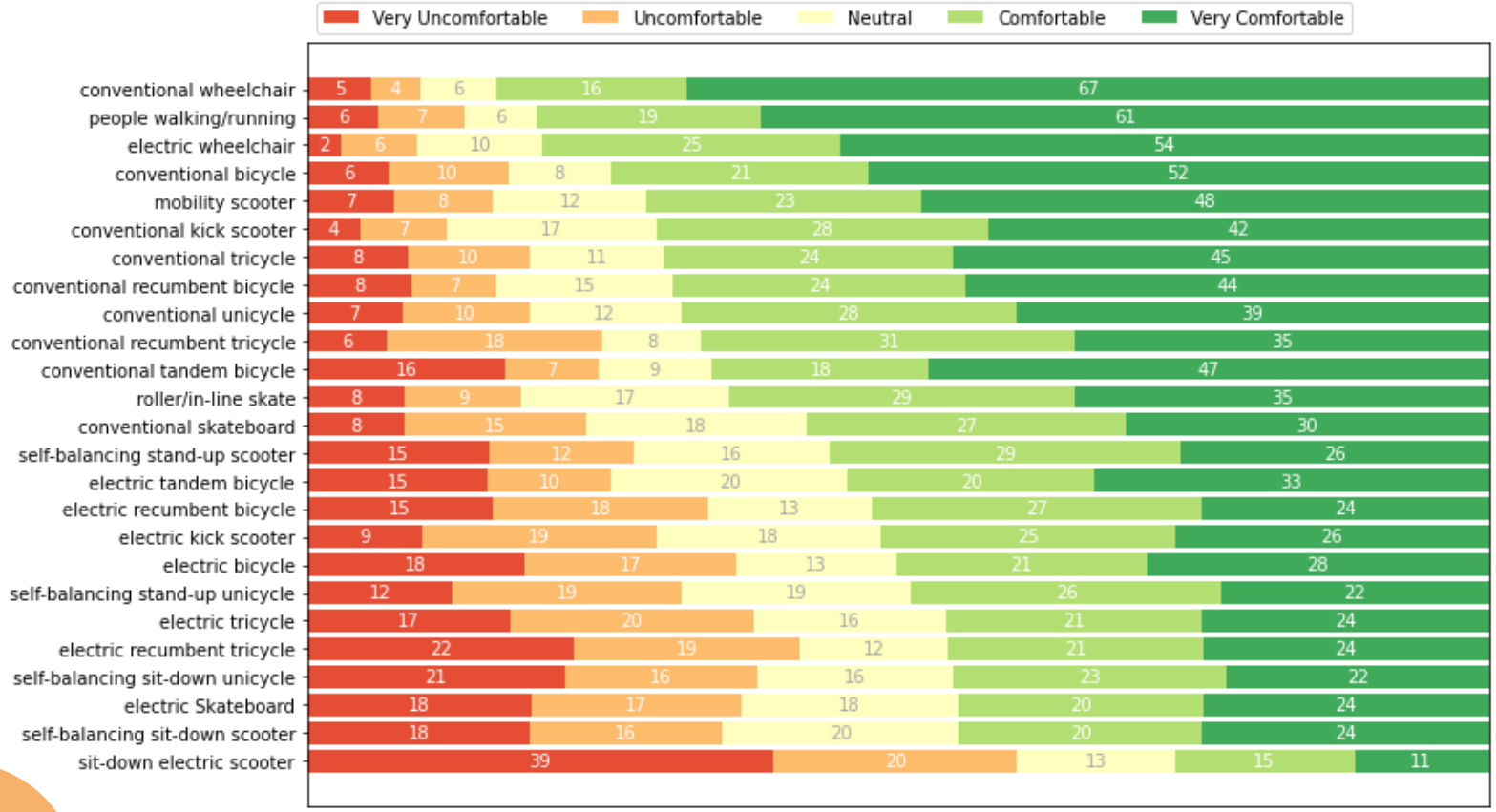
- Electric bicycles are perceived to be 4 km/h faster than they actually are.





