



DNB311: CAPSTONE RESEARCH REPORT

# BICYCLES AS A UTILITY

EXPLORING THE PERCEPTIONS, ATTITUDES AND REQUIREMENTS  
FOR A SUCCESSFUL CYCLING CITY

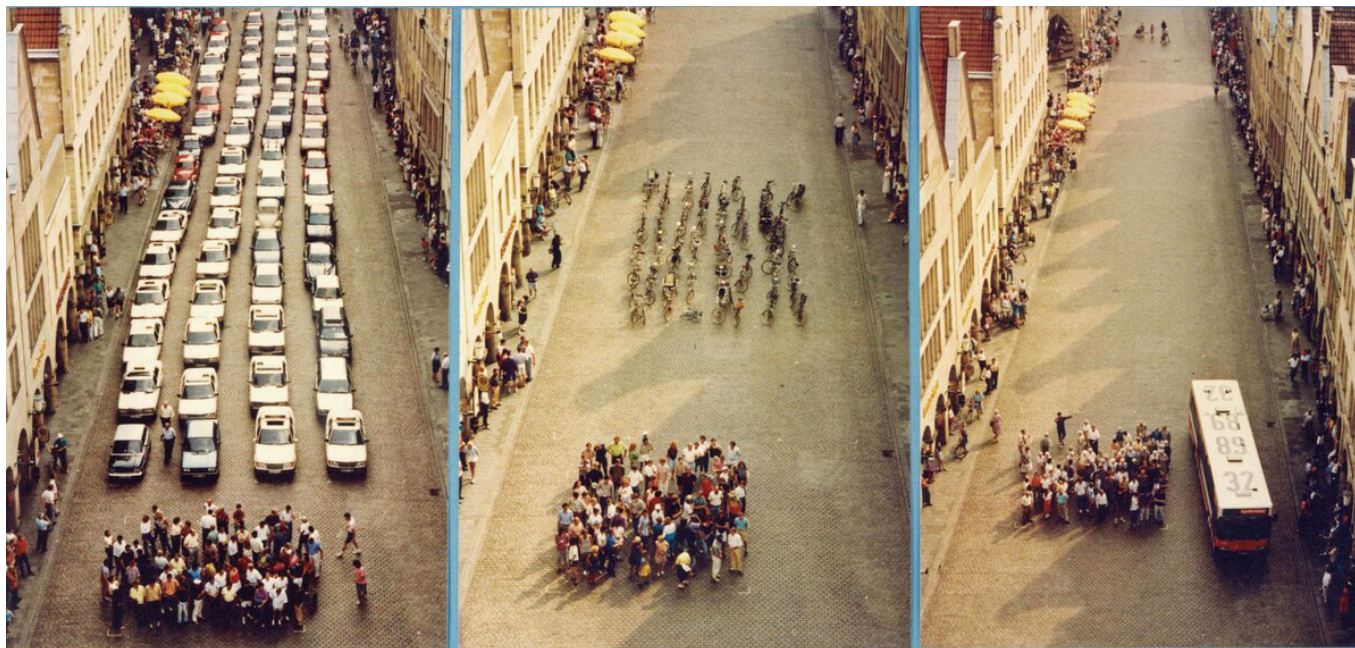
NICHOLAS BENTLEY







In the last 20 years, the population of the Brisbane Metropolitan Area has grown from 1.7million to over 2.5 million, an increase of over 47%. This kind of rapid population growth has led to a noticeable increase in motor vehicle traffic as more and more people commute to and from work each day, putting a strain on the existing car related infrastructure.



*'Comparison of space needed to transport the same amount of people with bike, bus or car'*

Cars kind of suck. They are expensive, have high running costs, and the infrastructure required for them to function takes up a lot of valuable space and funding. Add traffic to the mix, and you have a very unpleasant transportation experience. Public transport, cycling and other modes of active transport can provide a solution to this unpleasantness, as well as alleviate motor vehicle congestion by getting more people off the road, and on a bus, walkway or bike.

The bicycle has been proven to be the most energy efficient method of transport, with up to 99% efficiency, the bicycle uses 2.4x less energy than a bus with 50 people in it, 3x less than walking, 28x less than a modern hatchback. Bikes are much more environmentally friendly with CO2 emissions less than 3% of driving, and also provide a form of physical activity without the monotony of running on a treadmill.

***So why is Brisbane (and other modern cities) so reluctant to adopt this as a popular mode of transport?***



## AIM

The aim of this report is to investigate the local perceptions and attitudes towards cyclists, analyse case studies of successful cycling adoption, and explore the justification against cycling for transport, to better understand the needs of the general public and design a solution, to help incentivise the widespread adoption of bicycles as a car alternative for local transport.

This report will be split into 3 sections; Literature Review, Primary Research & Discussion and Design Implications.



## HARRASSMENT

A study conducted in 2009, surveyed 1830 members of Bicycle Queensland asking questions about any experience of harassment from motorists in the past 12 months. The study had also gathered data regarding the respondents' demographic like, age, gender, education & Socio-Economic Indexes for Areas (SEIFA) and cycling habits like frequency, cycling behaviour & years of experience. Interestingly, over 90% of respondents said they cycle for recreation with 17% saying they also compete, while only 58% cycled for transportation (Fig 1.).

Variables	% who reported harassment
<b>Gender</b>	
Male	<b>75.60%</b>
Female	<b>71.70%</b>
...	
<b>SEIFA</b>	
Decile 10 (most advantaged)	69.90%
Decile 9	<b>76.20%</b>
Decile 8	<b>78.90%</b>
Decile 7	70.60%
Deciles 1-6 (most disadvantaged)	73.70%
...	
<b>Cycle for recreation?</b>	
No	66.10%
Yes	74.90%
<b>Cycle for transportation?</b>	
No	71.70%
Yes	75.70%
<b>Cycle for competition?</b>	
No	70.80%
Yes	<b>89.60%</b>

Figure 2: Excerpt from Table 2 (Heesch, 2014)

Characteristics	Subcategory	Sample %
Gender	Male	60
	Female	40
Cycle for recreation	No	9.3
	Yes	90.7
Cycle for transport	No	42.2
	Yes	57.8
Cycle for competition	No	82.9
	Yes	17.1
Exp. motorists' driving too close	No	34.4
	Yes	65.6
Exp. motorists' shouting abuse	No	36.8
	Yes	63.2
Exp. motorists' making obscene gestures or sexual harassment	No	55
	Yes	45
Exp. motorists' deliberately blocking your path	No	76.8
	Yes	23.2
Exp. motorists' throwing objects	No	83.4
	Yes	16.6

Figure 1: Excerpt from Table 1 (Heesch, 2014)

The survey found that 76% of male respondents and 72% of female respondents had experienced some form of harassment in the past year (Fig. 2), with the majority of harassment pertaining to deliberately driving too close (66%), verbal harassment (63%), and obscene gestures/sexual harassment (45%). This can be broken down further into demographics, finding that the demographics most likely to experience harassment were competition cyclists at almost 90%, and those living in more advantaged socioeconomic areas of SEIFA 8 & 9. The study discusses that experiences of harassment are more likely among healthy male recreation and sports cyclists, suggesting that cities and countries with a high number of cyclists, 'may be due in part to the predominance of utilitarian cycling'. The study recommends that improving cycling infrastructure, educating cyclists and motorists about their rights and responsibilities, as well as raising awareness of the issue, could lead to decreased divide between motorists and cyclists.



