What are the Social and Physical Infrastructures that Encourage People to Cycle in Christchurch?

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Executive Summary

This report provides an analysis of the social and physical infrastructure that encourages people to cycle in Christchurch. Methods of analysis include a participant survey, and the results were discussed using local and international literature. Data analysis showed that infrastructure which considers cyclists will help increase perceptions of safety and therefore, willingness to cycle. Furthermore, the research findings show that individuals cycle because it is a form of exercise, addresses environmental concerns and is an enjoyable experience. Recommendations for further research and authorities responsible for cycling planning include:

1) Research into school cycling education programmes.
2) Explore cycling education marketing.
3) The need for infrastructure that increases both actual and perceived safety.

The report also discusses the limitations involved in the research. COVID-19 limited our ability to interact with schools and group members, our survey was constrained to only ten questions without paying for a subscription, and we were unable to collect observational data as our group members were not in Christchurch.

Key Words

Cycling, Social, Physical, Infrastructure, Ōtautahi, Christchurch, Resilience

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1. Introduction

The aim of this report is to identify the different social and physical infrastructures which encourage people to cycle in Ōtautahi Christchurch. This aim was developed by reviewing Christchurch's transport network and key literature. Understanding how urban livability can be made resilient through cycling as a sustainable, accessible, and environmentally friendly mode of transport, is important within the context of Christchurch's climate change emergency. Past cycling literature is outlined to form the base of our understanding of what infrastructures encourage people to cycle. This is then followed by survey methods, results and discussions, limitations of the research, conclusions and recommendations for future research.

2. Past Research

This review evaluates cycling literature aiming to identify social and physical influences of cycling. Primary social influences leading to cycling include persuasion from community and friends, age and gender differences, and cycling culture, as well as additional factors discussed in the social infrastructure section below. Availability and length of educational resources may also affect a person's decision to cycle. The literature on physical infrastructure primarily focuses on rider safety. The urban design of main cycleways, intersections, and integrations with other modes of transport is widely reviewed, as well as the segregation of bike lanes from motorised vehicles and accessibility to main social hubs and amenities that are discussed below. Identified influences are then compared with programs, social norms, and infrastructure available in Ōtautahi Christchurch.

2.1. Social Infrastructure

Social infrastructure encapsulates how society functions and defines people and their actions through culture, values, norms, sense of belonging, relationships and networks (The Treasury, 2013). Influential research focused on analysing cycling transport motivations, Helen Fitt (2015) found social meanings and influences as a form of social infrastructure fundamentally motivating with the potential to encourage and discourage cycling. Extensive research exists on how social infrastructure and social meaning influences students cycling to school in New Zealand (Frater, 2015; Frater et al., 2017), however, there is limited research into the broader

understanding of social infrastructure influences on cyclists across Christchurch. Analysing social infrastructure is important in understanding what could encourage cycling within Christchurch in the future to help achieve greater goals associated with the state of climate emergency such as carbon neutrality and resilient and sustainable urban transport networks.

2.1.1. Social Norms

Subjective social norms and social stereotypes or the pressure to act in the same way as others including injunctive and descriptive norms have a positive influence in supporting and encouraging cycling (Fitt, 2015). Under these social norms, transport cycling by teenagers to and from school in New Zealand and cycling within different UK cities was positively encouraged by the behaviour of friends, family and the wider community (Frater, 2015; Aldred & Jungnickel, 2014). A key example of this has been shown where cycling to school in response to perceived social pressure was encouraged and influenced by social norms (Frater et al., 2017).

2.1.2. Gender Roles

Gender also plays a major role in influencing cycling to both encourage and discourage cycling depending on normative views (Frater & Kingham, 2018). Gender differences and norms can cause discouragement towards cycling in females through negative perceptions of appearance and body image (Frater & Kingham, 2018; Molina-Garcia et al., 2018), while encouraging males (Fitt, 2015). Statistics New Zealand (2014) found a disparity between genders in all age groups nationally with significantly more men cycling compared to women. This can, however, depend on cycle prevalence within different cities (Aldred et al., 2016). Age can also have an impact on who and how much people cycle, with younger people, generally cycling more than older, although this is location dependent (Fitt, 2015; Frater, 2015).

2.1.3. Culture

Cycling transport can be encouraged through a sense of cycling culture established by high prevalence of utility and leisure cycling, combined with social influence and pressure from community culture to incorporate cycling into livelihood (Aldred & Jungnickel, 2014). An example of this culture is visible in various cities across the UK and Europe, particularly in the Netherlands (Gossling, 2013; Aldred & Jungnickel, 2014; Frater, 2015). Cycling culture can be increased through physical infrastructure such as dedicated cycle routes, parking, services and

workplace facilities which encourage positive cycling behaviour (Gossling, 2013; Pucher et al., 2010). However, the influence of culture to encourage cycling may be restricted to high use communities (Aldred & Jungnickel, 2014; Aldred et al., 2016).

2.1.4. Health, fitness and environment

Health and fitness are an obvious encouragement and positive motivator towards cycling as personal responsibility for recreation, leisure, exercise, and commuting to work (Fitt, 2015; Kingham et al, 2011). There is also a strong link between cycling for health and the environment as a commitment to using environmentally sustainable transport to positively benefit healthy wellbeing, while being sustainable (Fitt, 2015). Cycling can also be encouraged and motivated as an environmentally friendly mode of transport to help positively protect and better connect with the local environment, create greener lifestyles, and reduce dependency on less sustainable transport (Daley and Rissel, 2011; Aldred, 2010). Cycling for the environment has also become more normal in response to growing environmental issues (Aldred, 2010).