RESULTS

Perceptions of comfort in sharing path with vehicles



RESULTS

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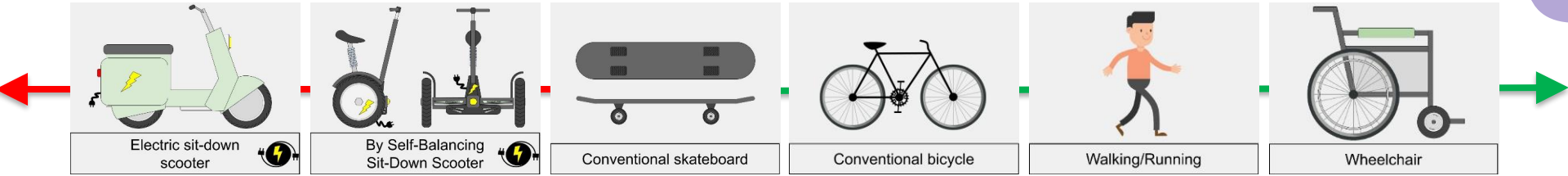


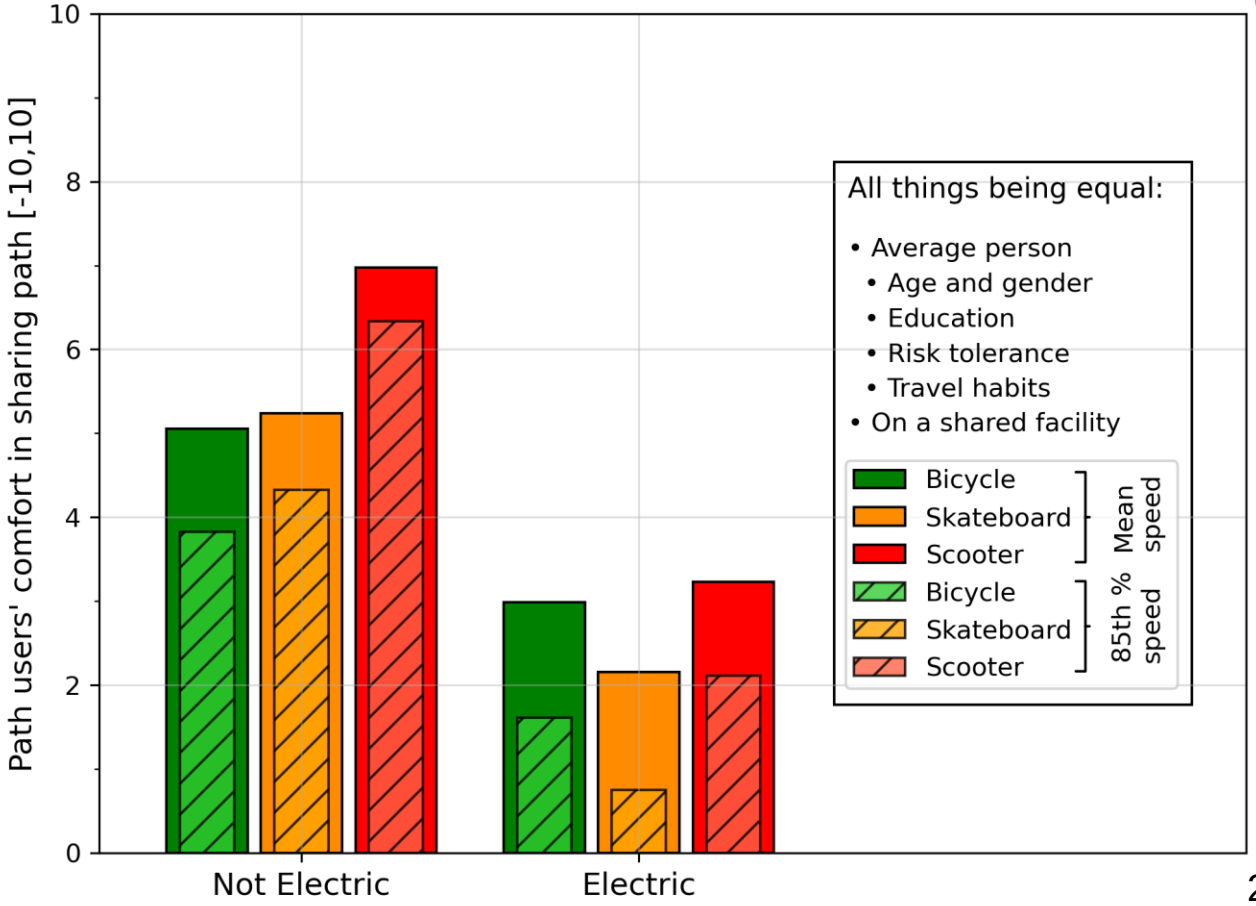
Least comfortable sharing path with

Most comfortable sharing path with

Most travellers are comfortable sharing paths with all the vehicle types <u>except</u> sit-down electric scooters.

