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# Understanding factors influencing choices of cyclists and potential cyclists: A case study at the University of Auckland

**Judith Y. T. Wang[1,2*], Leila Mirza[3], Alan K. L. Cheung[4], Siamak Moradi[1]**

[1] Department Engineering Science, The University of Auckland

[2] School of Civil Engineering & Institute for Transport Studies, University of Leeds

[3] School of Architecture and Planning, The University of Auckland

[4] School of Environment, The University of Auckland

## Abstract

Like many other cities in the world, Auckland has been very much a car-based city for decades with a car modal share of almost 80%. Promoting the use of active modes, including walking and cycling, is no doubt one of the key strategies that should be considered. To help transform Auckland into a bicycle-friendly city, our first step is to determine the motivators of and deterrents to cycling. This study has two components. We first performed a comprehensive literature review of the lessons from international experience, focussing on what factors were found to have significant influence on the decision to use bicycles as a mode of transport. Based on the findings, we designed a web-based survey to identify the factors influencing the decision to commute by bicycle or not, as well as cyclists' and potential cyclists' route choice criteria. A pilot survey was conducted at the University of Auckland as a case study. The survey results are consistent with our findings from the literature review. We conclude that there are five main factors missing in Auckland: (1) safety; (2) a well-connected network of cycleways; (3) convenience; (4) policies to discourage car use; and (5) a good public transportation system integrated with cycling facilities.

[*] Corresponding author: Dr Judith Y. T. Wang, School of Civil Engineering & Institute for Transport Studies, University of Leeds, Woodhouse Lane, Leeds LS2 9JT, UK, Tel.: +44 113 343 3259; Fax: +44 113 343 3265; Email: j.y.t.wang@leeds.ac.uk.

# 1 Introduction

Like many other cities in the world, Auckland has been very much a car-based city for decades. Tin Tin *et al.* (2009a) analysed the New Zealand (NZ) Journey-to-Work Statistics over a 15-year period (1991-2006) and concluded that increased car use from 1991 to 2006 occurred at the expense of active means of travel, including walking and cycling, as the trends in public transport use remained unchanged during that period. Auckland's transport system currently accommodates 4.2 million passenger trips each day, with modal shares of 80% private transport (mainly car), 16% active modes (mainly walking) and 4% public transport (mainly bus) (Auckland Council, 2011). This shows that Auckland's transport system is not sustainable at all as it is heavily reliant on fossil fuels. As summarised in May & Crass (2007), a sustainable transport system should:

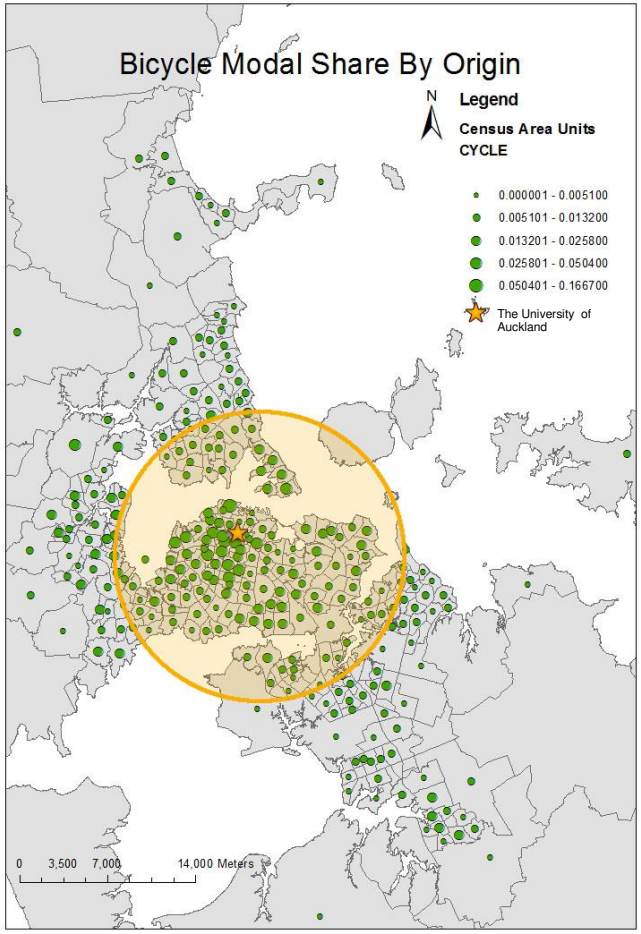
- Promote health (social sustainability);
- Increase equity within and between generations (social sustainability);
- Be affordable and efficient (economic sustainability);
- Use resources within renewal or replacement rates (economic and environmental sustainability); and
- Minimise the use of land (economic and environmental sustainability).

Applying this philosophy to transport planning, cycling is no doubt one of the most sustainable modes among all the transport modes, while the use of cars is definitely not sustainable. Cycling promotes health, does not require non-renewal resources like fossil fuels, does not produce vehicle emissions, poses less risk to other road users, and occupies much less space than cars.

Based on Census statistics of journeys to work in NZ, the modal share of bicycles is only 2.3% nationwide while in Auckland it is 0.9%, whereas the modal share of car trips is 74.8% nationwide and 78.8% in Auckland (Statistics NZ, 2006). Spatial analysis of the Census 2006 journey-to-work statistics of Auckland is performed to identify the current demand patterns of cycling trips are as illustrated in Figure 1. It is observed that bicycle commuting trips are concentrated around the central area, as highlighted by the circled areas in Figure 1.

Lindsay *et al*. (2010) estimated that a 5% of modal shift of short trips by motor vehicles nationwide is consistent with the goal of 30% modal share of urban trips by walking and cycling in the New Zealand Transport Strategy (MoT, 2008). However, based on the data collected from a marketing survey conducted by Sport and Recreation NZ (SPARC) and the Cancer Society of NZ to segment adults in terms of physical activity and healthy eating habits, Sullivan & O'Fallon (2006) found that the percentage in the 'precontemplation' stage, i.e. those who do not even consider using a bicycle, was as high as 45% for Auckland. For school children, Mackie (2009) found that the most significant barriers to students cycling to school for six intermediate schools were: the route to school, the amount and speed of traffic, crossing busy roads, and personal and bike security. As a result, the need for safe routes to school was a very clear priority for students and parents.

Promoting the use of active modes, including walking and cycling, is no doubt one of the key strategies to improve sustainability in transport (Auckland Council, 2011). In this study, our objective is to determine what might have been the deterrents to cycling in Auckland and what motivators might be effective to promote cycling.



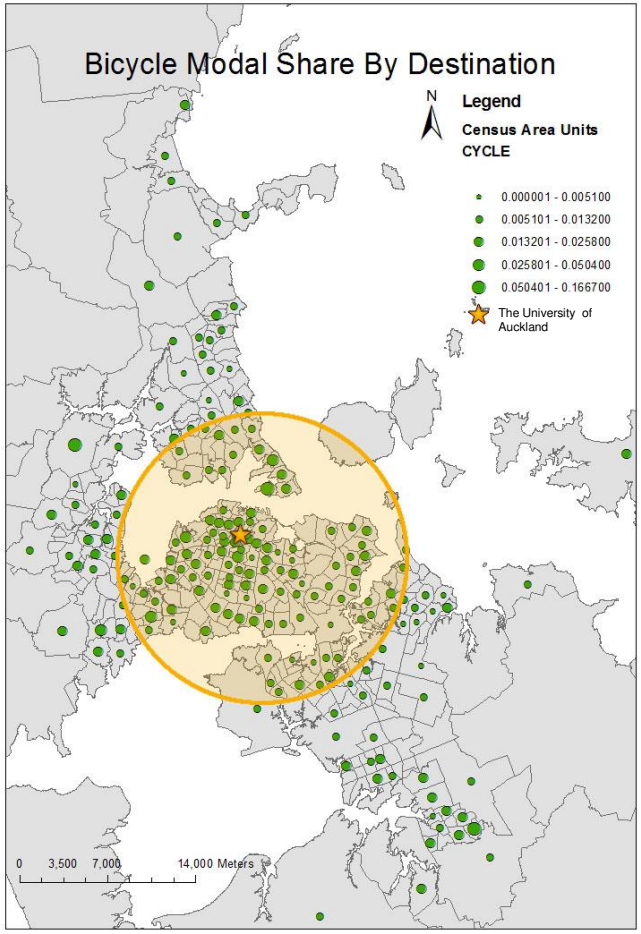




**Figure 1 (a) & (b) Spatial pattern cycle trip modal share in Auckland by origin & destination (derived based on census data 2006 provided by Statistics NZ)**