## CULTURAL BARRIERS & GENDER GAP

A research paper conducted by Jayden Forbes-Mitchell & Iderlina Mateo in 2015, explored cycling as a form of commuting, with a specific focus on the gender disparity of cycling. The study mentions that only 1.3% of the Australian population cycle to work, with women making up only 23% of that. The study also conducted a survey with 93 respondents, all living in Newstead or West End, finding that only 36% cycled to work, with 43% of male respondents and only 30% of female respondents. The survey also gathered the opinions regarding potential barriers considering both personal & sociocultural (Fig. 3) and environmental factors.

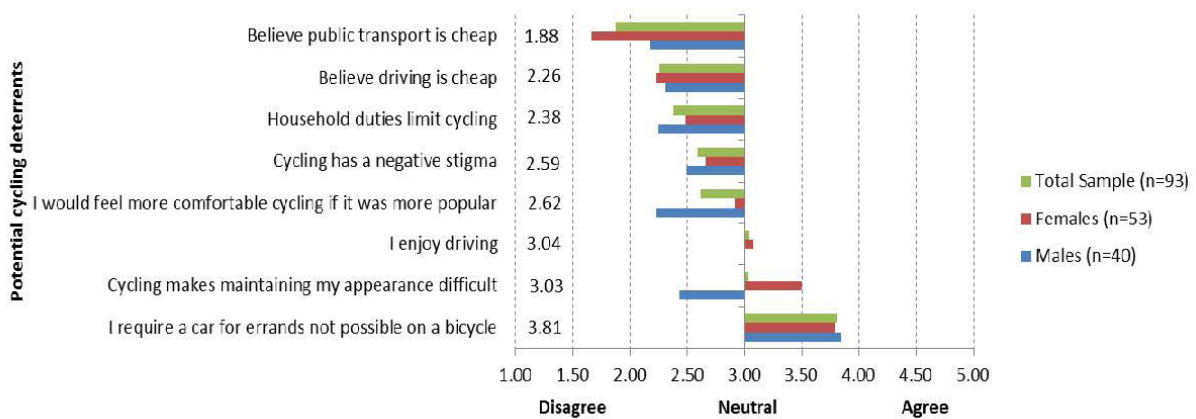


Figure 3: Potential personal and sociocultural barriers to cycling - mean scores of survey respondents (Forbes-Mitchell, 2015)

While most opinions were unanimous, there were some key factors that divided the answers between gender, notably concerns for appearance, safety at night and climate yielding polarising results with women agreeing and men disagreeing and all safety concern related opinions being higher for women than men. Women also agreed more than men that the popularity of cycling (specifically among women) would make them more comfortable cycling. The study suggests that these factors are largely the major barriers preventing more women from cycling to work as well as the barriers of comfort and safety being the biggest concerns for both men and women. The paper believes the improvement of cycling infrastructure and promotion of cycling as a sustainable and healthy mode of transport would encourage more people to cycle to work.

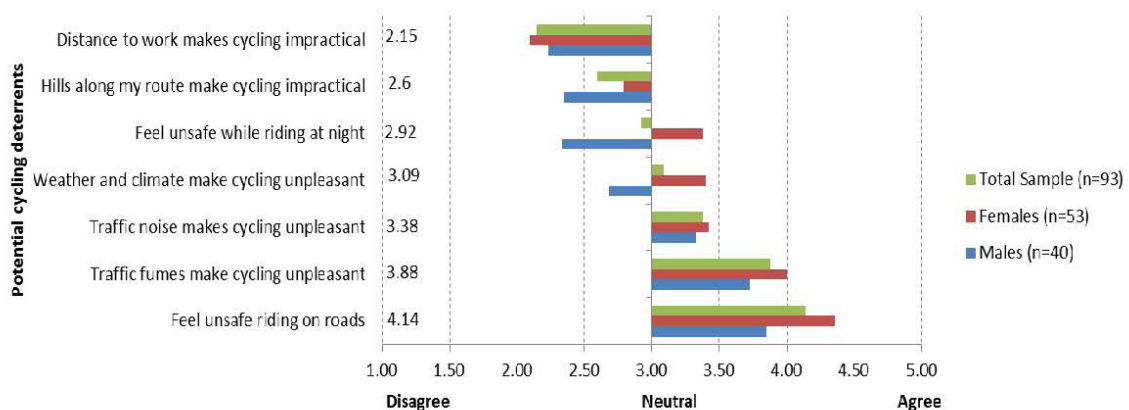


Figure 4: Potential environmental barriers to cycling - mean scores of survey respondents (Forbes-Mitchell, 2015)



## INTERNATIONAL OPINIONS & IMPORTANCE

To effectively encourage and incentivise cycling as a car alternative, it is crucial to understand what people find most important when transporting by bicycle. A 2010 study by the Delft University of Technology in the Netherlands did just that. The study surveyed over 4000 Dutch adults, analysing their opinions and the importance of different bicycle commuting characteristics using Likert scale questions.