2.1.5. Education

The New Zealand Transport Agency (NZTA), (2015) found that cycling education and programs in schools play a fundamental role in increasing participation amongst younger demographics through improved confidence. These programs, if conducted correctly, may decrease injuries within younger age groups (NZTA, 2015). There are numerous local education schemes aimed at school-aged children, such as BikeReady, BikeOn and CycleSafe. In contrast, a study conducted by McClaughlin and Glang (2010) compared trained and untrained individuals, they demonstrated that education has a positive effect on cycling knowledge such as road markings and traffic rules. However, other studies have revealed that educational programs do not have a substantial impact on learning outcomes as there is limited retainment of knowledge after more than six months (Hodgson & Worth 2015). It has been seen that cycling rates in secondary schools marginally increased if the Bikeability program was offered in primary schools for consecutive years rather than one-off training (Hodgson & Worth 2015).

In New Zealand, there is a range of adult cycling training programs such as Tauranga's Ride Leader program and Auckland Transports adult cycling training initiatives (Mandic et al., 2019). These initiatives have an impact on confidence and participation. However, due to the

nature of self-reported data and no comparison group, the reach of these programs is limited. Christchurch has a lack of adult training programs. Although BikeReady offers training, the reach is minimal as there is a lack of advertisement. A cycle skills system for adults in Christchurch would need to consider a new approach in order to facilitate participation (Mandic et al., 2019).

2.2. Physical Infrastructure

In New Zealand, cyclists are 15 times more likely to experience injury or fatality per hour of travel than a car user (Tin et al., 2010). In order for cycling to become a viable way of transport for everyone on a day to day basis, it must be made safe, convenient and feasible. International and local literature has found that cycling can be promoted and encouraged as a good transport option for everyone through several urban design techniques.

2.2.1. Cycling Facilities and Infrastructure

Both globally and in New Zealand, roads are often constructed for motorised vehicles which results in cycleways being an afterthought and worked into pre-existing roadways (International Transport Forum [ITF], 2013; Cycling Safety Panel [CSP], 2014). To achieve the goal of safe, cycle-friendly urban roads and roadsides, a consistent, continuous, convenient and complete urban cycle network is required (CSP, 2014).

When looking at 19 Organisation for Economic Cooperation and Development (OECD) countries, it was seen that the more separate linear cycle infrastructure that was present in a country, the fewer injury accidents involving at least one cyclist were recorded (ITF, 2013). Research comparing separated cycling facilities adopted by European countries to a mixed traffic approach utilised in North America also found that the former is safer, and is perceived as such (Lusk et al., 2011; Teshke et al., 2012).

When complete separation is not feasible or practicable, on-road infrastructure that is well designed and can keep cyclists visible creates a sense of security (CSP, 2014), this can be seen in painted bike lanes on the edges of roads in many countries including New Zealand.

2.2.2. Intersection Modifications

Although cycle lanes and separated cycleways reduce the number of head-on and rear-end collisions involving bicycles, intersections are a large safety concern due to the risk of being overlooked by drivers (ITF, 2013). To reduce this risk, highly visible bike lanes leading up to the intersection with plenty of space for bikes to stop ahead of cars, such as the bicycle boxes seen in figure 1, can improve visibility for both cyclists and drivers (CSP, 2014; Pucher & Buehler, 2008). Cyclist-activated traffic lights, as seen in figure 2, timing traffic lights to allow a 'green wave' for cyclists rather than cars, and priority bicycle traffic signals can also help to prioritise and increase the safety of bicycle travel (Pucher & Buehler, 2008).

Figure 1: Bicycle boxes seen in Edinburgh (left) and St. Germain-en-Laye (right) gives cyclists room to stop ahead of cars (ITF, 2013).

Figure 2: Interactive, cyclist-activated traffic light seen in Christchurch, New Zealand.

It has also been found that when left-turn only lanes or left-turn splitter islands are present in Australia and New Zealand, the risk of injury to cyclists is about four times lower (Pucher & Buehler, 2008; Turner et al., 2011; CSP, 2014).

2.2.3. Traffic Calming

Calmer traffic conditions lead to safer, less stressful cycling. Traffic calming in residential areas can be achieved through altering streets to include road narrowing, raised intersections, extra curves and speed humps (Pucher & Buehler, 2008), these methods are commonly seen throughout New Zealand cities including Christchurch. Traffic calming in the city centre can be achieved by implementing a car-free zone (Pucher & Buehler, 2008).

2.2.4. Safe and Convenient Bicycle Storage

Bicycle safety influences people's decision to cycle. An example of an innovative European parking facility is the bike station adjacent to the main train station in Münster, Germany which houses 3,300 bikes, offers repairs, hires our rental bikes and provides full access to the train network (Pucher & Buehler, 2008).

Transforming parking structures to house more bikes than cars is also economically beneficial. A cost-benefit analysis conducted in Melbourne, Australia found that although individual cyclists spent less to park their bikes compared to car drivers, more money can be made from bicycle parking compared to car parking per square meter (Rissel et al., 2013).

2.2.5. Coordinating Cycling with Public Transport

Cycling plays an important role as a feeder and distributor service for other public transportation, therefore, the connections between cycling and other modes of public transport is important in designing integrated transport networks (ECMT, 2004; Pucher & Buehler, 2008). Measures to improve this interface include the development of parking facilities at bus stops and renting bicycles at public transport stations (ECMT, 2004).

3. Methodology

3.1. Online Survey

Primary data was collected through an online survey and can be found in the appendix. The purpose of this survey was to identify the various social and physical infrastructures that encourage Christchurch to cycle. Respondents were limited to 18 years or older and the survey was open between the 2nd and 17th of May 2020. This survey was designed and produced using the online system SurveyMonkey. Our respondents were chosen based on an interest in cycling, through various online groups and the Christchurch cycling community as a whole.

The survey consisted of 10 questions, both open-ended and multi-choice. Survey questions were designed based on broad literature themes that affect people's cycling decisions and patterns. Social infrastructure is a key influence in cycling decisions and encouragement through age and gender, culture, education and health, fitness and the environment (Gossling,

2013; Aldred & Jungnickel, 2014; Frater, 2015; NZTA, 2015; Frater et al., 2017; Mandic et al., 2019). Similarly, physical infrastructure encourages cycling through urban cycling network designs to make urban cycling safe, convenient and resilient through cycling facilities and routes, intersection modification, safe cycle storage and am integration of cycling and public transport (ECMT, 2004; Pucher & Buehler, 2008; Rissel et al., 2013; CSP, 2014). A question relating to how the COVID-19 lockdown during the pandemic affected respondents cycling patterns was also included due to the timing of the research.