**Table 1 Summary of a literature review on motivators of and deterrents to cycling**

| | | | Motivators | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Deterrents | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Safety | | | | | | | | Cycleways | | | | | | | | | Discourage Car use | | | | | | | Convenience | | | | | | PT | | Convenience | | | | | | Discourge Car Use | Cycleways | Safety | | | | | |
| | Reference | Case Study | Safety Education | Low Traffic Volume | Presence of Safety Cameras | Low Traffic Speed | Better Lighting | Higher Population Density | Good Land-use Mix | Shorter Commuting Distances | Beautiful Scenery | Continuous Bike Facilities | Infrastructure | Smooth Surface Quality | Traffic Calming for Cyclists | Direct Route (Shorter Distances) | Flat to Moderate Hills | Off-street Path | Segregated Bike Paths and Routes | Presence of Safety Cameras | Increase Fuel Cost | Limited Auto Parking | Speed Limit in Residential Area (30 km/h) | Car Free Zones | Give Cyclist Priority (Cycling Right-of-way) | Low Traffic Speed | Secure Parking at Work | Availability of Rental Bikes | Detailed Hardcopy Maps | Presence of Shower and Locker at Workplace | Providing Internet Route | Promotional programs and Financial incentives | Linking Bicycles with Public Transport | Parking Facilities at Stations | Type of Destination | Time of Departure | Dress Code | Longer Travel Time | Employment Status (i.e. part/full-time, etc.) | Adverse Weather Condition | Pollution & Noise | Gradient | Dangerous Traffic Condition | Lack of Daylight | Percentage of Heavy Traffic | Street with Auto Parking | Number of Difficult Intersections | Inconsiderate Drivers |
| 1 | Betz *et al*., 1993 | USA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | | * | | | | | | | | | | | | | | | |
| 2 | Antonakos, 1994 | Michigan | * | * | | * | | | | | | | | * | | | | | * | | | | | | | * | | | | | | | | | * | * | * | | | | | | | | | | | |
| 3 | Hopkinson & Wardman, 1996 | Britain | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | | | | | | | | | | |
| 4 | Stinson & Bhat, 2003 | USA | | * | | | | | | | | * | | * | | | * | | * | | | | | | | | | | | | | | | | | | | * | | | | | | | * | * | * | |
| 5 | Dill & Carr, 2003 | USA | | | | | | | | | | | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Stinson & Bhat, 2004 | USA | * | | | | | | * | * | | | * | | | | * | | | | | * | | | | | * | | | * | | | | | | | | * | | * | | | * | * | | | | |
| 7 | Hunt & Abraham, 2007 | Canada | | | | | | * | * | | | * | | | * | | * | | | | | | | | | | | | | | | | | | | | | | | | | * | | | | | | |
| 8 | Gatersleben & Appleton, 2007 | UK | * | | | | | | | | | | * | | | | * | | * | | | | | | | | | | | | | | | | | | | | | * | | * | | | * | | | |
| 9 | Tilahun *et al*., 2007 | USA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Martens, 2007 | The Netherlands | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | | | | | | | | | | | | | | |
| 11 | Dill & Voros, 2007 | USA | | * | | * | | | * | | | * | * | * | | * | | | * | | | | | | | * | * | | | * | | | * | | * | | | | * | * | | * | | | | | | |
| 12 | Wardman *et al*., 2007 | UK | | | | | | | | | | | | | | | | | | | | | | | | | * | | | * | | * | | | | | | | | | | | | | | | | |
| 13 | Parkin *et al*., 2008 | UK census | | * | | | | | | | | | | | | | | | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | Pucher & Buehler, 2008a | USA | * | | | | | | | | | | | | | | | | * | | | | | * | | | * | | * | | * | * | * | | | | | | | | | | | | | | | |
| 15 | Pucher & Buehler, 2008b | Review (Denmark, Netherland, Germany) | * | | | | | | * | | | | | | | | | | * | | | | * | * | * | | * | * | * | | * | * | * | | | | | | | | | | * | | | | | |
| 16 | Akar & Clifton, 2009 | USA | * | | * | | * | | * | * | | * | | * | * | * | | | * | * | * | | | | | | | | * | | | | | | | | | | | | | | * | | | | | |
| 17 | Koorey *et al.*, 2009 | Christchurch | | | | | | | | | | | | | | | | | | | | | | | | | * | | | * | | | | | | | | | | | | | | | | | | |
| 18 | Winters & Teschke, 2010 | Vancouver (Canada) | | | | | | | | | | | | | | | | | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 | Winters *et al.*, 2011 | Vancouver (Canada) | | * | | | * | | | | * | | | | | | * | * | * | | | | | | * | | | | | | | | | | | | | | | * | * | | | | | | | |

There are two key components in this study. We first conducted a comprehensive literature review of the lessons from international experience from successful countries such as the Netherlands, Denmark and Germany, and unsuccessful countries such as UK and USA, focussing on what factors were found to have significant influence on the decision to use bicycles as a mode of transport.

Based on the findings from the literature review, we designed a web-based survey to fulfil two objectives: (1) to understand why the current bicycle modal share is so low, what the motivators that can attract potential cyclists are and, in particular, how their decisions to cycle or not are influenced by the built environment; and (2) to understand what factors are influencing the route choice of current and potential cyclists.

A survey was conducted via the University of Auckland intranet during the period 7th April to 6th May 2011. There were over 140 participants in total, including staff and students of the university. An incentive was given as an opportunity to win a NZ$50-coupon for the University Bookshop in a lucky draw. The location of the University of Auckland is right in the city centre of Auckland, as shown in Figure 1.

In this paper, we will first present the key findings from our literature review in Section 2, followed by the survey results in Section 3. A comparison of results from the literature review with other studies in New Zealand and the survey is then presented in Section 4. Finally, conclusions are drawn in Section 5.

# 2 Literature Review on International Experience

The factors with most significant effect on the decision to use bicycles as a mode of transport can be classified into five categories: (1) safety; (2) a well-connected network of cycleways; (3) convenience; (4) policies to discourage car use; and (5) a good public transportation system integrated with cycling facilities. An earlier version of the literature review is presented in Mirza & Wang (2011). A summary of the papers reviewed is depicted in Table 1. The key findings are summarised as follows.

## 2.1 Safety

Safety has been consistently identified in a large body of literature as the most influential factor on commuters' decision to cycle (Akar & Clifton, 2009; Dill & Carr, 2003; Dill & Voros, 2007; Gatersleben & Appleton, 2007; Hunt & Abraham, 2007; Koorey *et al.*, 2009; Parkin *et al.*, 2008; Pucher & Buehler, 2008a, 2008b; Stinson & Bhat, 2003, 2004; Winters & Teschke, 2010; Winters *et al.*, 2010). Some important factors considered as deterrents include: dangerous traffic condition (such as presence of numerous major crossing intersections, high traffic volume, etc.), presence of on-street parking and poor lighting at night (Antonakos, 1994; Dill & Voros, 2007; Hunt & Abraham, 2007; Parkin *et al.*, 2008; Stinson & Bhat, 2003, 2004; Winters *et al.*, 2010).