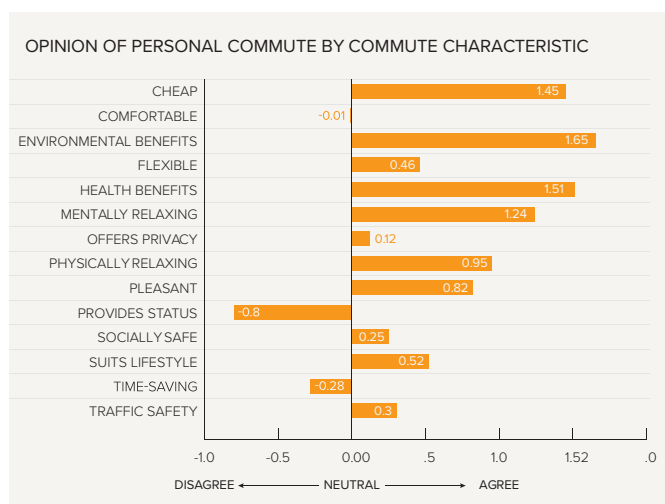


Figure 5: Graph Opinion of Personal Commute, Extrapolated from table (Heinen, 2010)

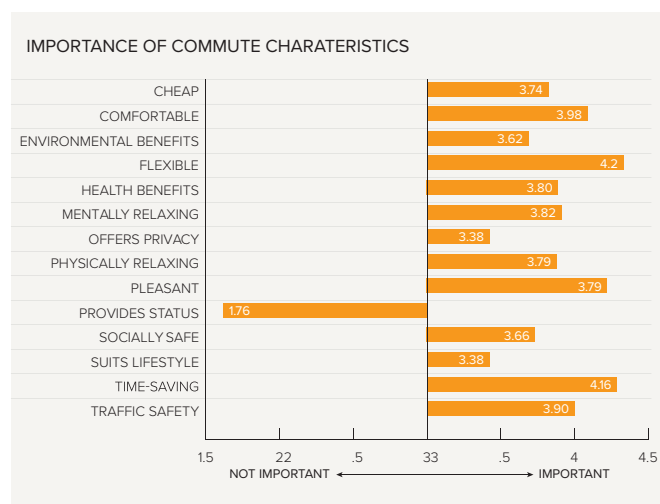


Figure 6: Importance of Commute Characteristics Extrapolated from table (Heinen, 2010)

The study revealed that most people strongly believe that cycling to work has environmental benefits, followed closely by health benefits and affordability. Additionally, most people feel that their commutes do not provide status, do not save time, and are not comfortable. The things that people find most important for their commutes are flexibility, time-savings, pleasantness, comfort, and safety, with status being the least important factor.

It is important to acknowledge that this survey was conducted in a country with a very well-established cycling culture, so the values may not reflect exactly the same way in Brisbane. However, it can provide insight from people who have extensive experience in the cycling-for-transportation sphere, and what they do and do not find important, which could be valuable information on what could be implemented to incentivise utilitarian cycling.





## MELBOURNE CYCLING STRATEGY

Melbourne has been working hard to improve and encourage cycling in the city for the past 15 years, and it is working. Peak-hour cycling has increased by nearly 70% from 2011 to 2019. The Melbourne City Council (MCC) attributes this to the large increase in dedicated cycling infrastructure, which has increased rider confidence and made it more likely that people will choose to cycle instead of drive. The MCC expects that over 3.3 million people will commute within the city each day by 2030, a forecasted increase of 57% since 2012. The MCC's transport mode targets for 2030 are 30% walking, 10% cycling, 40% public transport, and 20% private car. This means that they are hoping to achieve an increase of over four times the number of people cycling in the city in 18 years, from 81,000 to 334,000 every single day.

A background paper created by MCC in 2018 focuses on why people choose not to ride bicycles for transport, stating a lack in cycling confidence due to risk and safety concerns as the predominant barrier to participation. The study found that 77% of people who could ride a bicycle for transport but choose not to, consider themselves as cautious riders, taking longer routes to avoid roads where possible. It was then found that a protected bicycle lane would improve the confidence when riding by 83% of people. These protected bike lanes have now been integrated into their plan for 2030, where they are providing '50km of connected, physically protected bicycle lanes' and are awaiting approval for further 40km. The city is also trialling protected intersections, which

provide dedicated bike lanes through junctions for safer navigation.

Additionally the 2030 transport strategy is focussing on delivering community programs to encourage cycling. The council is looking to increase e-bike ownership, especially for those looking to carry heavier loads by advocating for ebike subsidy programs, amending speed and power restrictions for larger cargo bikes. Improved lighting conditions for night riding is also being implemented to enhance visibility and safety.

The city of Melbourne has been, and is currently, implementing almost all recommendations stated in previous research papers; adding dedicated cycling infrastructure, running incentive programs, promoting the sustainability and health benefits of cycling and creating a physical separation between motorists and riders to improve safety, confidence and perceptions of both groups.



As the goal of this research was to find ways to incentivise cycling as active transport by better understanding the values, attitudes and perceptions, the researched demographic was able to be quite wide. With this in mind, the chosen primary research conducted for this report are; a general public survey, and 2 observations of a busy cycling area in brisbane.

## THE SURVEY

The survey was generated to gather the following information from the general public:

- Demographic,
- Transport habits,
- Perceptions and attitudes towards cyclists,
- Bicycle ownership,
- Cycling habits,
- & Possible improvements.

As this is a general public survey, it was designed to cater to both those that have a bicycle and those who don't, as well those who are considering one and those who do not. This was accomplished by splitting the survey into sections with conditional questions, like 'Do you own a bicycle?' & 'Are you considering getting a bicycle?' that would skip sections that are irrelevant to that surveyee, depending on their response. This meant that, while there were a total of 27 questions, the individual would only have to answer 13 - 19 questions, hopefully improving the retention of potential respondents. The survey was distributed to the general public through social media, and received a total of 36 responses.

**DNB311: CAPSTONE SURVEY**

This research project is being undertaken as part of an Industrial Design Capstone project for Nicholas Bentley. This project is focused on finding ways to incentivise the use of bicycles as a mode of transport, while considering perceptions and attitudes regarding cyclists.

This survey will be used to collect information from the general public regarding cycling perceptions, wants and needs, as part of a research-led industrial design research report and design solution.

It will take 5 - 10 minutes to complete this survey.

[nickbuddypal@gmail.com](mailto:nickbuddypal@gmail.com) [Switch account](#)

Not shared

\* Indicates required question

**Participation Involvement**

This survey participation involves a variety of questions; most are multiple choice or check box, with some linear scale, short form answers. If you are not comfortable answering some questions please feel free to skip them. There are only 2 mandatory questions which are necessary for correct progression of the survey, these questions are; 'Do you own a bicycle?' and 'Are you considering getting a bicycle?'. If you are not comfortable answering these feel free to skip this survey.

**Data Collection & Privacy**

All comments and responses are anonymous i.e. it will not be possible to identify you at any stage of the research, because personal identifying information is not sought in any of the responses and no traceable information is collected via the server or survey tool.

Any data collected as part of this research project will be stored securely on personal computers or password protected cloud storage systems (not on public storage systems). Data will be deleted once the project is complete at the end of the semester.

**The submission or return of the completed survey is accepted as an indication of your consent to participate in this research project.**

How old are you?

12 - 17

18 - 25

26 - 35

36 - 50

50 +

What City and Country do you live in?