Survey questions which were important in answering our aim were based upon these key infrastructure themes and techniques affecting people's decisions to cycle, how cycling can be encouraged in Christchurch, and how COVID-19 conditions affected these. Questions included age and gender demographics, social and physical motivations, infrastructures present, cycle safety programs used and the influence of the COVID-19 pandemic. Development of this online survey was achieved through careful consideration of our research aim and our understanding of past literature themes as the framework of these questions.

In response to the challenges of the COVID-19 pandemic, an online survey was chosen as our method for easy and straightforward access for participants across Christchurch (Hay, 2010). Data collected allowed for standardised and structured community interaction while effectively gathering important data of community behaviour, experiences and attitudes (Hay, 2010). The quantitative data collected from the survey were analysed using SurveyMonkey and Microsoft Excel software. The qualitative comments from the survey questions were analysed based on key themes and are presented as descriptive statistics.

4. Results and Discussion

4.1. Demographics

Figure 3 below shows the amount of people within each age group as well as their gender-specific as male, female. The highest number of participants were in the 51-64 age group, followed by the 36-50 age group. Within each age group had a close to even split between genders. Of the 243 participants in the survey, one person did not respond to gender and one person preferred not to say. There were four participants who did not respond to age. We did not include any questions on participants' ethnicity. Increases in participation rates across demographics is a key element in addressing environmental concerns such as the prevalence of carbon-based travel (Perry, 2020).

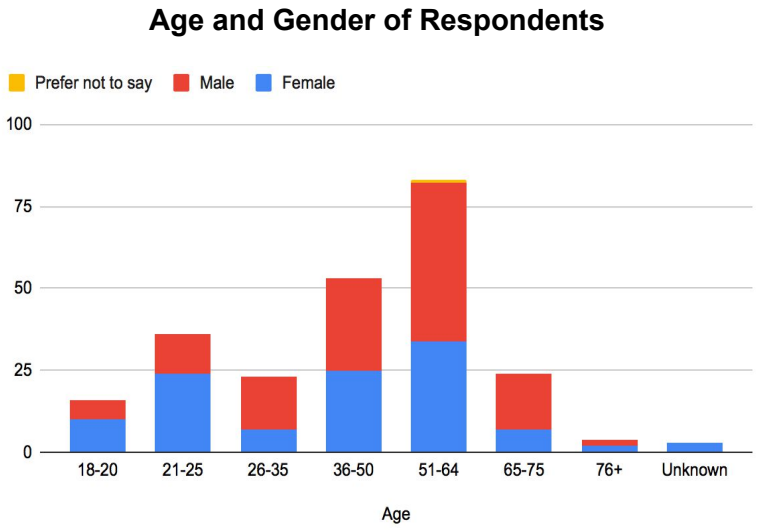

Figure 3: Graph showing the age and gender of survey respondents.

There were 159 participants that included their postcode in responses. The majority of these were located in West Christchurch in suburbs including Avonhead, Riccarton, Upper Riccarton, Sockburn, Cashmere, Hornby, Ilam, Hoon Hay and Hillsborough. There were also several respondents whose postcodes were not within Christchurch, some of these were identified as being from the Selwyn District, Waimakariri District, and a few from the North Island.

4.2. Cycling Frequency

As seen in figure 4, the majority of participants (78%) cycled daily to more than twice a week with only a few participants (6.5%) commented that they never or almost never cycled.

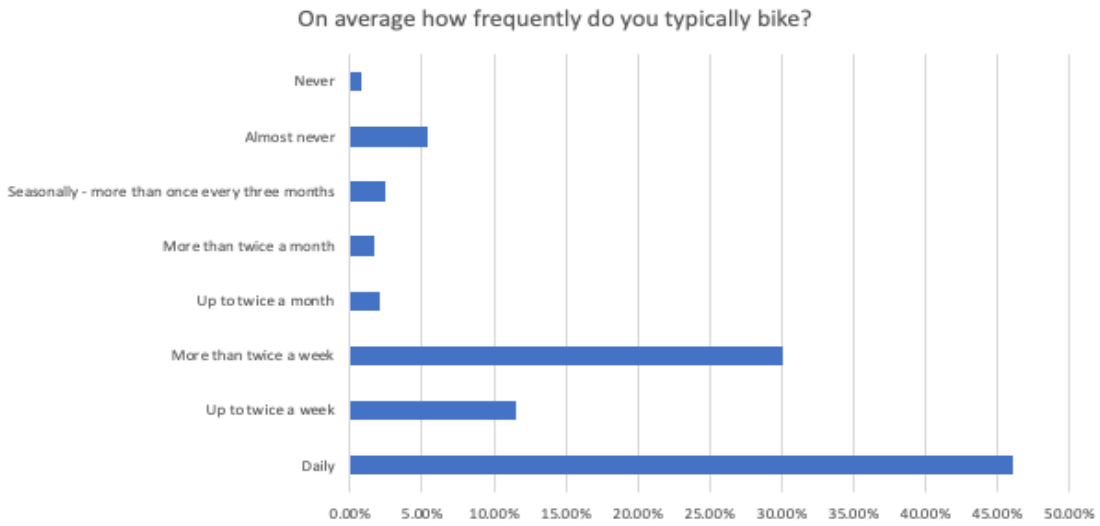

Figure 4: Graph showing the average frequency people cycle.

Bicycle type and accessibility were recorded and it was seen that most people owned their own traditional bike (86%) however some owned e-bikes (18.2%) or modified/speciality bikes (18.6%), and 13.6% of people used a shared bicycle.