It is also recognised that safety education is important not only to cyclists but also to motorists (Antonakos, 1994). This is because the requirements as regards to safety might vary among individuals due to their differences in their perception about safety as well as the level of importance of safety to them. For instance, senior citizens and women are often more conscious about safety on the road and thus courtesy of motorists are important to them. Comprehensive safety education for cyclists of all age groups and training motorists to understand how to interact with cyclists sharing the road space is vitally important to promote safety in cycling (Akar & Clifton, 2009;

Antonakos, 1994; Gatersleben & Appleton, 2007; Pucher & Buehler, 2008a, 2008b; Stinson & Bhat, 2004).

Cycling-favoured traffic laws, such as putting all the responsibility of the crashes on motorists (except deliberate ones) and implementing the cyclist's right of way by police and courts, can also help improve safety for cyclists (Pucher & Buehler, 2008b). It is interest to note that, in unsuccessful countries such as USA, legislating safety helmets for cycling not only put all the responsibilities on cyclists' shoulders but also make cycling inconvenient. Moreover, the helmets might bring a false sense of safety for cyclists and increase the possibility of dangerous riding behaviour; simultaneously, motorists might reduce their consideration by assuming that helmets make cyclists less vulnerable (Pucher & Buehler, 2008a). This is supported by the accident statistics of 37.5 injuries per 10 million cycled-km in USA (where wearing helmet is mandatory) compared to 1.4 in the Netherlands (where wearing a helmet is not mandatory) (Parkin *et al.*, 2008).

### 2.2 A well-connected network of cycleways

Presence of well-connected cycleways, which can enhance the safety of the cyclist en route, is recognised as one of the most important motivators (Akar & Clifton, 2009; Dill & Voros, 2007). In terms of route choice, the most common features of a route which makes it desirable to cycle are: most direct, segregated bicycle lane with smooth surface quality, continuity of the route and en-route facilities (Dill & Carr, 2003; Dill & Voros, 2007; Hunt & Abraham, 2007; Stinson & Bhat, 2003; Wardman *et al.*, 2007). Different groups might have different preferences. For example, hilly routes are preferred by experienced cyclists for the purpose of exercising (Antonakos, 1994; Stinson & Bhat, 2003), increasing the pleasure of cycling (Antonakos, 1994) and offering more scenic views (Stinson & Bhat, 2003). The scenery is not an important issue for bike commuters; however, beautiful view along the route accompanied by flexible working time can encourage more people to cycle to work (Antonakos, 1994; Winters *et al.*, 2010). For fulfilling the needs of different types of cyclist, the best approach would be a mix of facilities (Antonakos, 1994).

### 2.3 Convenience

Flexible working hours, provision of secure parking, locker and shower facilities can all be effective incentives, and previous studies identified that secure and sufficient parking is more important and should be given a higher priority (Dill & Carr, 2003; Dill & Voros, 2007; Koorey *et al.*, 2009; Pucher & Buehler, 2008a, 2008b; Stinson & Bhat, 2004; Wardman *et al.*, 2007). Wardman *et al.* (2007) found that daily financial incentive is the most effective approach to attract commuters to cycle in the UK. Another successful approach in the Netherlands, Denmark and Germany is the provision of free bicycles for use during the day for short business trips (Pucher & Buehler, 2008a).

### 2.4 Policies to discourage car use

Discouraging car use creates an environment in favour of cycling and is therefore considered as one of the most important motivators. First of all, less private cars en route makes cycling safer and consequently encourage more people to cycle. Reducing speed limits also makes the environment more cycle-friendly.

Dill & Voros (2007) found that the number of cars in a household is negatively correlated with the decision to cycle. Accordingly one approach is to make owning a

car more expensive. Dutch, Danish and German cities impose high tax on car purchase, ownership and use in different ways (Pucher & Buehler, 2008a, 2008b; Stinson & Bhat, 2004).

Parking management policies such as high parking rates, limiting the number of car parks in the city centre (Stinson & Bhat, 2004), and changing car parking facilities to bicycle parking (Pucher & Buehler, 2008b), have been found to be effective policies to discourage car use. Other policies that other countries have successfully adopted are car-free zones, police cameras at intersections, advance stopline favouring cyclists, and turn restrictions just for cars (Pucher & Buehler, 2008b).

### 2.5 A good public transportation system integrated with cycling facilities

The combined use of bicycle and public transport has been considered by countries with successful cycling outcomes as a necessary step to make cycling irresistible (Pucher & Buehler, 2008b). It is pertinent to mention that bike racks to facilitate bike-and-ride is the only pro-cyclist policy that USA transportation manages to implement better than in the Netherlands. Nevertheless, data on the number of cyclists in the USA has revealed that this policy alone is not sufficient to increase bicycle ridership. Some other successful policies to promote bike-and-ride include: secure and extensive bike parking facilities in the stations, bike racks on public transport, and quick and cheap rental bikes at station (Pucher & Buehler, 2008b).

## 3 Survey results

Respondents are first classified into one of the following four categories, namely, cyclists, infrequent cyclists, potential cyclists and non-cyclists, based on whether they are already commuting by bicycle, whether they own a bicycle and whether they are interested in cycling. Obviously, cyclists are the ones who are already commuting by bicycle. Those who own a bicycle but do not commute by bicycle are considered as infrequent cyclists. Ones that do not own a bicycle but are interested in cycling are considered as potential cyclists, while the rest are non-cyclists. Each group will then be addressed with an appropriate set of questions. The questionnaire is available from the corresponding author upon request.

There is a slightly higher percentage of female respondents (55%). The distribution by type, namely, cyclists, infrequent, potential and non-cyclists, are quite different among the two genders. As highlighted in Table 2, 38% of the male respondents are cyclists while only 18% of the female respondents are cyclists.

**Table 2 Number of repondents by type and gender**

| Type | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| Cyclist | 24 | 38% | 14 | 18% | 38 | 27% |
| Infrequent Cyclist | 25 | 39% | 35 | 45% | 60 | 42% |
| Potential Cyclist | 8 | 13% | 23 | 29% | 31 | 22% |
| Non-Cyclist | 7 | 11% | 6 | 8% | 13 | 9% |
| Total | 64 | 45% | 78 | 55% | 142 | 100% |

It is important to note that there is a much higher proportion of cyclist respondents (27%) as compared to the observation made in analysing the census data (0.9%). We believe that the key reason is that the respondents to the survey are all university staff and students. Cycling is generally a more popular mode of transport

for this community, especially for students, since they often live close to campus and have low income, and cycling does not cost money.

Due to the small sample size per group, we analyse the survey results for two subgroups: cyclists and others (infrequent, potential and non-cyclists), except when we compare the behaviour of male respondents to that of female ones. Note that the survey was designed to find out the motivators of and deterrents to cycling. It is important to separate cyclists from others.

## 3.1 Motivators of current cyclists

As shown in Figure 2, the number one motivator of cycling is to improve health and fitness, followed by care for the environment and cycling for fun.

