Re-Cycling the Streets:

Exploring the Allocation of Public Space

for Transport

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Abstract

This study explored the extent to which road space reallocation from on-street parking to an arterial cycle way may be warranted between Wellington city's southern suburbs and city centre. Latent demand and preferences for transport cycling were assessed using an intentional behaviour change model, and a study of the economic contribution of the on-street parking on Tory Street to adjacent businesses was undertaken.

This study identified a significant latent demand for transport cycling in Wellington. Transport cycling is suppressed primarily because of a perceived lack of safety. Road safety improvements were identified as the key change required to encourage the uptake of transport cycling. In particular, people in Wellington desire a continuous and connected network of separated and dedicated cycle ways. Potential cyclists indicated that they would be likely to cycle for transport more often if a cycle path connecting Wellington's southern suburbs and city centre was constructed. Contrary to what might be expected, it appears that the majority of people would support the removal of some on-street parking to provide for this cycle way. Additionally, this study found that the contribution of those who use on-street parking to adjacent retail vitality on Tory Street is minor, compared to the contribution of those who do not require parking and those who use off-street parking.

This research concludes that, considering Wellington's context and policy, the reallocation of road space from on-street parking to an arterial cycle way between Wellington's southern suburbs and city centre may well be warranted.

Key words:

Road space reallocation, transport cycling, latent demand, cycle way/lane/path, on-street car parking, Transtheoretical Model, public space

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Table of Contents

List of Figures

List of Tables

1 Introduction

> *"The progressive impact of the car on [Wellington] city has been so dramatic over the past 80 years that the management and design of the city environment has often developed primarily to provide for the ease and priority of vehicle-orientated travel and amenity, often at the cost of pedestrians and cyclists."*
>
> Wellington City Council (2010b, p. 6)

1.1 Background

This thesis explores the extent to which road space reallocation is warranted from on-street car parking to a proposed arterial cycle way in Wellington city.

Over the last half-century large amounts of public space have been reallocated to accommodate high volumes of motor vehicle traffic in cities worldwide. This phenomenon has been driven by the conventional transport planning approach that legitimated rapidly growing car use and provided capacity for peak traffic demand through enormous public investment in roads (Goodwin, 1997). The consequence of such 'predict and provide' planning is evident in the current high levels of car use and car dependence in developed urban areas around the globe (Banister, 2008). Between the 1950s and 2005, vehicle ownership rates in New Zealand more than tripled and between the years 1980 and 2000 vehicle kilometres travelled per annum more than doubled (Ministry for the Environment, 2007).

There are numerous well-documented negative externalities associated with high levels of car use. These external costs are inequitably distributed, at a range of spatial and temporal scales, in the way they fall upon the environment, society, and the economy (Woodcock*, et al.*, 2007).

In recognition of the serious problems associated with car dependence, many cities are shifting their transport-planning focus to a sustainable mobility paradigm (Banister, 2008). A major element within the sustainable mobility paradigm is 'travel demand management'. One form of travel demand management is road space reallocation from private motor vehicles to dedicated use by sustainable transport modes (Banister, 2008).

The practice of road space reallocation arises out of the recognition that car dependent societies may have moved beyond the optimal allocation of road space for cars, to a state where costs outweigh benefits and where the space and planning for alternative modes of transport has been underprovided (Cairns*, et al.*, 2002). Although road space could be reallocated for a range of uses, the focus of this research is the potential for reallocation from on-street car parking to a cycle route.

The use of cycling for transport has declined dramatically over past decades in many developed cities alongside the increase in car use. New Zealand's Ministry of Transport's Household Travel Survey data from 2007 to 2010 shows that on-road bicycling trips make up 1.4 per cent of trip legs nationally, while car and van trips account for a total of 78 per cent of all trip legs (Ministry of Transport, 2011a). However, for trips less than 5km, 2.3 per cent of trips are cycled (Ministry of Transport, 2013b). While many older New Zealanders cycled to school when they were young, cycling is now uncommon in many households, with 54 percent of New Zealand households reporting not owning a bicycle (Ministry of Transport, 2011a). Shifting short trips from the private car to cycling for transport is widely recognised to provide substantial co-benefits to the environment, society, and the economy (Giles-Corti*, et al.*, 2010; Woodcock*, et al.*, 2007).