Brisbane, Australia

Sydney, Australia

Melbourne, Australia

Figure 8: Survey Screenshot





## THE OBSERVATIONS

The two observations were conducted at both ends of the Goodwill Bridge, which is a green bridge that connects the CBD to Southbank. This bridge sees a lot of traffic from pedestrians, cyclists and other wheeled personal transport like electric scooters and skateboards.

At the southbank entrance to the bridge, is a very busy ‘intersection’ which involves individuals crossing the bridge, entering the southbank parklands, going down to the river, and making their way to the train station. There are also cars that drive through this area to allow access to the various accommodation that surrounds, which is limited to 20 km/h.

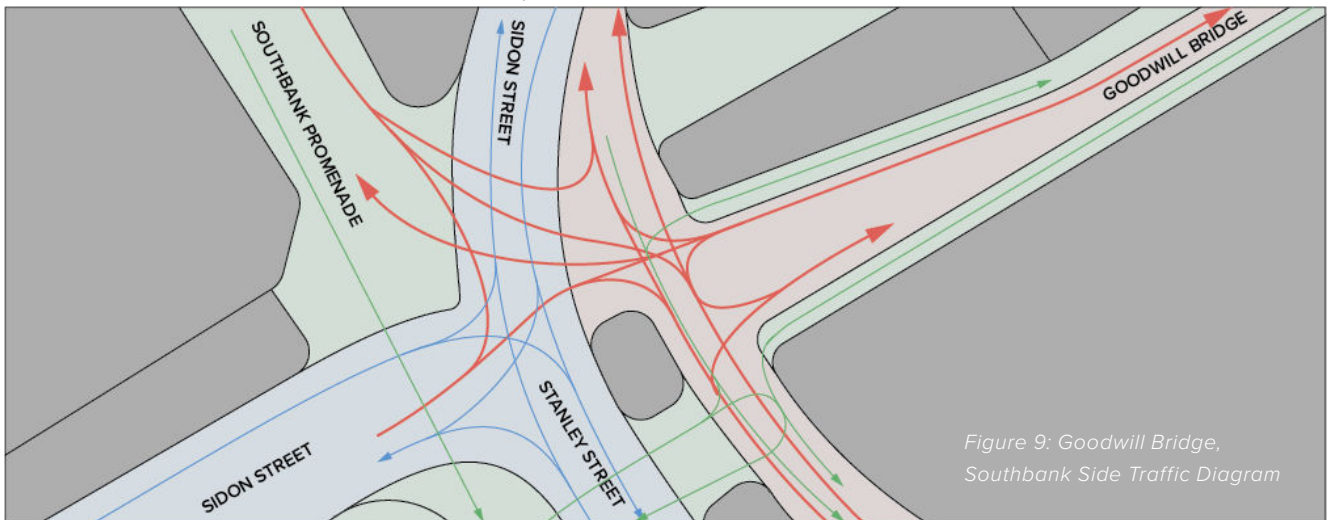


Figure 9: Goodwill Bridge, Southbank Side Traffic Diagram



The CBD side enters onto the QUT Garden Point Campus, where there are additional pathways that go towards the botanic gardens which go further to eagle st pier and westbound following the Brisbane River. As these are heavily trafficked areas, an observation time of 30 minutes per location was all that was necessary to get a clear understanding of the typical use case for the bridge. These observations were conducted between 9:30 AM and 10:30 AM on the 1st of September 2023.

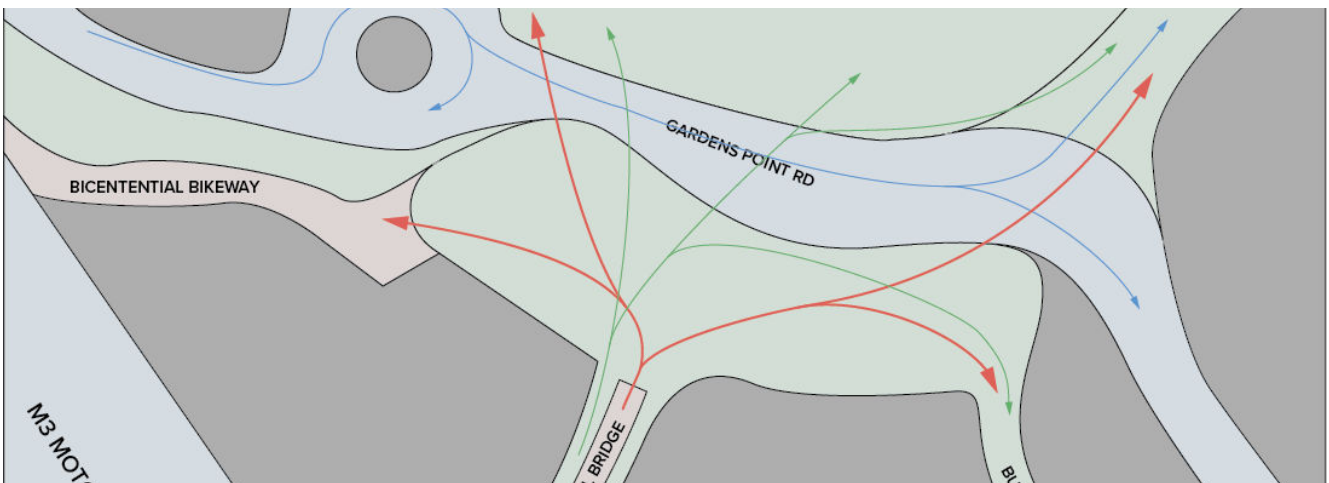


Figure 10: Goodwill Bridge, CBD Side Traffic Diagram



## SURVEY

The survey yielded a total of 36 respondents; with 27 respondents from Brisbane, 4 in other Australia cities, and 4 International (North America, Central & Northern Europe). Nearly 70% of respondents were in the age bracket of 18-25, followed by 26 - 35 at 19.4%, there were no respondents under 18.

The first section of the survey, asked 3 demographic questions, 'How old are you?' 'What city do you live in?' & 'What method of transport do you use most to travel short trips (2 km or less)?'. These questions have been used to sort the survey responses in 3 different ways, by age, by location and by main transport type.

The second section of the survey focussed on perceptions and opinions of different cyclists, 2 photos of cyclists were shown, one 'commuter cyclist' and one 'sports cyclist'. The respondents were then asked how they feel about these two cyclists on a likert scale, and then provide a reason for their response. The reasons were then grouped into 5 sections; Consideration, Commuting, Environmental, Appearance & Health, with additional groups sections for Indifferent & No response.