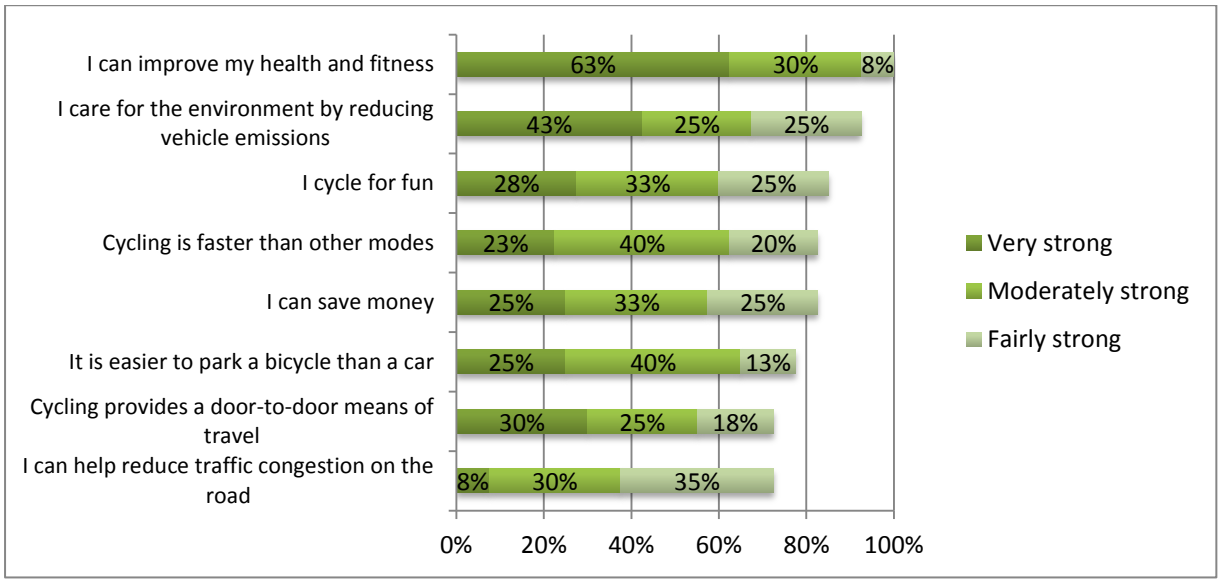



**Figure 2 Motivators of current cyclists**

## 3.2 Deterrents to cycling in Auckland

### *3.2.1 Safety*

**Safety is the number one deterrent to cycling**. As shown in Figure 3, for infrequent, potential and non-cyclists, safety is the number one deterrent to cycling in Auckland. Other strong deterrents include unfavourable weather conditions and the need to carry things.

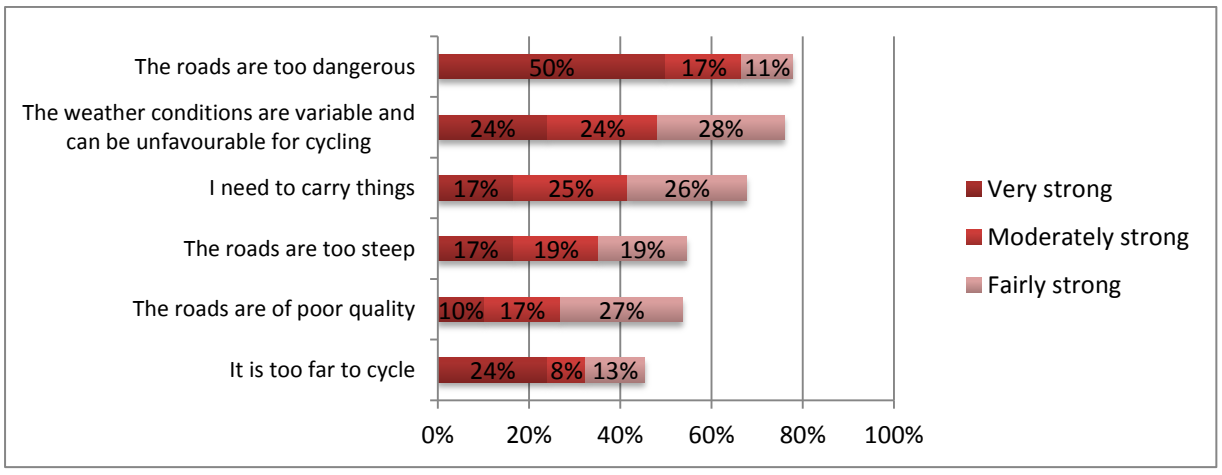



**Figure 3 Deterrents to cycling**

**Women are more conscious about safety.** As shown in Figure 4, 65% of male cyclists are cycling to work even though they are feeling unsafe while only 50% of female cyclists are doing so.

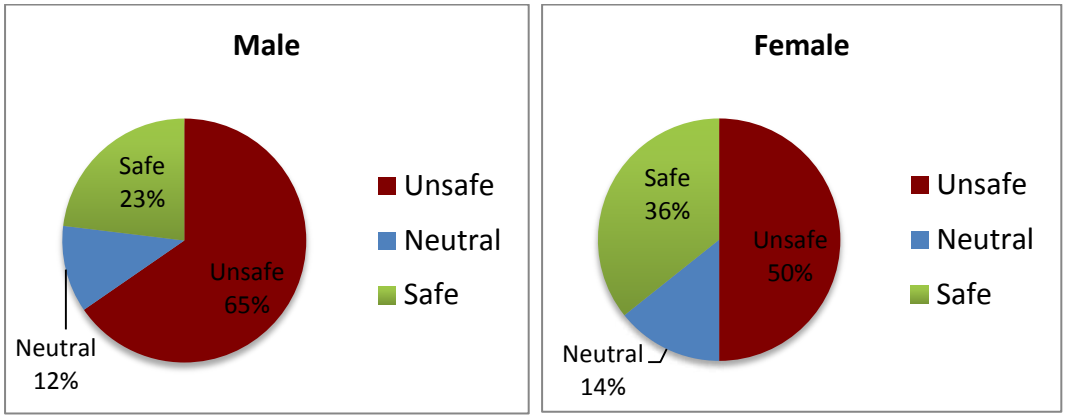



**Figure 4 Cyclists' perception about safety**

**Not wearing a helmet may or may not be a good idea**. Wearing a helmet is currently mandatory in Auckland. As shown in Figure 5, 48% of cyclists and 52% of infrequent, potential and non-cyclists are neutral towards making it not mandatory. Nevertheless, 43% of cyclists do not think that this is a good idea while only 24% of the others have negative feelings about it.

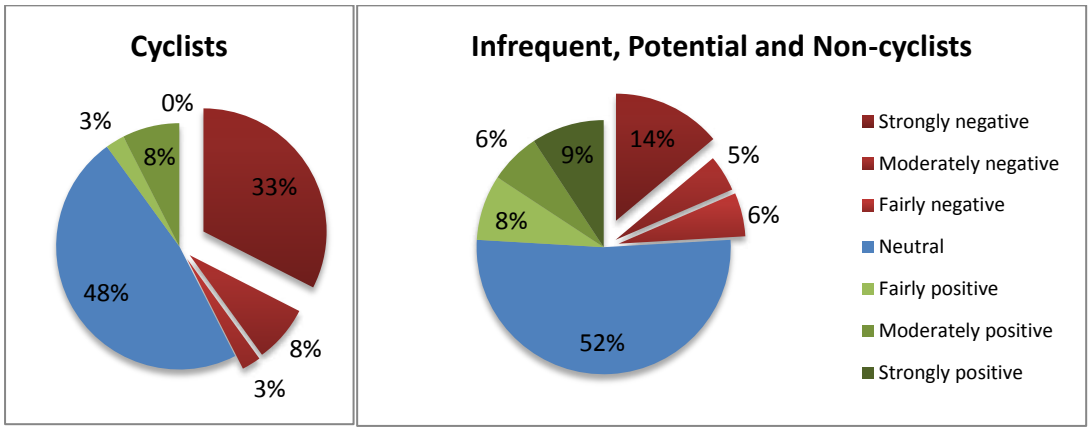



**Figure 5 Influence of making wearing a helmet NOT mandatory**

**Everyone prefers less interactions with traffic and riding in safer conditions.** Although cyclists and the others have different priorities in terms of their wishes, as highlighted in yellow in Table 3, both groups consider that improvement in safety at major junctions, reduction in traffic volume with less car, bus and truck traffic, enough lighting after dark and provision of special bicycle streets are preferred characteristics. Cyclists also consider other aspects that are related to their safety important, including strict enforcement of cyclists' rights, reduction of roadside parking, and motorists assumed by law to be responsible for almost all crashes with cyclists, as highlighted in blue in Table 3.