1.2 Introduction

1.2.1 Wellington City

Wellington city is used as the case study for this research. Wellington is the capital city of New Zealand and has an estimated population of around 197,700 people (Statistics New Zealand, 2013). Wellington city has a temperate climate and varied terrain. The central city and some surrounding suburbs are relatively flat, while other surrounding suburbs are hilly.

Household Travel Survey data shows that for the Wellington region, between 2008 and 2012, cycling accounted for just four per cent of all journeys to work (Ministry of Transport, 2013b). According to the 2006 Census, 17 per cent of Wellington residents use public transport to commute, 17 percent walk, run or cycle, while 45 per cent commute by private motor vehicle (Wellington City Council, 2010a).

1.2.2 Public Road Space in Wellington City

In 2004 the Wellington City Council commissioned a public space study of Wellington's city centre by urban architect Jan Gehl. His report found that vehicular traffic dominates public space citywide. He found that roads and car parks occupy much of the space in the central city due to years of unlimited access for vehicles (Gehl, 2004). The report described car dependency as "prevalent" in Wellington, with significant detrimental impacts on the walkability of the city and quality of the streetscape. He cautioned that vehicle traffic in Wellington would continue to grow "as long as it is easy to drive" (Gehl, 2004, p46).

The overall supply of parking in Wellington city is described by the local authority as 'high' in comparison to other cities of similar size (Wellington City Council, 2007). In Gehl's (2004) public space study, the visible supply of on-street car parking was described as dominating. Gehl proposed that reducing vehicle traffic in Wellington should include limiting vehicle parking. He claimed that "a better use is possible" than the present occupation of excess road space by on-street car parking (Gehl, 2004, p12).

Gehl's report described great potential for cycling in the central city due to its relatively flat topography. However, cycling in Wellington's central city was described as "a risky experience trying to make way through a traffic dominated city with little room for, and awareness of, bikes" (Gehl, 2004, p. 23). It was also noted that Wellington lacks an inner city cycle network and there are no dedicated cycle lanes on central city streets (Gehl, 2004).

Figure 1: Wellington's southern suburbs and Tory St. Base map and software by Google (2013).

Wellington's Mayor, re-elected for a second three-year term in 2013, advocates strongly for cycling and sustainable transport. She has publicly committed to improvements in Wellington's cycle network and hopes for Wellington to become "one of the world's great cycling destinations" – both for recreation and transport cycling. She believes that cycling in Wellington has suffered from years of "significant underinvestment" and that "the benefits of a well-developed strategic cycling network [are] too good to cast aside" (Wade-Brown, 2012).

1.2.3 The Present Study

Given the high 'external' costs to society and the environment of car use, and the potential benefits of encouraging cycling, Gehl's findings warrant further investigation. Is there the potential for more cycling, and cycle ways in Wellington city? Should the space to provide these cycle ways come from on-street parking? It is the intention of this research to address these questions using the case study of a proposed arterial cycle way connecting Wellington's southern suburbs and city centre.

The Wellington City Council is considering a south coast to city arterial cycle way, with funding consultation for the route beginning in 2013 (Wade-Brown, 2012). This cycle way was initially proposed and investigated by Martin Hanley at the Victoria University of Wellington's School of Architecture, before being taken into consideration by the Wellington City Council (Barker, 2012). Hanley proposed that the cycle way should travel along Tory Street, in Wellington's city centre. Tory Street is shown as the red line in Figure 1, and the southern suburb 'catchment' is highlighted in yellow.