RESULTS

Mixed-effect regression model of traveller comfort sharing the path with bicycles, scooters, and skateboards



RESULTS

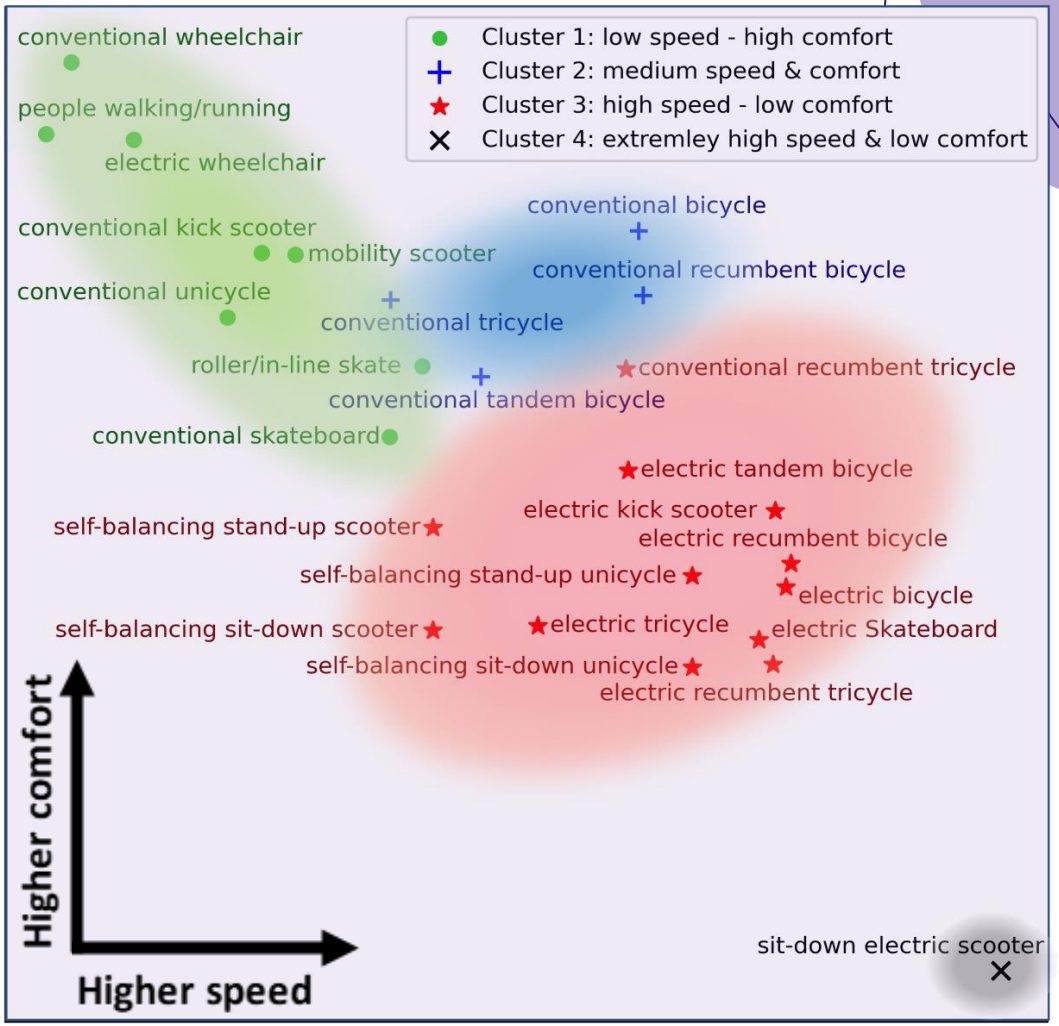
of travellers sharing
scooters, and
mixed-effect
regression method

E-assist reduces comfort for other path users equivalent to a 9 km/hr faster vehicle.