### *3.2.2 Provision of cycleways*

**Provision of a cycleway separated from traffic for the entire route is the number one motivator**. As shown in Figures 6 and 7, all cyclists and 80% of infrequent, potential, and non-cyclists wish that there is a cycleway separated from traffic for the entire route.

**Table 3 Top Ten Wishes**

| Factor | Cyclists | | Infrequent, Potential and Non-cyclists | |
|---|---|---|---|---|
| | Rank | Percentage | Rank | Percentage |
| There is a cycleway separated from traffic for the entire route | 1 | 100% | 1 | 80% |
| Improvements in safety at major junctions, e.g. advanced stop lines, traffic signal priority for cyclists, etc. | 2 | 98% | 2 | 79% |
| Strict enforcement of cyclist rights by police and courts | 3 | 93% | 13 | 64% |
| Secure indoor/covered bicycle parking at destination | 4 | 93% | 5 | 71% |
| Reduction in traffic volume with less car, bus and truck traffic | 5 | 90% | 4 | 73% |
| The route has enough lighting after dark | 6 | 90% | 10 | 67% |
| Reduction of roadside parking | 7 | 85% | 19 | 59% |
| Cycling takes less time than other modes | 8 | 80% | 20 | 57% |
| Be able to take the bicycle on public transport | 8 | 80% | 9 | 68% |
| Motorists assumed by law to be responsible for almost all crashes with cyclists | 10 | 78% | 17 | 61% |
| Provision of special bicycle streets that limit car speeds and give cyclists priority over the entire width of the road | 10 | 78% | 10 | 67% |
| Good weather conditions | 30 | 33% | 3 | 76% |
| The route is flat | 32 | 23% | 5 | 71% |
| The route is away from traffic noise and air pollution | 28 | 36% | 7 | 69% |
| No need to carry bulky or heavy items | 12 | 75% | 8 | 69% |

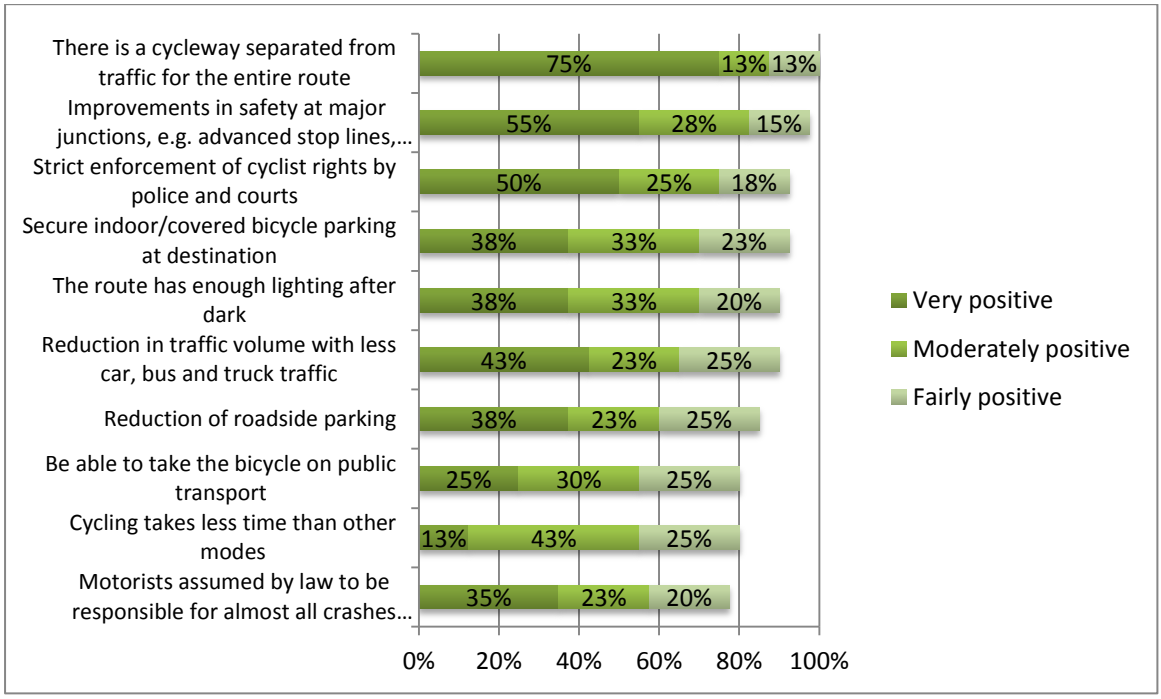



**Figure 6 Top ten wishes of cyclists**

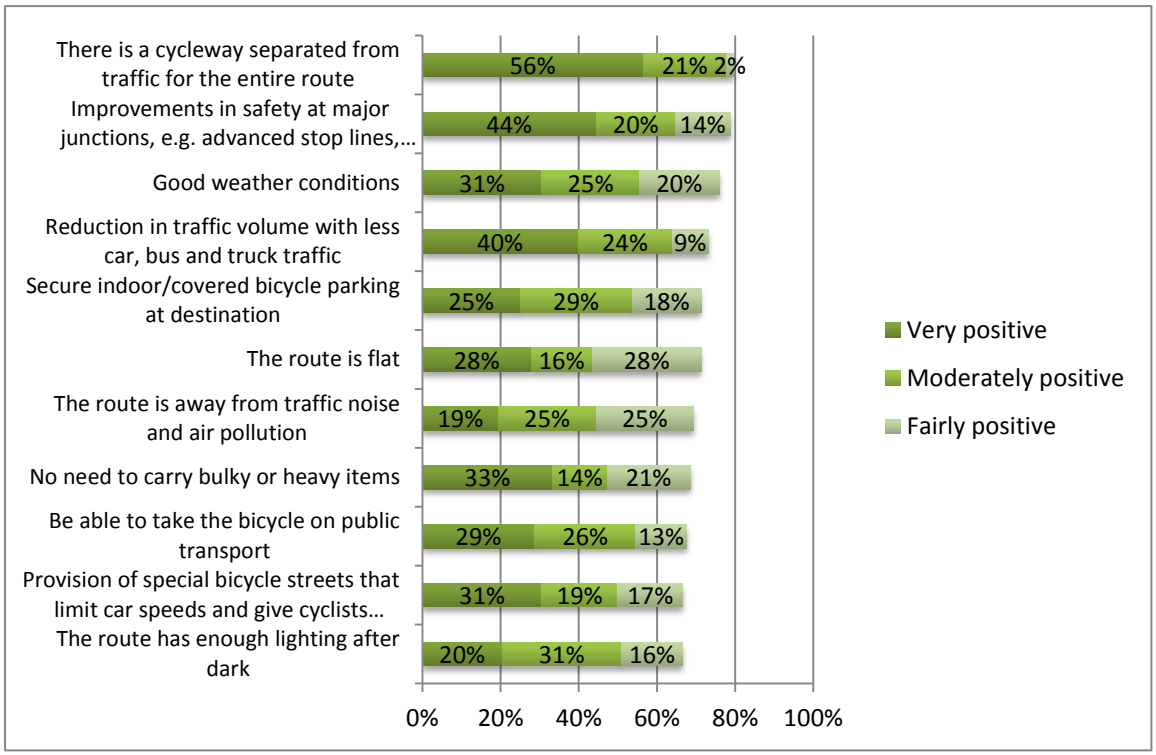



**Figure 7 Top eleven wishes of infrequent, potential, and non-cyclists**

**Good surface quality, adequate width, being separated from traffic and continuity of cycleways are very important to everyone.** As shown in Table 4, although cyclists as compared with the others have different priorities when it comes to preferred route characteristics, both groups have exactly the same set of top ten desired route characteristics. Among the ten, as highlighted in yellow in Table 4, good surface quality, adequate width, being separated from traffic, away from traffic noise and air pollution, and continuity of cycleways are the qualities that both groups are looking for at higher priority. The breakdowns of the percentage of respondents considering these factors to have positive influence are summarised in Figures 8 and 9.