Wellington's southern suburbs included in this study are Island Bay, Berhampore, Newtown, and Mount Cook. The distance from Island Bay to Wellington's waterfront is approximately six kilometres, which is generally seen as a distance that can be cycled (Buehler & Pucher, 2012). These suburbs are some of the older parts of Wellington and consist of inner and outer residential areas that stretch from the city fringe to the coast. It is predominantly medium density development and contains some key educational facilities, the Wellington Regional Hospital, and the zoo. Approximately 26,000 people live in the area, in more than 10,000 dwellings (Wellington City Council, 2013b).

It has been proposed that the city centre portion of the cycle way travel along Tory Street, as shown in Figure 1. Tory Street runs north to south, and connects Mt Cook with the waterfront. It has a range of shops, services, and businesses, including restaurants, cafes, a supermarket, homeware stores, several gyms, a hotel, several high-rise apartment buildings, multiple parking buildings, and a primary school. Tory Street has two travel lanes (one in each direction), and on-street parking along both sides of the street, as seen in Figure 2.

Figure 2: Tory Street, looking north towards the intersection with Courtenay Place.

This proposed cycle way is in its initial stages, and as such, the route and design are not finalised. Tory Street has been suggested as an option and is therefore used as a case study for this research. However, others routes may, and should, be considered by decision makers.

1.3 Aim

It is the intention of this research to provide information that will be useful to decision makers when considering this case study cycle way. As such, the aim of this research is to address the question:

> **To what extent is road space reallocation from on-street car parking to an arterial cycle way warranted, between Wellington's southern suburbs and city centre?**

This research aim is centred on a practical, real-world case study. As such, the research questions that will address this aim are developed using a review of relevant academic and grey literature, and the relevant policy and case study context. This is to ensure that the research questions not only address the aim, but do so in a way that provides information that is appropriate specifically to the case study context, and therefore, may be useful to decision makers when considering this cycle way.

The following chapter discusses the relevant literature and theory on road space reallocation, and the provision of cycle ways and on-street parking. The next chapter (Chapter 3) then explores the relevant policy framework for transport planning in Wellington, and the current context. The research questions are then presented, followed by the methods chapter (4), which outlines the research process. This leads on to the results (5) and discussion chapters (6), which present the findings of this research and discuss the implications for this case study and wider transport policy.

2 Literature Review

2.1 Conventional Transport Planning

The conventional 'predict and provide' approach to transport planning has been dominant in the cities of most developed nations since the end of World War II (Kenworthy, 2006). This approach anticipated massive growth in car ownership and use, and sought to provide public road infrastructure with the capacity to handle such growth. Roads were built with enough capacity to manage the predicted peak traffic 'flow' and parking was provided at destination points to ensure ample 'terminal capacity' (Shoup, 2005). This planning approach has been described as a self-fulfilling prophecy (Schaeffer & Scalar, 1975), where additional infrastructural capacity generated and induced additional traffic, which in turn created congestion, which was 'solved' through providing additional capacity, thus reinforcing further traffic growth (Goodwin, 1999; Kenworthy, 2006; Noland & Lem, 2002).

Challenges to the 'predict and provide' approach to transport planning come from two main areas. Firstly, from those who say the resulting dominance of the car, and car-orientated infrastructure, have created a plethora of adverse effects on the environment and society, and even the economy. Secondly, from those who say that the basic assumptions behind the 'predict and provide' approach simply no longer apply.

2.2 Impact of Predicting and Providing

The costs of this 'predict and provide' approach to planning transport in cities are now well known, as many cities, economies, and the environment are currently suffering from interconnected problems associated with car dependency (Banister, 2008; Newman & Kenworthy, 1989; Verhoef, 1994). New Zealand is highly dependent on motor vehicle transport, with private motor vehicles dominating the provision of mobility in New Zealand (Ministry for the Environment, 2007). New Zealand has one of the highest rates of car ownership in the world (Conder, 2009), and the fifth highest of member countries in the OECD (Ministry for the Environment, 2007).