4.3. Reasons to cycle

To address our key aim, it is important to understand the social and physical reasons for why participants cycle in Christchurch. Research by the NZTA into cycling attitudes and perceptions formed the basis of this question which asked participants to choose one or more reasons for cycling. It is assumed that these reasons are acting as encouragement for cycling.

As shown in figure 5, cycling respondents found exercise (83%), enjoyment (76%), recreation (71%), transport for work or education (68%) and environmental concerns (60%) as five major reasons for cycling. Some respondents chose to provide other reasons for cycling stating it was a fast and convenient transport method and beneficial for mental wellbeing. Figure 5 highlights the diverse range of reasons affecting why people cycle in Christchurch socially and physically with cyclists often motivated by multiple reasons. These results indicate that it is

essential to incorporate the social motivations of recreation, exercise and overall enjoyment into future transport planning to encourage greater uptake and use of cycle routes to reduce dependency carbon-based transport to make Christchurch transport environmentally friendly and sustainable (Daley and Rissel, 2011; Fitt, 2015), as well as people's overall enjoyment for cycling inadvertently also benefiting physical and mental health and the environment.

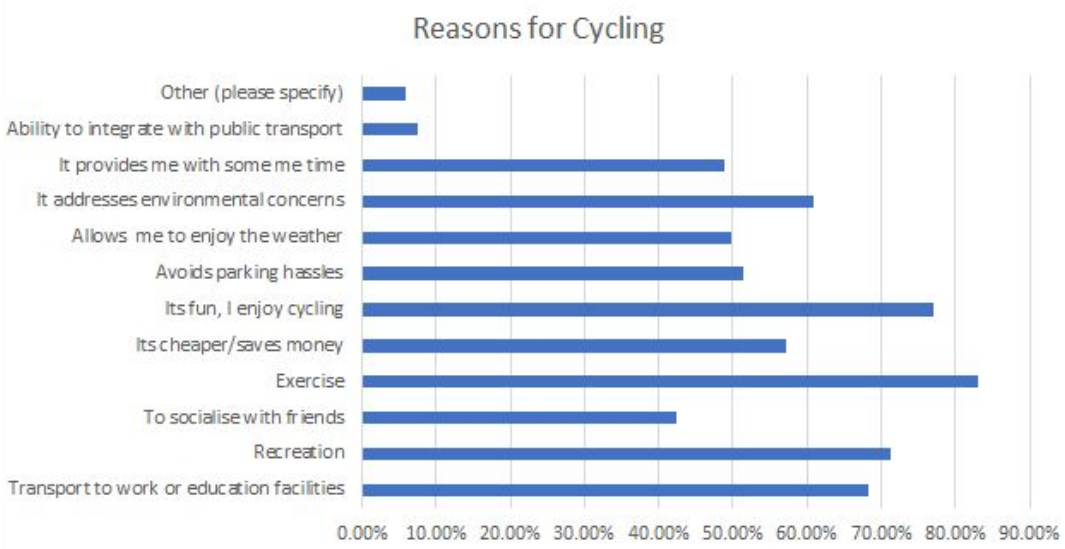

Figure 5: Graph showing reasons for cycling chosen by survey participants.

These findings help answer our aim and are supported by findings by Fitt, (2015), Frater (2015) and Kingham et al, (2011) locally in Christchurch, and by Aldred & Jungnickel, (2014) and Gossling, (2013) overseas which found positive overall cycling patterns and encouragement through motivations for health, fitness, environment, recreation and culture.

4.4. Decisions to Cycle

Figure 6 below, shows what affects people's decision to cycle. After respondents selected one or more options, the most common response was weather conditions (68.2%), followed by the amount of traffic (44.2%), the physical condition of the road (33.5%), the inconvenience to carry belongings (32.6), presence of cycle lanes (29.8%) and the distance being too far (28.5%).

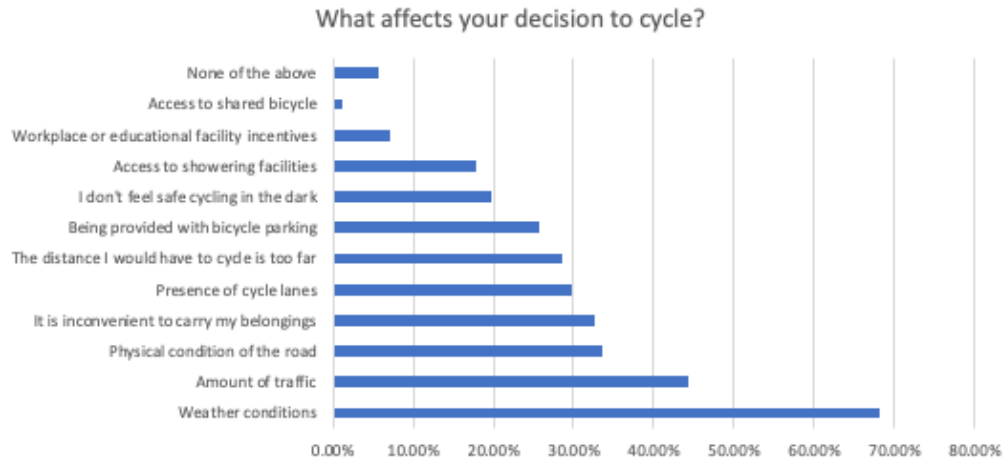

Figure 6: Graph showing how people's decision to cycle is influenced.

4.5. Cycling tools

As seen in table 1 below, participants are more likely to utilise physical cycling tools over social cycling tools. The most common cycling tool used was the Christchurch City Cycle Map (53.3%). There were 36.3% of participants that had used none of the tools listed, 25.4% had used bike racks on buses. Just 8.3% of participants had used any of the four educational programmes, Confident Cycling resources, Bike Ready, Cycle Safe and Bike On.