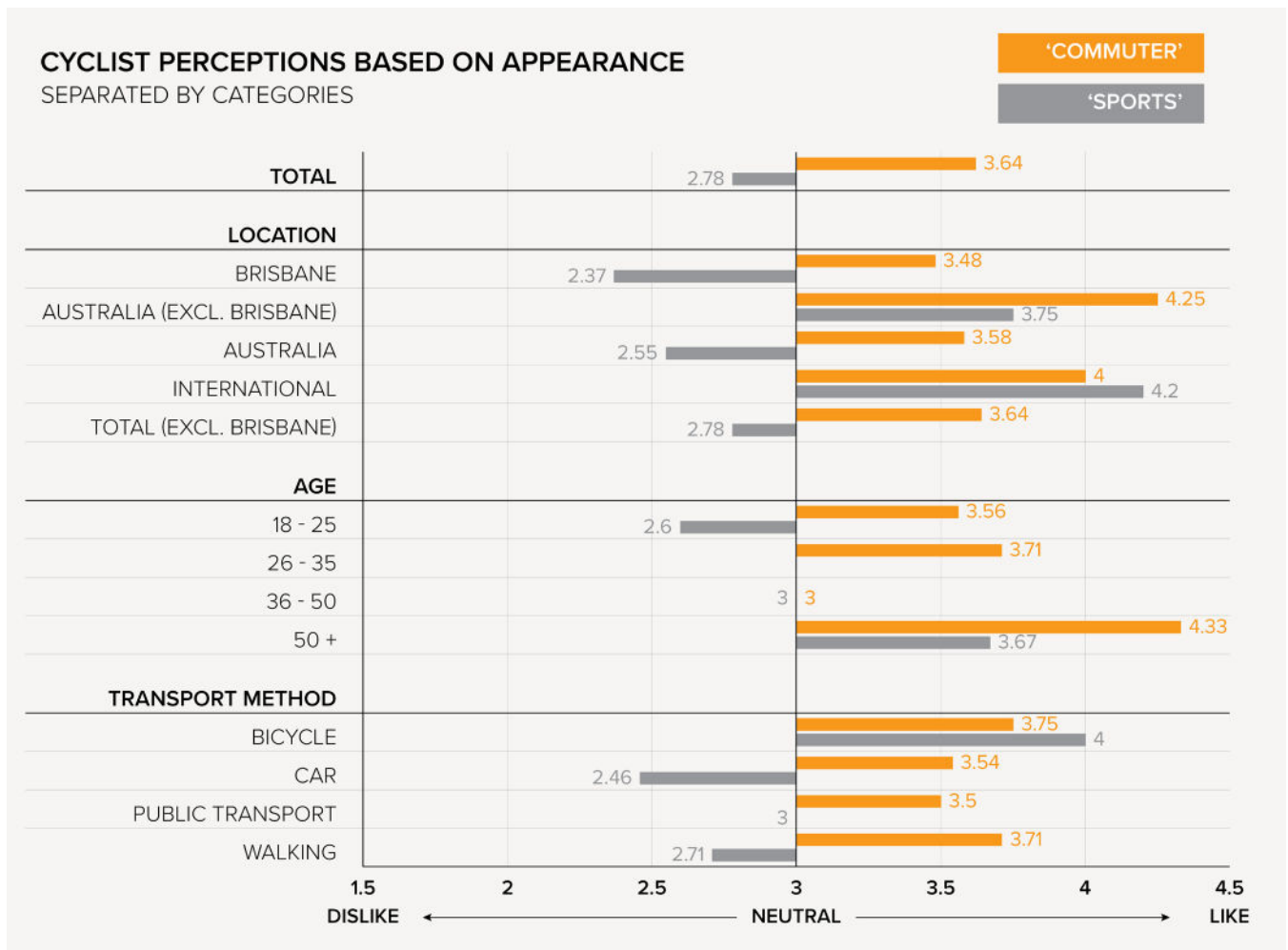


Figure 11: Cyclist Perceptions Based on Appearance

# ANALYSIS & FINDINGS



The overall result received was as expected with the average value of the commuter being liked more than the sports cyclist ( 3.64 vs 2.37), whats interesting though, is the discrepancies between the different demographics.

## LOCATION

The respondents from brisbane scored both cyclists lower than any other demographic, with a 3.48 and 2.37, interestingly, both the Australian and Overall average score when brisbane is excluded increase substantially to 4.25(+22%) & 3.75(+58%) and 4.11(+18%) & 4(+69%). The results between the commuter and sports cyclists are much closer.

## AGE

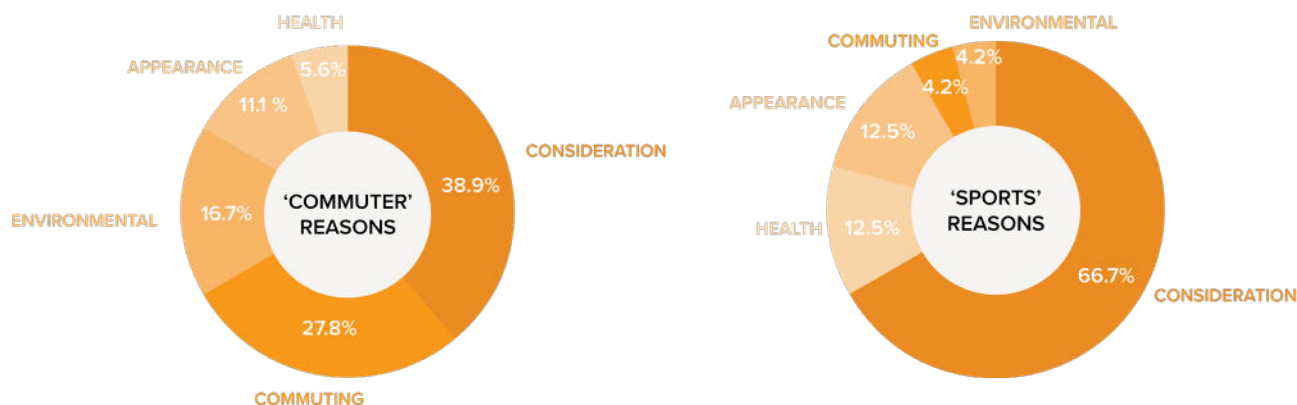
There seems to be upwards correlation in age and perception, as every older age bracket is scoring both cyclists higher than the previous (excl. 26-35, only 1 respondent). Oddly though, the younger generation seems to like these cyclists the least.

## TRANSPORT

It is no surprise that the cyclist respondents rated both cyclists higher than any other transport method. Motorists, rating the sports cyclist the lowest, which aligns with the previous research regarding harrassment, with male competition cyclists being the most targeted demographic.