Previous experience of an incident reduces traveller comfort equivalent to an 11 km/hr faster vehicle.

RESULTS

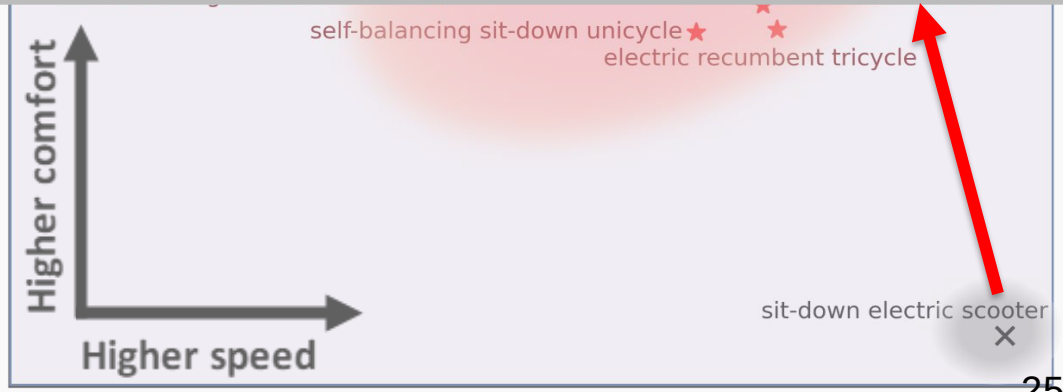
Our proposed four speed- and comfort-aligned clusters can be used for design and policy implications such as **separation of pedestrians and vehicles** in multi-use paths in Metro Vancouver.



RESULTS

Our proposed four speed-comfort clusters can be used for design and implementation of **separation of pedestrians and vehicles** in multi-use paths in Metro Vancouver.

We should work to eliminate the use of sit-down electric scooters on paths and cycling facilities