Table 1: *Participant answers when asked what cycling tools they have used.*

Answer choices	Percentage	Responses
Christchurch City Cycle Map	53.33%	128
Confident Cycling resources	2.08%	5
Bike Ready programme	0.83%	2
Cycle Safe programme	5.0%	12
Bike On programme	0.42%	1
Recycle a Dunger (RAD) Bikes	9.58%	23
Bike racks on Buses	25.42%	61
Bicycle parking at bus interchange	15.42%	37
None of the above	36.25%	87
Other	4.58%	11
Total	100%	240

Physical cycling tools may be utilised more than social cycling tools due to accessibility. Physical resources such as bicycle parking at the Christchurch bus interchange and bike racks on buses are easily visible to users which may lead to a wider knowledge and use of them. In

comparison, social cycling tools such as the Confident Cycling resources, and the Bike Ready, Cycle Safe and Bike On programmes are educational tools, which are utilised more in school-aged children, who are below the age limit of the survey and research conducted by Johnson and Margolis (2013) found that adults are less likely to utilise such programmes. This lack of utilisation can be attributed to stigmas associated with learning to cycle at an older age, which may indicate why there was little response to these tools (NZTA, 2017). A greater participation by adults in cycle education programmes may be helpful in increasing usage and safety while cycling in Christchurch and addressing environmental concerns.

4.6. Cycling infrastructure

As seen in figure 8 below, the most common response for what was present on people's typical cycling route was bike lanes (84.7%), this was followed by shared pathways (71.1%), social amenities such as parks and trees (64.1%), bicycle traffic lights (59.1%), shops and businesses (53.3%), and segregated cycleways (50%). There were also 4.6% of people who responded saying that none of these features were present in their typical route, while some responders mentioned other features such as roadworks, signposting, e-bike charging stations and highways to be present.

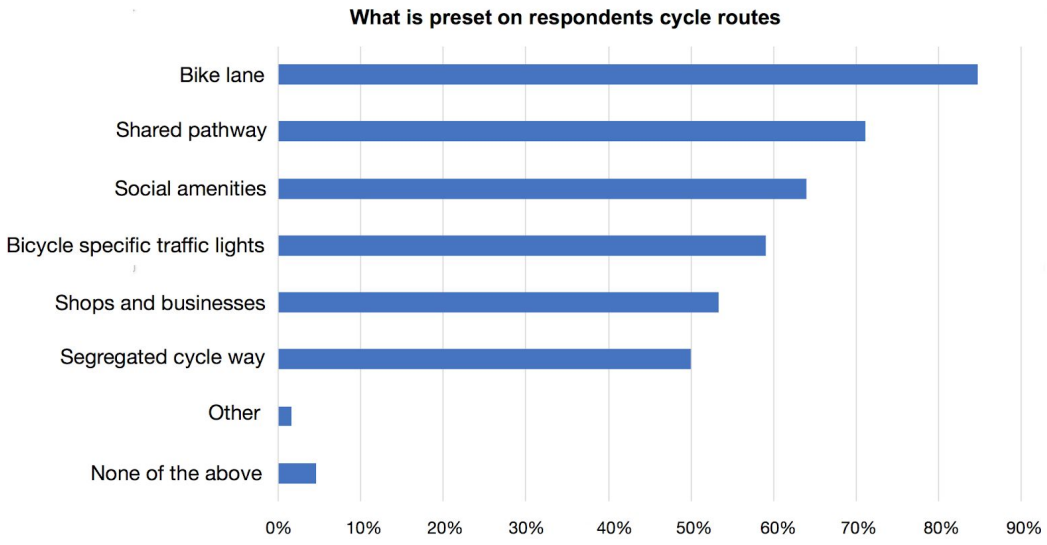

Figure 8: Graph showing what is present on survey respondents 'typical' cycling route.

4.6.1 Perceived safety

Figure 9 below shows that people's sense of safety increases as separation from traffic increases. This is seen as only 2.1% of people surveyed feel very safe cycling on the road compared to 52.3% feeling very safe cycling on segregated cycleways. Bike lanes and shared pathways are seen as a middle ground between these options with 17.8% and 25.2% of people surveyed feeling very safe on these respectively.

The reverse is seen in how unsafe people felt while cycling on these different infrastructures. While biking on the road, 10.4% of people surveyed feel very unsafe. Biking on a bike lane, on a shared pathway and on a segregated cycleway only triggers this response in 2.1%, 1.2% and 0.8% of people surveyed, respectively.

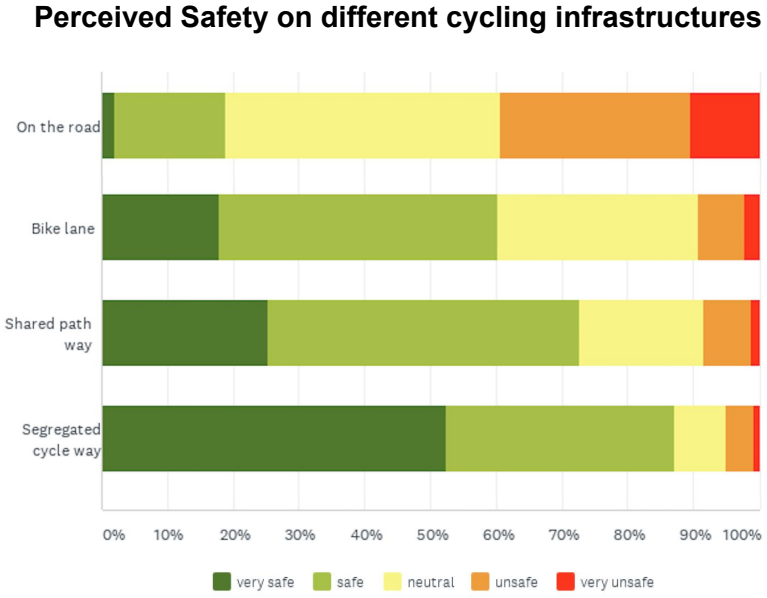

Figure 9: Graph showing how safe people feel cycling on the road, a bike lane, a shared pathway and a segregated cycleway.