## REASONS

The difference in the distribution of reasons between the two cyclists, shows that more people used consideration (or lack thereof) as a reason for the sport cyclists, paying little mind to the environmental benefits, unlike the commuter. More people considered the health benefits with regard to the sports cyclist than the commuter.

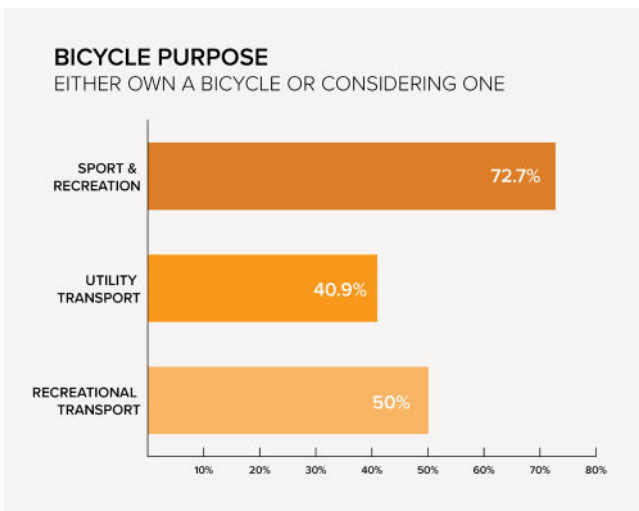




# ANALYSIS & FINDINGS



The third section of the survey looked at people who did cycle and asked what they used it for, and what barriers they have to cycle. Of the pool of 36 respondents, exactly 50% of them owned a bicycle, of the 18 that did not, only 4 were considering getting a bicycle. These respondents were then asked what they use (or would use) their bicycles for. 73% use them for recreation, 41% for utility transport, and 50% recreation transport.



A follow up was then whether they had used their bikes to go grocery shopping, only 4 people had, when asked why they would not, most people said their shops were too large to carry on a bicycle, followed by the time it takes, and the distance.

The reasons that people who were not considering a bicycle, were largely due to convenience and personal preferences, followed by a disinterest in riding with one person stating they did not know how to ride a bike. When asked what would make them reconsider a third responded that an improvement in infrastructure would make them reconsider.

The final part, asked what people think a bike is missing or could see an improvement in; nearly 50% mentioned improved storage solutions as well as an improvement in safety and visibility with 30% of respondents saying that bikes could do with an improvement in comfort.

Given that some of the core reasons for not using a bike for utility is its carry capacity, and that 47% of individuals think that bike storage should see an improvement, there is a possibility that focussing carry capacity and hauling could yield some interesting solutions.

# ANALYSIS & FINDINGS



## OBSERVATION STATISTICS

### OBSERVATION 1

LOCATION:

GOODWILL BRIDGE, SOUTHBANK SIDE

TIME:

9:19 - 9:49

WEATHER:

SUNNY 21 DEGREES C

TOTAL NUMBER OF BIKES:

100

### OBSERVATION 2

LOCATION:

GOODWILL BRIDGE, CBD SIDE

TIME:

9:19 - 9:49

WEATHER:

SUNNY 21 DEGREES C

TOTAL NUMBER OF BIKES:

100

CATEGORY	OBSERVATION 1		OBSERVATION 2		TOTAL	
	SAMPLE	%	SAMPLE	%	SAMPLE	%
Total	100		69		169	
<b>STORAGE TYPE</b>						
No Storage	49	49.00%	35	50.72%	84	49.70%
Backpack	32	32.00%	24	34.78%	56	33.14%
Pannier	11	11.00%	6	8.70%	17	10.06%
Crate/Basket	4	4.00%	1	1.45%	5	2.96%
Frame Bag	2	2.00%	2	2.90%	4	2.37%
Cargo Bike	2	2.00%	1	1.45%	3	1.78%
<b>BIKE TYPE</b>						
Traditional	85	85.00%	61	88.41%	146	86.39%
Electric	15	15.00%	8	11.59%	23	13.61%
<b>PURPOSE</b>						
Sports	28	28.00%	16	23.19%	44	26.04%
Utility /Transport	72	72.00%	53	76.81%	125	73.96%



## OBSERVATION FINDINGS

The initial queries for the observation were to simply record the number of bikes, the perceived purpose of the bike ride, and whether the bike was electric or not, however after receiving the results from the survey, an additional focus for the observations was added; the cargo and hauling solutions of each rider.

On paper, the number of people who do not carry anything on their rides, seems surprisingly high (49.7% overall), but it is important to consider that every single rider whose purpose was sport, did not carry any cargo. This means that of the utility/transport riders, about a third of all riders, were not carrying anything. It is not surprising that the most popular form of storage is a backpack (33% overall, 66% excl. no-storage riders)), as it isn't anything proprietary to just cycling, and can be used anywhere. Having said that, in my personal experience, having a backpack on while cycling is incredibly uncomfortable, as it traps heat between you and your bag, and often generates a lot of sweat. The rest of the storage solutions made up less than 18% of the total (33% of all storage).

The percentage of electric bikes (13.6%), while it seems low, is actually higher than the normal when comparing the Australian market share of all bikes in Australia ebikes make up just under 10% (Statista, 2023)

Ignoring the numbers for a moment, overall, most riders seemed to be quite aware of their surroundings, slowing down and being careful to not run into pedestrians as well as giving way to each other. There were only a few observed 'close calls' where a sports cyclist would be riding off the bridge too quickly and turn without checking that it was clear to go.

These observations somewhat align with the comments of the survey respondents, where it seems that sports cyclists do tend to be less considerate of their surroundings, however it doesn't seem nearly as severe as the survey responses would suggest.





After all this research, it is evident that there is no ‘1 solution to fix everything’ to incentivise cycling as a utility. Almost all studies regarding bicycles state that improvements and advancements in infrastructure would likely have the biggest impact in increasing the number of cyclists in cities. This is backed up by the large proportion of the survey respondents stating that infrastructure is the biggest barrier to cycling participation.

The same holds true for perceptions and attitude towards cyclists, there is no quick and easy fix. There are education campaigns, improvements infrastructure (again) but these solutions are well out of the scope of this project.

It’s a difficult loop to get out of; there is low demand for cycling because there is a lack in infrastructure and education, but because there is a low demand for cycling, there is also a low demand for infrastructure. Someone has to go first. I think the way forward is to focus on ‘incrementalism’; making small but consistent steps forward to eventually get to where we want to be. I believe that is where the scope of this project is heading towards.