**Table 4 Top ten route characteristics**

| Factor | Cyclists | | Infrequent, Potential and Non-cyclists | |
|---|---|---|---|---|
| | Rank | Positive Influence | Rank | Positive Influence |
| The route surface is of good quality | 1 | 95% | 5 | 72% |
| There is a cycleway separated from traffic for the entire route | 2 | 93% | 1 | 80% |
| The width of the cycleway is adequate | 3 | 88% | 2 | 79% |
| Less car, bus and truck traffic en route | 4 | 85% | 6 | 71% |
| The route is sufficiently direct | 4 | 85% | 8 | 66% |
| The route has speed limit of 50km/hr | 6 | 78% | 10 | 56% |
| The gradient is reasonable | 6 | 78% | 7 | 67% |
| The route is away from traffic noise and air pollution | 6 | 78% | 9 | 61% |
| The cycleway is continuous across minor road intersections | 9 | 73% | 3 | 74% |

| | | | | |
|---|---|---|---|---|
| Advanced stoplines/traffic signal priority for cyclists at major junctions | 10 | 73% | 4 | 73% |

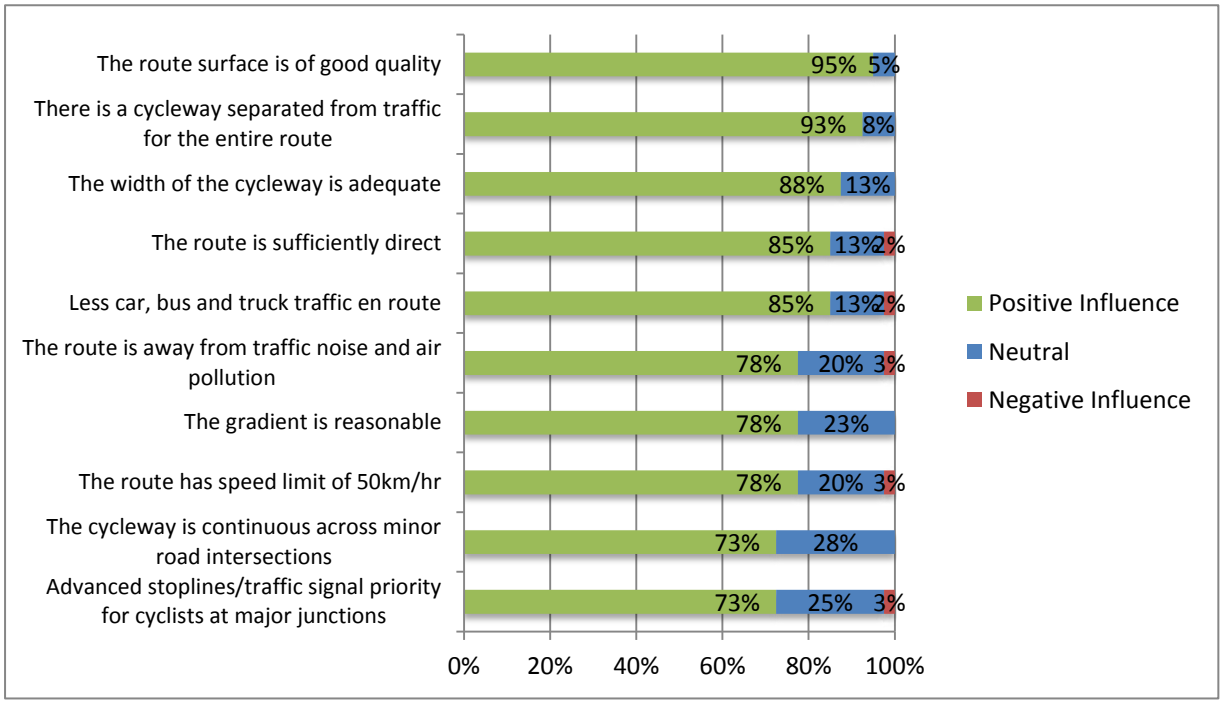



**Figure 8 Top ten route quality characteristics for cyclists**

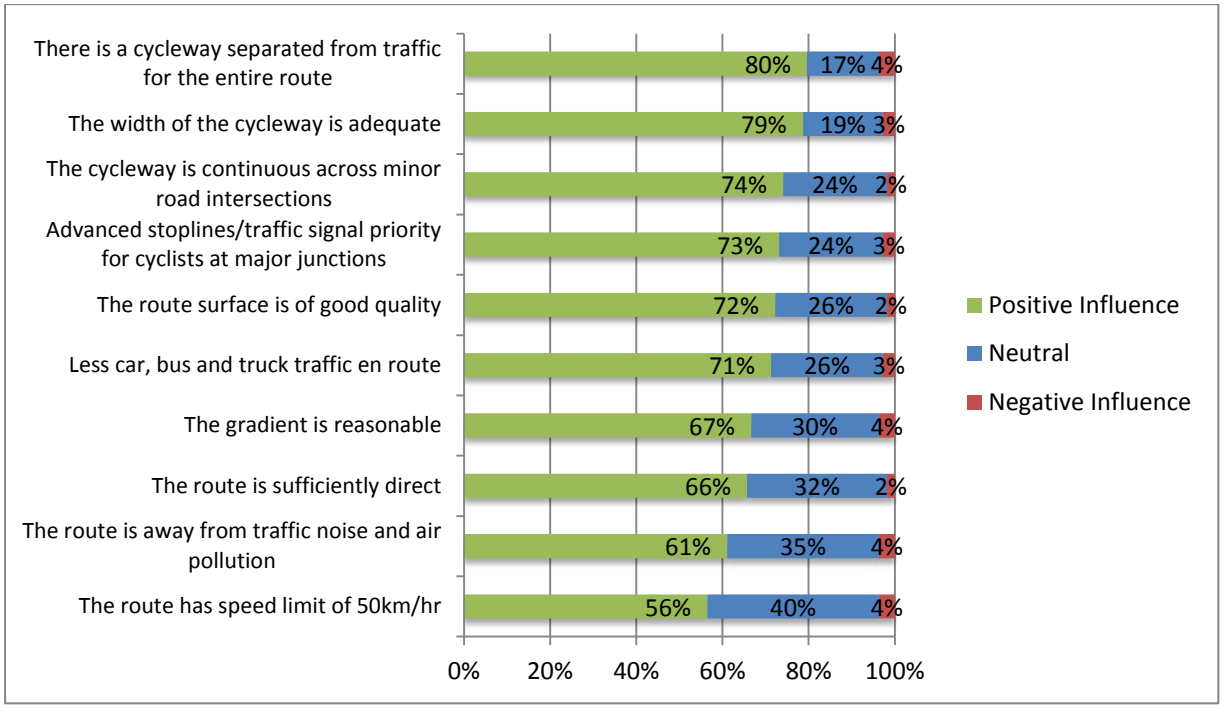



**Figure 9 Top ten route quality characteristics for infrequent, potential and non-cyclists**

**Cyclists and most of the others like to be separated from traffic as well as pedestrians**. As shown in Figures 10 and 11, 98% of cyclists and 81% of infrequent, potential, and non-cyclists prefer to ride on cycleways separated from traffic and pedestrians on both sides of the road. As shown in Figures 10 and 11, 88% of cyclists and 69% of infrequent, potential, and non-cyclists prefer to ride on

cycleways at least separated from traffic and pedestrians, even if the cycleway is on only one side.