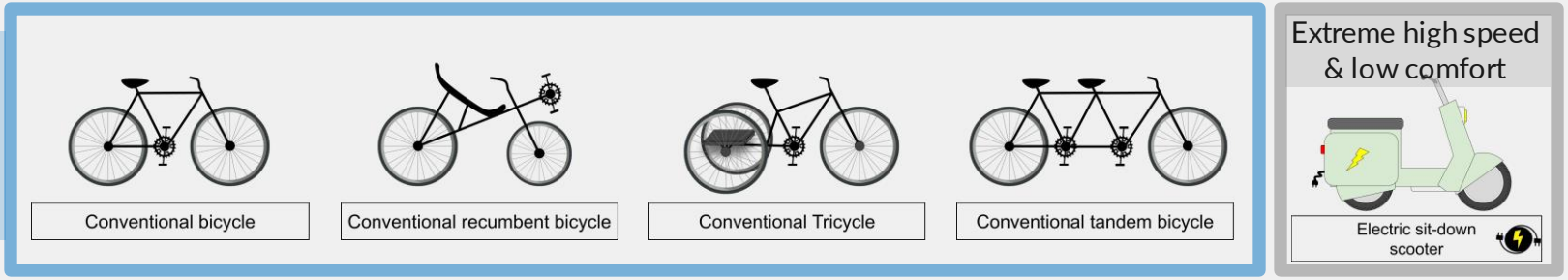


RESULTS

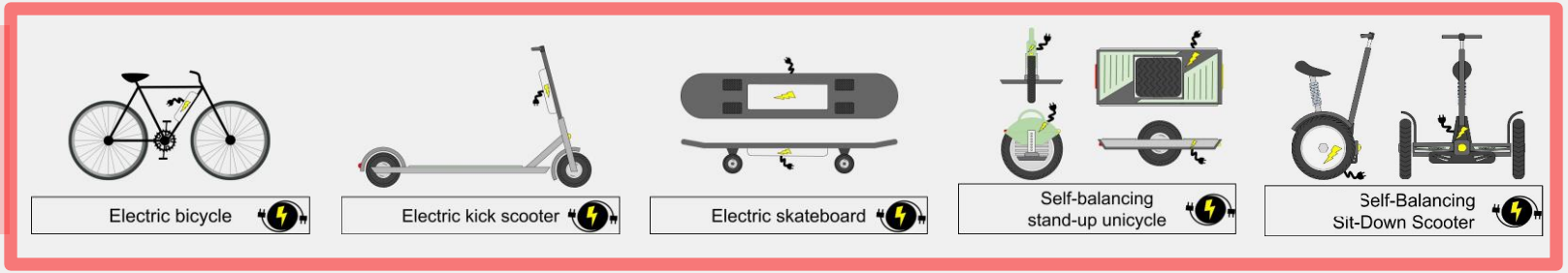
Proposed speed- and comfort-aligned vehicle type clusters by K-Means clustering

Low speed & High comfort (Low speed category)

Med. speed & Med. comfort (Conv. bike category)

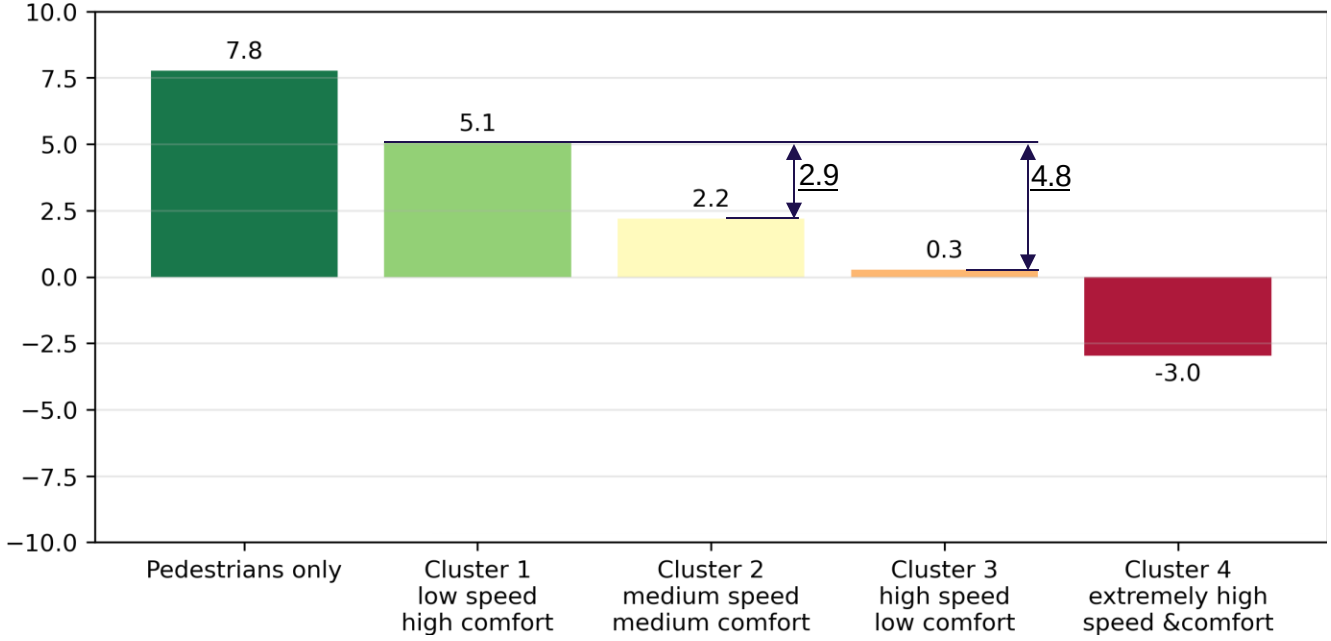


High speed & Low comfort (E-assist category)



RESULTS

Average pedestrian comfort sharing path with each cluster of vehicles [-10, 10]