There does seem to be some sort of gap in the ‘carry capacity’ side of bicycle utility. Sure, there’s a lot of different storage solutions on the market, but it seems that a lot of these are ‘cyclist first’ products. They may be great at carrying lots of things, but if they aren’t easy to use, convenient and unobtrusive, they’re not going to be useful to ‘non-cyclists’ who would like to use a bike to go shopping, or go on picnics, etc. Another issue with bike related cargo solutions is cost. Obviously if you wanted to do a family grocery shop, the best solution would be to get a cargo bike, but when they can easily cost over \$10,000, it is going to be difficult to convince someone who is on the fence. I think the area that could provide the most utility to a regular person, is finding a way to make carrying things easier with a bike that is affordable or available, so a low cost, easily justifiable purchase that makes using a bike for utility that little bit better.

With that in mind, here are my 3 (ish) concepts.



## ADAPTABLE BIKE RACK

This bike rack has the ability to fold out in 2 separate areas and directions. The first allows for a larger top platform to allow for items like a large crate to be secured in place. The lower sides also fold out and act as a supporting platform for bags, grocery or back pack. Between the top and upper side pieces, are several hooks, which allow for bags to loop over there. This combined with the lower platform would allow for a secure 2 point system.





## UNIVERSAL MODULAR SECURING SYSTEM (PART 1)

This concept allows for the cyclist to attach anything to their bike. This two part design secures onto the bike with the help of mass customisation, ensuring that the mount perfectly fits anywhere, the other part secures to the thing you want to carry, be it a backpack, water bottle, grocery bags, milk crate etc. Both parts magnetically and mechanically fasten together, once the two parts magnetically connect, it releases spring loaded mechanism which cinches over the other, providing a secure connection. To separate the parts, simply turn the outer part, 60 degrees, until the triangle points downwards. The device can be removed by overcoming the magnetic force keeping it in place. This device can be used in single point, dual point, and multi point securing methods, ensuring that the deviec you want to keep secure, stays that way.

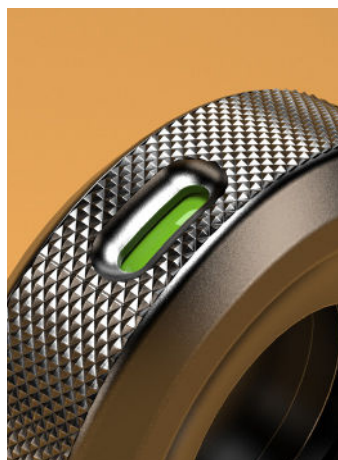
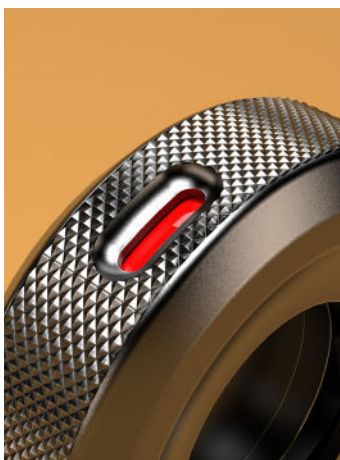
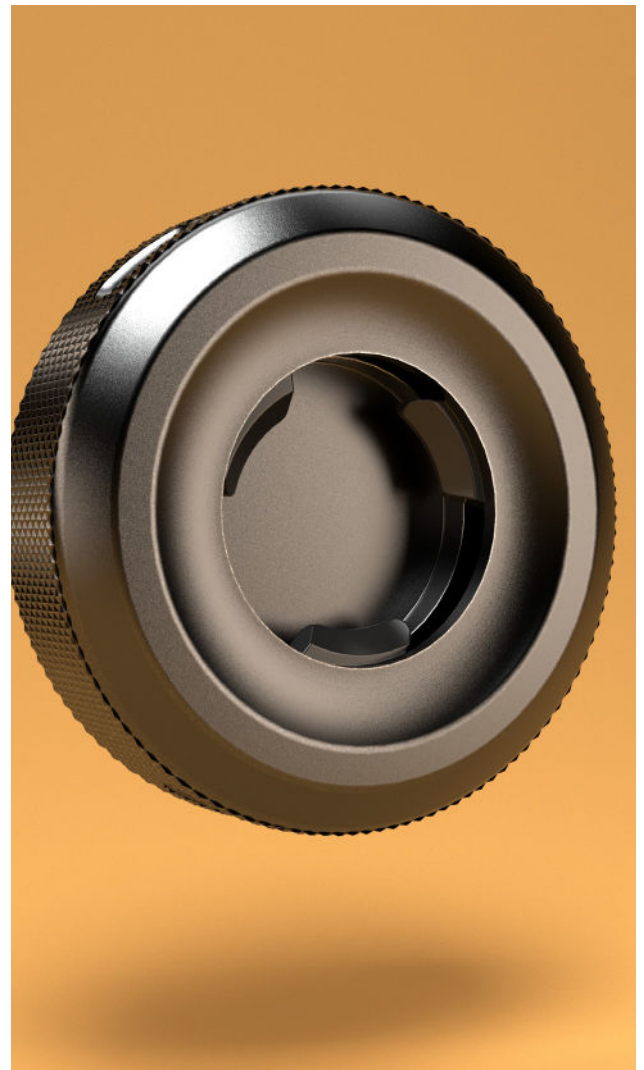


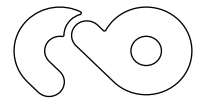




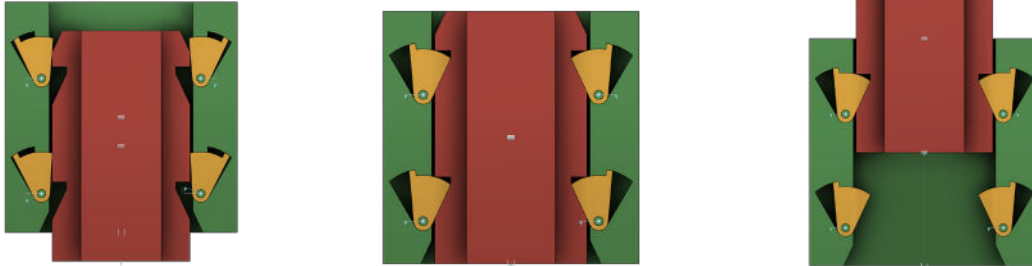
## UNIVERSAL MODULAR SECURING SYSTEM (PART 2)

This concept allows for the cyclist to attach anything to their bike. This two part design secures onto the bike with the help of mass customisation, ensuring that the mount perfectly fits anywhere, the other part secures to the thing you want to carry, be it a backpack, water bottle, grocery bags, milk crate etc. Both parts magnetically and mechanically fasten together, The device can be turned in either direction until the device clicks into place, and the outer indicators are red. This engages a rotational linkage which grabs around the other part, securing it in place. To unlock, you can simply do the opposite, turn in either direction until the indicators turn green. The device can be removed by overcoming the magnetic force keeping it in place. This device can be used in single point, dual point, and multi point securing methods, ensuring that the device you want to keep secure, stays that way.