**About half of the respondents do not like sharing a lane with buses**. As shown in Figures 10 and 11, 45% of cyclists and 56% of the others DO NOT want to share a lane with buses.

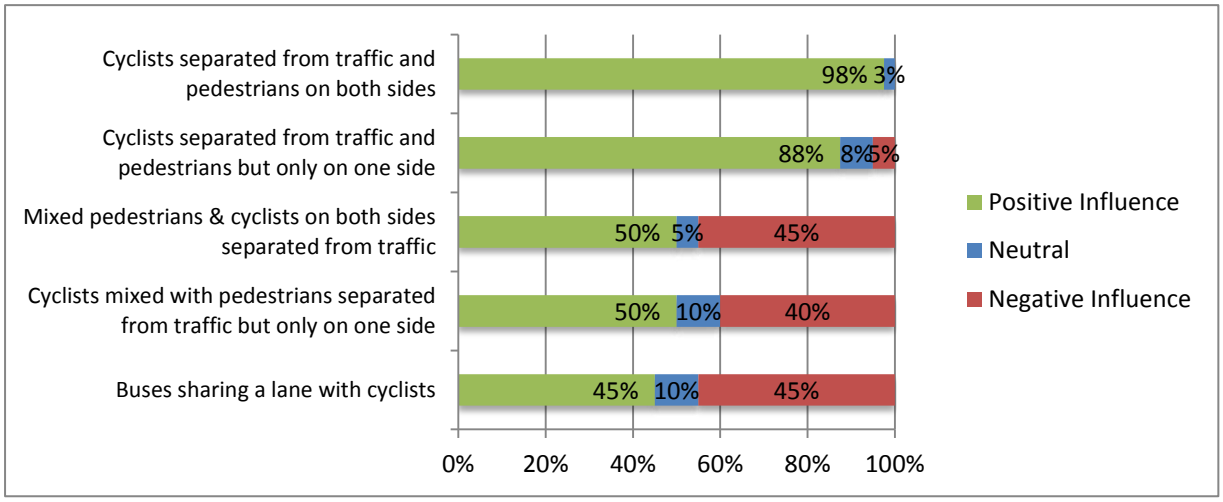



**Figure 10 Cyclists' preference on type of cycleways**

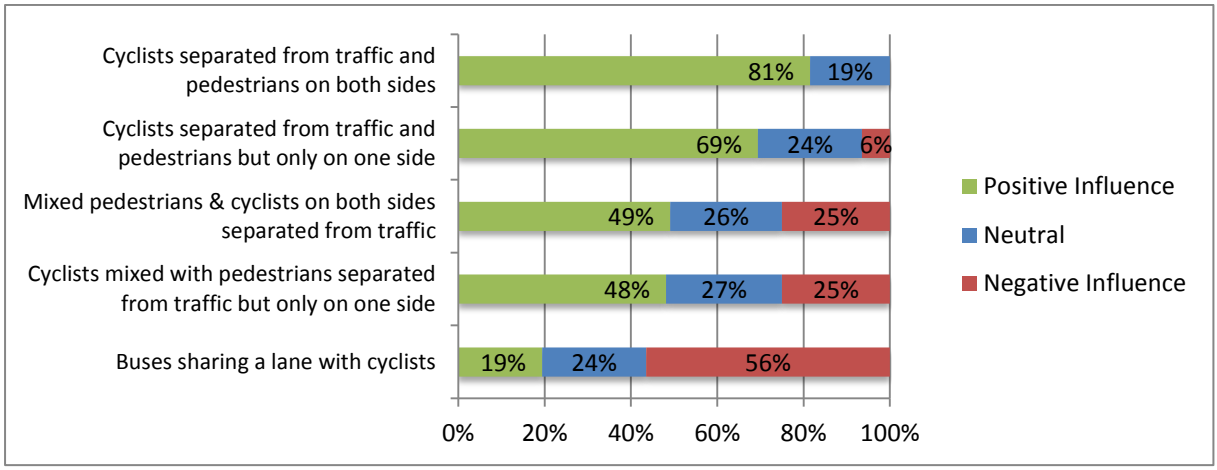



**Figure 11 Infrequent, potential and non-cyclists' preference on type of cycleways**

**Roadside parking causes fear to cyclists**. As shown in Figure 12 and 13, 48% of cyclists and 38% of infrequent, potential and non-cyclists have negative feelings towards roadside parking.

**The majority prefer parking between traffic and cyclists**. As shown in Figures 12 and 13, 95% of cyclists and 83% of infrequent, potential and non-cyclists prefer parking between traffic and cyclists (with segregation between parking and cyclists). The second choice (88% and 72% of cyclists and the others respectively) is a similar arrangement to the first choice, with level difference for cyclists but no segregation between parking and cyclists.

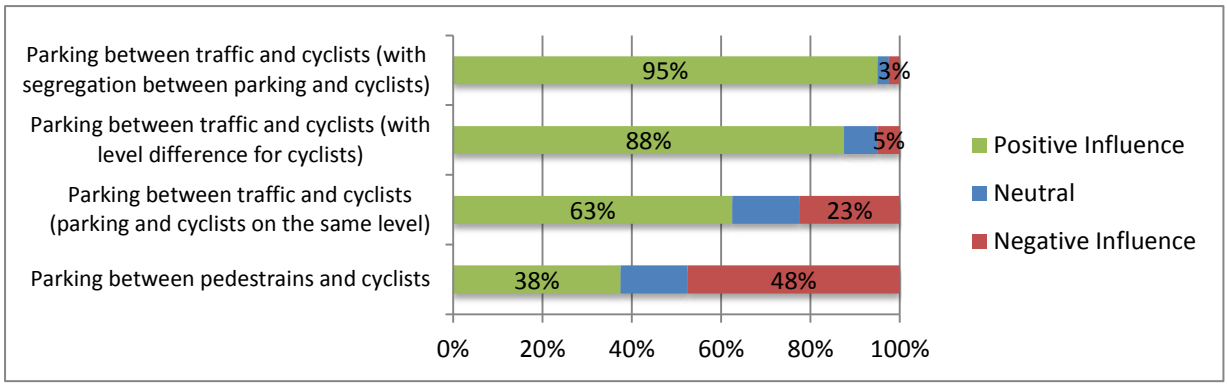



**Figure 12 Cyclists' preference on parking arrangement**

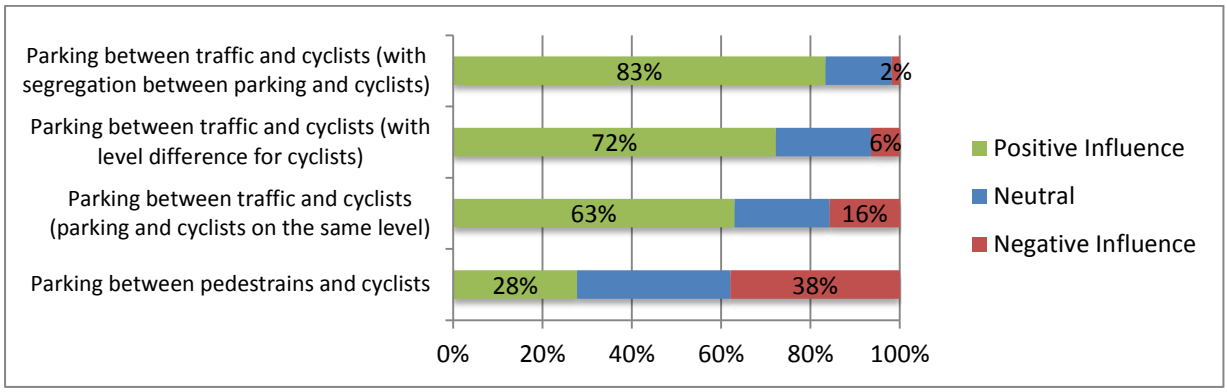



**Figure 13 Infrequent, potential and non-cyclists' preference on parking arrangement**

### *3.2.3 Convenience*

**Secure indoor/covered bicycle parking at destination is important for cyclists and others**. As shown in Table 3, the availability of secure indoor/covered bicycle parking is among the top five on the wish list of both groups.