It is interesting to note that out of the three infrastructure types which are intended for cycle use, people feel the least safe on bike lanes, however, these are what the most people recorded as being present on their typical cycling routes. Additionally, segregated cycleways which people feel safest on, were seen less. Although these results and past research show that physical separation from motor-dominated roads is safer and preferred, most often it is not the most practicable or feasible in urban areas due to the lack of space and funding.

4.7. Cycling decisions during COVID-19

Due to our survey being run during the time of level 4 and level 3 of the COVID-19 lockdown, a section of the survey investigated how peoples cycling patterns had changed over this period. Responses were sorted into themes depending on the content of the answer, table 2 below shows these themes. Out of respondents, 37.9% identified that they were cycling less during this period and 35.2% commented on the reduction of traffic, some identifying it made them feel safer or made it more enjoyable which can be linked to what affected people's decision to cycle and the reasons people cycle. Some of the responses participants gave can also be found below and show some of the main themes.

Table 2: *Themes for how people's cycling patterns were affected during COVID-19 lockdown.*

Theme	Count	Percentage
Cycle Less	45	19.6
Cycle Less - Commute	42	18.3
Reduced traffic - Safer	34	14.8
Reduced traffic - More enjoyable	26	11.3
Cycle More - Recreational	25	10.9
Reduced Traffic	21	9.1
Cycle More	16	7.0
No Difference	13	5.7
Not Applicable	8	3.5
Total	230	100

"No need to cycle commute anymore so doing more local cycling in the hills for pleasure"

"I enjoyed cycling more than usual as there was much less traffic so I felt a lot safer and less on edge. It also gave me more time to cycle which was nice."

"I went exploring by bike, normally I just ride to work or go shopping. It was very enjoyable and I will do it more often."

"Less traffic and car pollution made it such a more enjoyable experience. I cycled more and felt privileged and grateful for my bike.

4.7.1. Urban design post-lockdown

As seen in the numbers above and from global reports, COVID-19 has radically changed travel habits in a short time. In England, cycle-to-work schemes have seen a 200% increase in the number of bicycle orders, while car use is down by roughly 60% from mid-February (Davies et al., 2020). In March, the use of bike-share systems increased by around 150% in Beijing, China and by 67% in New York, USA (Perry, 2020). Cycling traffic has increased by 151% on trails in Philadelphia, USA and by 94% in Dundee, Scotland (Perry, 2020).

Cities such as London, Paris and Milan are adding more footways, restricting driving on streets and extending and widening cycle lanes (Davies et al., 2020). In Paris, France, 650km of new cycleways have been created, in Milan, Italy, 35km of roads have been converted into walking and cycling routes, in Bogota, Columbia, 120km of streets have been changed to car-free zones and in Brussels, Belgium, the entire city core will become a priority zone for cyclists and pedestrians for the foreseeable future (Laker, 2020; O'Sullivan, 2020; Perry, 2020; Davies et al., 2020).

In both London and Milan, the average commute is less than 5km, this makes the potential for active transport high for a large number of people (Laker, 2020; Davies et al., 2020). As well as decreasing pollution and making cities healthier to live in, active transport creates stronger social bonds (Davies et al., 2020). As Janette Sadik-Khan, former transportation commissioner for New York City and principal with Bloomberg Associates stated, "cities that seize this moment to make it easier for people to walk, bike and take public transport will prosper after this pandemic and not simply recover from it" (Perry, 2020). Cultural changes take a long time to take root and lasting changes need to be carefully planned with contribution from the public, but we are currently in a unique situation which may allow us to make large changes to reset our cities while looking towards the future if we choose to act.

In New Zealand, the NZTA has provided funding to help councils expand footpaths and install temporary cycleways to help maintain physical distancing under COVID-19 conditions (Genter, 2020). Councils can put forward projects and apply for funding under this initiative to create temporary changes to streetscapes. It may also help to look at what other cities around the world are doing in terms of more permanent measures and implement some of these.

5. Limitations

This research was limited in a few key areas. Firstly, without the premium SurveyMonkey software subscription, our questions were limited to 10, which limited our survey depth and focus. Had we known that SurveyMonkey would charge us for downloading data, we could have paid for the subscription at the beginning and included more questions such as how people feel about the infrastructures that are present and whether people would be more encouraged to cycle if there was more present. We also could have asked for respondents' ethnicity as another key demographic to aid in understanding social infrastructure from diverse perspectives.

Due to COVID-19 restrictions, we were limited in interactions with schools and students as this was a busy and stressful time and people were not on site. This limited our ability to gain insight into school cycle patterns as well as any cycling education programs used by students. Had students answered questions during this time, there would have also been a bias towards students who had access to computers and parents may have influenced answers due to not being in a controlled environment.

Survey postcode results suggested the potential that respondents were spread broadly and not limited to Christchurch City which could affect the context of our research.

Group members were not in Christchurch so no observation data could be collected. This also meant that it was more difficult to communicate with each other as well as community members, this may have led to bias in results due to survey advertising as not all demographics spend the same amount of time online, in the same places.

6. Recommendations

This research contributes to current literature gaps as the first step to developing cycling transport as a resilient and sustainable transport network in Ōtautahi Christchurch. After reflection upon the research process, there are several recommendations to make for future research into cycling infrastructure.

Future research could look into implementing more infrastructure where people feel safer and how cycling could be made more accessible and enticing as a future-focused, sustainable and resilient transport mode. The application of school cycling education programmes, how they are used and what benefits they offer to encourage cycling should also be investigated, and the marketing of different education programmes and cycling tools could also be explored to highlight groups of people that are not receiving information as well as programmes and tools not advertised effectively.

7. Conclusion

This report aimed to analyse the social and physical infrastructures encouraging people to cycle in Christchurch. An online survey based on literature was used to obtain primary data on perceptions of social and physical infrastructure.