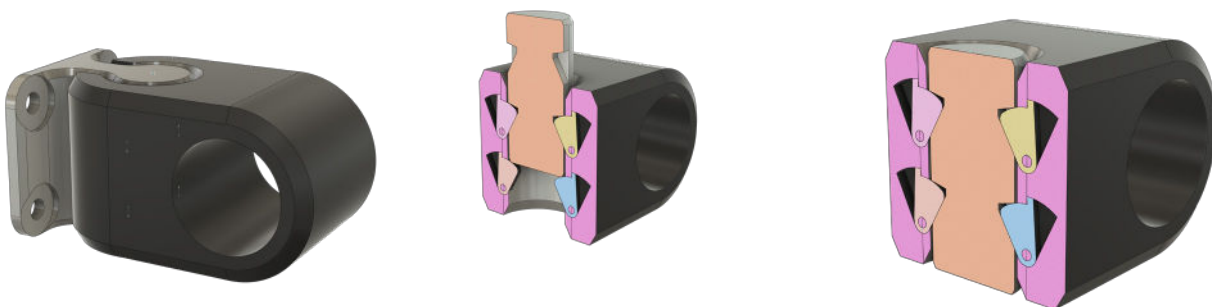




Flat Sliding Latch Mechanism



Round Version of Sliding latch- Insert from below, remove by pull up and out



Twist Latch Design, Concave triangle slots in, inner piece rotates around it, locking it into place





## DELTA

### An Open-Source, Modular, Mounting platform

Delta is a revolutionary new mounting platform that allows bike riders to attach any existing cargo to anywhere on their bicycle. Made of durable 6061 aluminum, Delta is small and lightweight enough for light loads, but strong enough to handle even the heaviest cargo.

Delta's self-locating design uses strong magnets to automatically align the cargo platform with the mounting bracket, making it easy to attach and detach cargo with one hand. The innovative lock switch secures the cargo to the bike while riding, preventing it from shifting or falling off.

Delta also features an open-source mounting design, meaning that users can get custom 3D-printed attachments to mount Delta anywhere on their bike. This makes Delta the most versatile and adaptable mounting platform on the market.

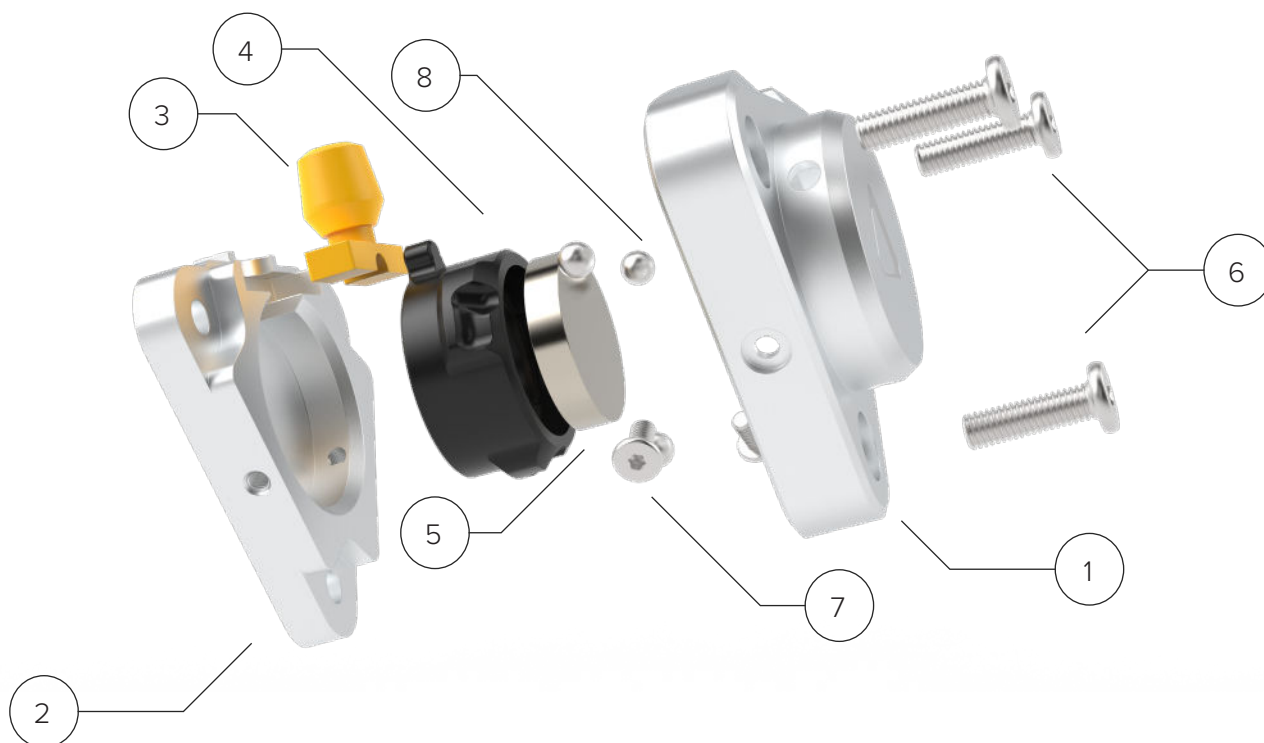
#### Why Delta?

- Versatile: Mount any cargo to any bike
- Durable: High-quality 6061 aluminum
- Secure: Innovative lock switch keeps cargo secure.
- Adaptable: Open-source mounting design for custom attachments.

With Delta, you can finally ditch the bulky racks and panniers and enjoy a sleek, streamlined ride.



# FINAL DESIGN - BOM



Item	Part Name	Qty	Material	Manufacturing Method	Mass
1	Front	1	Aluminum 6061	5 Axis CNC	8.078 g
2	Rear	1	Aluminum 6061	5 Axis CNC	7.245 g
3	Switch	1	PEEK	Injection Moulded	0.482 g
4	CAM	1	PEEK	Injection Moulded	1.386 g
5	15 x 3mm Magnet	1	N42 NdFeB Magnet	Standard Part	4.455 g
6	M3 x 12 T8 Torx Ultra Low Head Screw	3	Stainless Steel 316	Standard Part	0.677 g
7	M2 x 4 T5 Torx Ultra Low Head Screw	2	Stainless Steel 316	Standard Part	0.136 g
8	3mm Precision Ball	3	Stainless Steel 316	Standard Part	0.113 g