**Weather conditions do make a difference**. As shown in Table 3, 76% of infrequent, potential and non-cyclists will more likely cycle under good weather conditions. It is interesting to note that although only 33% of cyclists expressed that good weather conditions have positive influence on their level of satisfaction on cycling, as shown in Figure 14, 95% of cyclists would cycle less in winter while 84% will more likely cycle in summer.

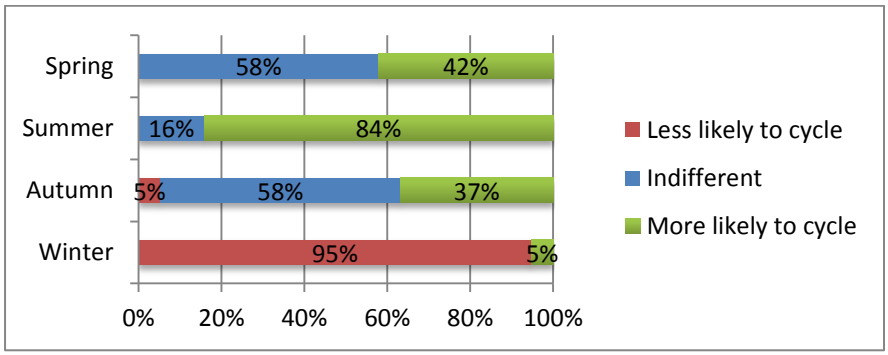



**Figure 14 Seasonal effect on decision to commute by bicycle**

### *3.2.4 Policies to discourage car use*

**Everyone prefers routes with less interactions with traffic and riding in safer conditions: lower speed limit and priority for cyclists.** As discussed earlier,

everyone prefers less interactions with traffic and riding in safer conditions. In particular, as shown in Table 4, both groups prefer routes with less traffic, lower speed limit, away from traffic noise and air pollution, and with priority for cyclists. This also implies that policies that can discourage car use will also indirectly encourage cycling.

*3.2.5 A good public transportation system integrated with cycling facilities*

**Being able to take the bicycle on public transport is one potential motivator.** As shown in Table 3, to be able to take the bicycle on public transport is on the top ten wish list of both groups, with 80% of cyclists and 68% of infrequent, potential and non-cyclists supporting this idea.

# 4 Discussion

As discussed in Section 1, the survey was conducted at the University of Auckland with a sample size of just over 140 staff and students. This can hardly be representative of the Auckland region. Nevertheless, as demontrated later in this section, the results from this survey also support the conclusions drawn from our literature review of international experience and results from other studies (Kingham *et al.*, 2011; Sullivan & O'Fallon, 2006; Tin Tin *et al.*, 2010).

**Safety.** Cycling in NZ is not safe generally. Tin Tin *et al.* (2010) investigated exposure-based rates and profiles of traffic injuries sustained by pedal cyclists resulted in death or hospital inpatient treatment in NZ. The rate of fatal and hospitalised injuries among pedal cyclists has been increasing over the last decade in NZ. Cyclists had the second highest rate of traffic injuries compared to other major road user categories. Tin Tin *et al.* (2009a) investigated regional and individual differences in cycling and walking to work in NZ over a 15-year period (1991-2006). Among different regions in NZ, Auckland had the lowest prevalence of cycling and walking. The largest decline in cycling over the 15-year period was among younger age groups, particularly 15-19 year olds. Tin Tin *et al.* (2009b) investigated cyclists' attitudes toward environmental and policy measures that would encourage them to cycle more, particularly for work trips. 55% of respondents considered that reduced motor vehicle speed is important. Of those who reported travelling to work at least once a week, 43% of the respondents would consider cycling more if there were fewer difficult intersections. Kingham *et al.* (2011) found that safety was the most significant issue for potential cyclists, particularly in relation to vehicle driver behaviour (the perception that car drivers were not courteous) and traffic volume.

In our survey, safety is the number one deterrent, with 78% of infrequent, potential and non-cyclists considered the roads too dangerous (Figure 4). Everyone prefers less interactions with traffic and riding in safer conditions (as highlighted in Table 3).

**Provision of cycleways.** The provision of cycleways, in particular in Auckland, is very poor. The top two important factors for cyclists' decision to cycle were the provision of bicycle lanes (88%), and the provision of bicycle paths (76%) (Tin Tin *et al.*, 2009b). Not enough cycle lanes or paths is considered as one of the most common neighbourhood barriers to physical activity (Sullivan & O'Fallon, 2006).

In our survey, provision of a cycleway separated from traffic for the entire route is the number one motivator (100% for cyclist; 80% for infrequent, potential and non-cyclists) in our survey (Table 3).

**Convenience.** 65% of cyclists consider better bicycle security an important factor in their decision to commute by bicycle, and 61% of commuting cyclists considered the availability of shower facilities at work will encourage them to cycle more (Tin Tin *et al.*, 2009b). Kingham *et al.* (2011) also found that not having facilities at the destination for showering and changing was a barrier. In contrast to experience in successful countries, the prevalence of cycling to work did not vary significantly by personal income level over the years (Tin Tin *et al.*, 2009a).

In our survey, secure indoor/covered bicycle parking at destination is important for cyclists (93%) and for infrequent, potential and non-cyclists (71%) (Table 3).

**Policies to discourage car use**. As discussed above, Tin Tin *et al.* (2009b) found that reducing speed limit and the number of difficult junctions were considered to be important factors in cyclists' decision to commute by bicycle. Kingham *et al.* (2011) also found that traffic volume was a factor that created safety issue for potential cyclists. Rising fuel cost was considered to be a significant factor by 41% of commuting cyclists to encourage them to cycle more (Tin Tin *et al.*, 2009b).

In our survey, most respondents prefer routes with less interactions with traffic and riding in safer conditions: lower speed limit and priority for cyclists (as highlighted in Table 4).

**A good public transportation system integrated with cycling facilities**. Bike-friendly public transport is considered to be an important factor by 38% respondents (Tin Tin *et al.*, 2009b).

In our survey, 80% of cyclists and 68% of infrequent, potential and non-cyclists would like to be able to take their bicycles on public transport.

# 5 Conclusions

In this study, we first performed a comprehensive literature review of the lessons from international experience, focussing on what factors were found to have significant influence on the decision to use bicycles as a mode of transport. We found that there are five main factors that might have been missing in Auckland: (1) safety; (2) a well-connected network of cycleways; (3) convenience; (4) policies to discourage car use; and (5) a good public transportation system integrated with cycling facilities. We then designed a web-based survey to determine the motivators of and deterrents to cycling in Auckland and to understand what factors are influencing the route choice of current and potential cyclists. A wed-based pilot survey was conducted at the University of Auckland as a case study, where about 140 staff and students participated in the survey. As demonstrated in our discussion in Section 4, despite the small sample size, the findings from our survey are all consistent with our literature review as well as other studies in New Zealand. These five main factors are indeed barriers to cycling in Auckland.

It is evident that safety is indeed a number one concern for cyclists as well as those who do not cycle. Provision of a well connected network of cycleways is a must in order to promote cycling. The availability of shower facilities at work and secure indoor/covered bicycle parking at destination are both important. For a city with sparse distribution of employment centres like Auckland, strategies to promote the use of bicycles will not be sufficient without integrated policies to discourage car use. The use of PT system together with cycling facilities is particularly important for a city with a hilly terrain like in Auckland.

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