People are encouraged to cycle because it is a good form of exercise, recreation, and transport that also addresses environmental concerns, among others motives. Cycling education can increase participation, though very few respondents had participated in these programmes. The decision to cycle is based on weather conditions, the amount of traffic and perceived safety. Cyclists feel safer as the separation from motor-dominated traffic increases, this is seen as participants felt the least safe on the road, and most safe on segregated cycle paths. It was also seen that under the calmer traffic conditions during the COVID-19 lockdown, people felt safer and found cycling more enjoyable. Therefore social influences, traffic, safe road conditions and the presence of cycle infrastructure were all major contributions to decisions and motivations to cycle.

These findings are supported by literature that suggests that health, fitness, environment, recreation and social culture are key social motivators as well as the overall importance of physical infrastructure such as road conditions and separation from traffic to encourage cycling. Areas for future research include how cycling infrastructure could be made more resilient, sustainable and safety conscious in response to what motivates and encourages cycling, school cycling education programmes and effective cycling and education marketing.

8. Acknowledgements

We would like to acknowledge and thank Rita Dionisio and Eric Pawson for their clear communication, teaching and guidance with this project. We could not have completed this project without your continuous help, especially your combined knowledge of adaptive urbanism and cycling infrastructure. Finally, we would like to thank the participants in our survey. Without the insight gained from your opinions and experience, we would not have been able to complete this research.

9. References

Aldred, R. (2010). "On the outside": Constructing cycling citizenship. *Social and Cultural Geography*, *11*(1), 36-52

Aldred, R., & Jungnickel, K. (2014). Why culture matters for transport policy: the case of cycling in the UK. *Journal of Transport Geography 34, 78-87.*

Aldred, R., Elliott, B., Woodcock, J., & Goodman, A. (2017). Cycling provision separated from motor traffic: a systematic review exploring whether stated preferences vary by gender and age. *Transport Reviews 37*(1), 29-55.

Cycling Safety Panel. (2014). *Safer journeys for people who cycle: Cycling safety panel final report and recommendations*. Retrieved from https://www.saferjourneys.govt.nz/assets/Safer-journeys-files/Cycling-safety-panel-final-report.pdf

Daley, M., & Rissel, C. (2011). Perspectives and images of cycling as a barrier or facilitator of cycling. *Transport Policy 18*(1), 211-216.

Davies, N., Cornes, C., & Sherriff, G. (2020, May 10). *How major cities are trying to keep people walking and cycling.* The Conversation. Retrieved from https://theconversation.com/how-major-cities-are-trying-to-keep-people-walking-and-cycling-137909

European Conference of the Ministers of Transport. (2004). *National Policies to Promote Cycling*. Organisation for Economic Cooperation and Development. Retrieved from https://www.itf-oecd.org/sites/default/files/docs/04cycling.pdf

Fitt, H. (2015). *The Influences of Social Meanings on Everyday Transport Practices* [Doctorate thesis, University of Canterbury]. UC Research Repository. https://ir.canterbury.ac.nz/handle/10092/11846

Frater, J. (2015). *Influences on cycling to school among teenagers: An investigation using the theory of planned behaviour and the prototype willingness model in Christchurch, New Zealand* [Doctorate thesis, University of Canterbury]. UC Research Repository. https://ir.canterbury.ac.nz/handle/10092/11959

Frater, J., & Kingham, S. (2018). Gender equity in health and the influence of intrapersonal factors on adolescent girls' decisions to bicycle to school. *Journal of Transport Geography 71*, 130-138.

Frater, J., Kuijer, R., & Kingham, S. (2017). Why adolescents don't bicycle to school:Does the prototype/willingness model augment the theory of planned behaviour to explain

intentions? *Transportation Research Part F: Traffic Psychology and Behaviour 46,* 250-259.

Genter, J. A. (2020). *Govt to fund temporary cycleways and footpaths post COVID-19 lockdown.* Wellington, New Zealand: Beehive. Retrieved from https://www.beehive.govt.nz/release/govt-fund-temporary-cycleways-and-footpaths-post-covid-19-lockdown

Goodman, A., van Slujis, E. M. F., & Ogilvie, D. (2016). Impact of offering cycle training in schools upon cycling behaviour: a natural experimental study. *International Journal of Behavioural Nutrition and Physical Activity*, *13*(34), 1-12. https://doi.org/10.1186/s12966-016-0356-z

Gossling, S. (2013). Urban transport transitions: Copenhagen, City of Cyclists. *Journal of Transport Geography 33,* 196-206.

Hodgson, C & Worth, J. (2015). *Research into the impact of Bikeability on children's ability to perceive and appropriately respond to hazards when cycling on the road.* Retrieved from *https://files.eric.ed.gov/fulltext/ED558729.pdf*

International Transport Forum. (2013). *Cycling, Health and Safety*. OECD Publishing. https://doi.org/10.1787/9789282105955-en.

Johnson, M., Charlton, J., Oxley, J., & Newstead, S. (2010). Naturalistic cycling study: identifying risk factors for on-road commuter cyclists. *Annals of Advances in Automotive Medicine/Annual Scientific Conference, 54,* 275-283. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3242541/pdf/file31-final.pdf/?tool=EBI

Johnson, R., & Margolis, S. (2013). A review of the effectiveness of adult cycle training in Tower Hamlets, London. *Transport Policy, 30,* 254-261. https://doi.org/10/1016/j.tranpol.2013.09.005

Kingham, S., Taylor, K., & Koorey, G. (2011). Assessment of the type of cycling infrastructure required to attract new cyclists (NZ Transport Agency research report: 449). Retrieved from http://www.nzta.govt.nz/assets/resources/research/reports/449/docs/449.pdf

Laker, L. (2020, April 21). Milan announces ambitious scheme to reduce car use after lockdown. The Guardian. Retrieved from https://www.theguardian.com/world/2020/apr/21/milan-seeks-to-prevent-post-crisis-return-of-traffic-pollution

Lusk, A. C., Furth, P. G., Morency, P., Miranda-Moreno, L. F., Willett, W. C., & Dennerlein, J. T. (2011). Risk of injury for bicycling on cycle tracks versus in the street. *Injury prevention*, *17*(2), 131-135.