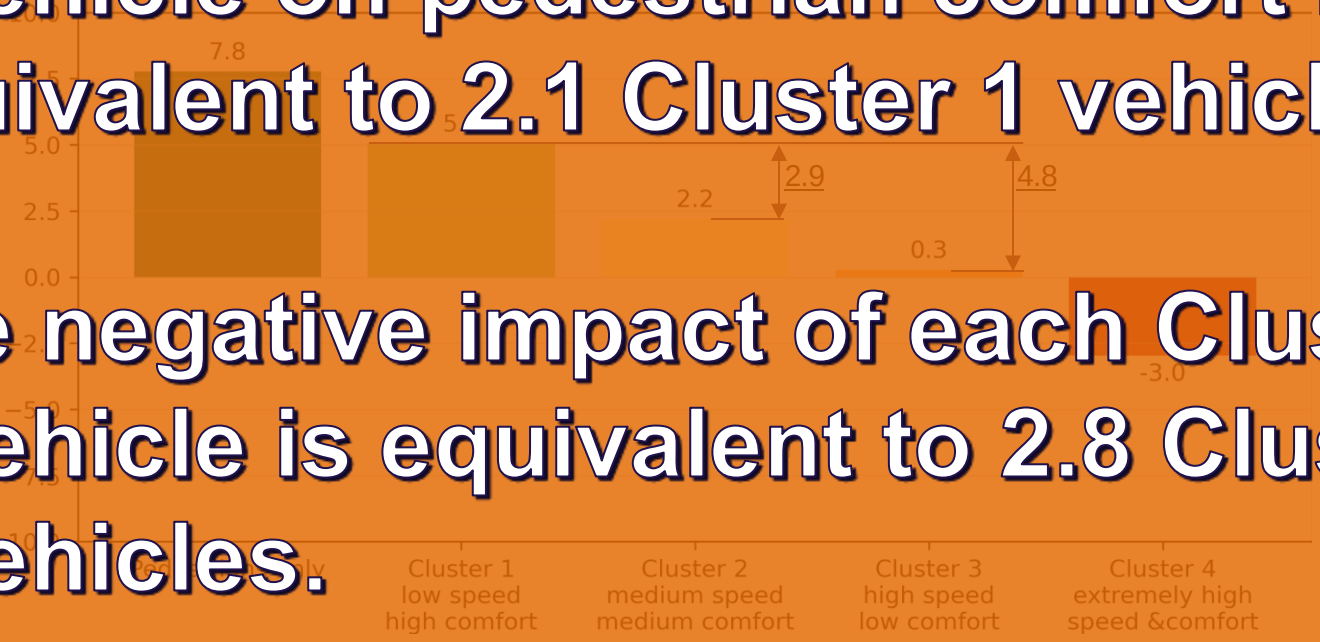


Using the data above, comfort-equivalent volume adjustments were created that can inform active transportation design guides.

RESULTS

The negative impact of each Cluster 2 vehicle on pedestrian comfort is equivalent to 2.1 Cluster 1 vehicles.

The negative impact of each Cluster 3 vehicle is equivalent to 2.8 Cluster 1 vehicles.




Arbutus Greenway, Vancouver

04

CONCLUSIONS & RECOMMENDATIONS

CONCLUSIONS & RECOMMENDATIONS

- The region is generally **ready to accommodate new mobility devices** in off-street paths without major effects on speeds and with only slight reductions in path user comfort.
- Pedestrian discomfort justifies **reduced volume thresholds for separating pedestrians** from other travellers on multi-use paths and greenways that accommodate new mobility devices.
- We should work to **eliminate the use of sit-down electric scooters** on off-street paths and cycling facilities, which are clear speed and comfort outliers.

CONCLUSIONS & RECOMMENDATIONS

- The current 32 km/h regulatory limit on e-assist cycle speeds **appears to be effective**. However, achieving lower speeds for other e-assist devices (e.g., the 24 km/h limit in the e-kick scooter pilot) may require additional speed control strategies. Monitoring of e-kick scooter speeds is recommended.
- Active transportation design guidelines **should be updated to reflect real-world speeds**, particularly for e-assist bicycles and devices. The 30 km/h design speed for cycling facilities suggested in the BC ATDG is appropriate.
- Further research is needed to include **other design aspects of new devices** such as stopping distances and turning radii.

THANK YOU

Do you have any questions?

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