Mandic, S., Jackson, A., Lieswyn, J., Mindell, J., Bengoechea, E. G., Spence, J. C., & Hinckson, E. (2019). Key Policy Recommendations for Active Transport in New Zealand. Retrieved from: https://www.otago.ac.nz/active-living/otago710121.pdf

McLaughlin, K. A., & Glang, A. (2010). The Effectiveness of a Bicycle Safety Program for Improving Safety-Related Knowledge and Behaviour in Young Elementary Students. *Journal of Pediatric Psychology, 35*(4), 343–353. https://doi.org/10.1093/jpepsy/jsp076

Molina-García, J., Queralt, A., García Bengoechea, E., Moore, A., & Mandic, S. (2018). Would new zealand adolescents cycle to school more if allowed to cycle without a helmet? *Journal of Transport & Health 11*, 64-72.

New Zealand Transport Agency. (2015). *Good practice in road safety education. Research summary: effective community and school-based road safety for young people*. Retrieved from https://education.nzta.govt.nz/assets/Education-portal/Guidelines-and-research/Fact-sheets/Research-summary-effective-community-and-school-based-road-safety.pdf

New Zealand Transport Agency. (2017). *Making adult cycle skills training more appealing*. Retrieved from https://www.nzta.govt.nz/assets/Walking-Cycling-and-Public-Transport/docs/NZTA-x-Empathy-full-report-Adult-cycle-skills-training-research.pdf

O'Sullivan, F. (2020, April 22). Europe's Cities are Making Less Room for Cars After Coronavirus. Citylab. Retrieved from https://www.citylab.com/transportation/2020/04/coronavirus-reopen-cities-public-transit-car-free-bike-milan/610360/

Perry, F. (2020, April 30). *How cities are clamping down on cars.* Future Planet. Retrieved from https://www.bbc.com/future/article/20200429-are-we-witnessing-the-death-of-the-car

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, 50, 106-125.

Pucher, J., & Buehler, R. (2008). Cycling for everyone: Lessons from Europe. *Transportation Research Record: Journal of the Transportation Research Board, 2074*(1), 58-65. doi:10.3141/2074-08

Teschke, K., Harris, M. A., Reynolds, C. C., Winters, M., Babul, S., Chipman, M., ... & Monro, M. (2012). Route infrastructure and the risk of injuries to bicyclists: a case-crossover study. *American journal of public health,* 102(12), 2336-2343.

The Treasury. (2013). The Treasury's Living Standards Framework: Living Standards: A Short Guide to 'Social Infrastructure'. The Treasury.

Tin, S. T., Woodward, A., & Ameratunga, S. (2010). Injuries to pedal cyclists on New Zealand roads, 1988-2007. *BMC public health*, 10(1), 655.

Turner, S., Singh, R., Allatt, T., & Nates, G. (2011). *Effectiveness and selection of treatments for cyclists at signalised intersections* (No. AP-R380/11).

10. Appendix

Survey Monkey Questions

Q1.Bicycle ownership

I own a...
Traditional bike, E-Bike, Modified/Specialty Bike, Not Applicable
I share a...
Traditional bike, E-Bike, Modified/Specialty Bike, Not Applicable

Q2.On average how frequently do you typically bike?

Daily

Up to twice a week

More than twice a week

Up to twice a month

More than twice a month

Seasonally - more than once every three months

Almost never

Never

Q3. Reasons for cycling (Select one or multiple)

Transport to work or education facilities
Recreation
To socialise with friends
Exercise
It's cheaper/saves money
It's fun, I enjoy cycling
Avoids parking hassles
Allows me to enjoy the weather
It addresses environmental concerns
It provides me with some ,alone time
Ability to integrate with public transport
Other (please specify)

Q4. What is present on your cycling route? (Select one or multiple)

Bike lane
Shared pathway
Segregated cycleway
E-bike charging stations
Bicycle specific traffic lights
Shops
Social amenities (parks and trees)
None of the above
Other (please specify)

Q5. Have you used any of the following cycling tools? (Select one or multiple)

- Christchurch City Cycle Map
- Confident Cycling resources
- Bike Ready programme
- Cycle Safe programme
- Bike On programme
- Recycle a Dunger (RAD) Bikes
- Bike racks on Buses
- Bicycle parking at the bus interchange
- None of the above
- Other (please specify)

Q6. Rank how safe you feel on each of the below

- Bike lane
  - Very Safe, Safe, Neutral, Unsafe, Very Unsafe
- Shared pathway
  - Very Safe, Safe, Neutral, Unsafe, Very Unsafe
- Segregated cycleway
  - Very Safe, Safe, Neutral, Unsafe, Very Unsafe
- On the road
  - Very Safe, Safe, Neutral, Unsafe, Very Unsafe

Q7. Which of the below affects your decision to cycle? (Select one or multiple)

- Weather conditions
- Amount of traffic
- The physical condition of the road
- It is inconvenient to carry my belongings
- Presence of cycle lanes
- The distance I would have to cycle is too far
- Being provided with bicycle parking
- I don't feel safe cycling in the dark
- Access to showering facilities
- Workplace or educational facility incentives
- Access to shared bicycle
- None of the above

Q8. How did the COVID-19 lockdown affect your cycling patterns? (Multiple answers may include: more time to cycle, less traffic made me feel safer/more confident, etc.)

- Open-ended

Q9.Demographic questions: What is your age?

- 18-20
- 21-25
- 26-35
- 36-50
- 51-64
- 65-75
- 76+
- I would prefer not to say

Q10. Demographic questions: What is your gender?

- Female
- Male
- Gender Diverse/ Non-Binary
- I would prefer not to say

Demographic questions: What is your Postcode

- Open-ended