Private motor vehicles offer unique and unprecedented mobility benefits for those who choose to, and are able to, use them. As a form of personal, private transport motor vehicles offer the user convenient and on-demand access to distant resources, goods and services (Jakob*, et al.*, 2006). However, the privatised benefits of car use come hand in hand with significant environmental, social, and economic external costs (Verhoef, 1994). Such externalities can be difficult, if not impossible to quantify which means they regularly go unvalued or undervalued (Verhoef, 1994). As such, many of these costs are not paid for by the user but borne externally at a range of temporal and spatial scales (Verhoef, 1994; Woodcock*, et al.*, 2007).

This uncorrected market failure makes car use artificially cheap and attractive compared to alternative, more sustainable modes (Woodcock*, et al.*, 2007). As a result current levels of consumption for private motorised transport may now be beyond the socially optimal level (Verhoef, 1994). Because of this, and due to the increasing environmental impact of externalities such as carbon emissions, the current high level of use of motorised transport is a major global issue.

In cities around the world, huge amounts of urban public space have been allocated to the movement and parking of private motor vehicles (Newman & Kenworthy, 1999). This has led to the severance of communities by roads and motor vehicle traffic. The ability to live further from the city centre and travel by car has led to urban sprawl, increased travel times, and the loss of food-producing land (Kenworthy, 2006).

Provisions for public transport, walking, and cycling have often been overlooked, or even seen as unnecessary, in a planning system geared to provide for the private car (Goodwin, 1999). As a result, people in many urban areas have become car dependent, where car travel is by far the dominant form of transport, and where attractive alternatives to the car are often not readily available (Kenworthy, 2006). Those unwilling or unable to travel by car, such as children, the elderly, the poor, or disabled, have been disadvantaged in a transport system that does not always provide viable alternatives (Goodwin, 1999).

Car dependence is correlated with several major public health problems including diseases related to inactivity and air pollution, and traffic injury (Woodcock*, et al.*, 2009).

Worldwide, carbon emissions from motor vehicle use are a major cause of climate change (Pachauri & Reisinger, 2007). However, carbon emissions from vehicle use are only part of the total emissions associated with vehicles. Additional emissions are created through the extraction of materials, production and distribution, and end-of-life disposal. Infrastructure built to move and park motor vehicles also comes with carbon emissions such as during construction and maintenance (Woodcock*, et al.*, 2007).

2.3 Do Predict and Provide Assumptions Still Apply?

The second main challenge to the predict and provide paradigm comes from those who argue that although previous decades have seen enormous growth in car use, recent evidence suggests it may not be wise, nor realistic, to expect such trends to continue into the future.

Newman and Kenworthy (2011) argue that many cities in developed countries appear to be experiencing 'peak car' use, whereby "the first signs of declining car use … are being observed" (p.31). This trend was first documented in the US by Puentes and Tomer (2009), who showed that Vehicle Miles Travelled (VMT) began to plateau in 2004 and began to decline later that decade. In similar research, Millard-Ball and Schipper (2010) conducted a cross-national analysis of passenger transport trends in eight developed, industrial nations (the USA, Canada, Sweden, France, Germany, the UK, Japan, and Australia). They found that travel activity has reached a plateau in all eight countries, and that in most of the countries private vehicle use has declined "in recent years" (p.372).

New Zealand's own motor vehicle use data appears to show similar trends. Figure 3 shows New Zealand's total annual Vehicle Kilometres Travelled (VKT) for the decade 2001 to 2011. These data are taken directly from vehicle odometer readings during Warrant of Fitness and Certificate of Fitness checks. The figure shows that in the six years from 2005 to 2011 national annual VKT has ceased to grow. The Wellington regional data shows a very similar trend (Ministry of Transport, 2013b). Figure 4 shows similar trends in New Zealand's vehicle ownership rates.

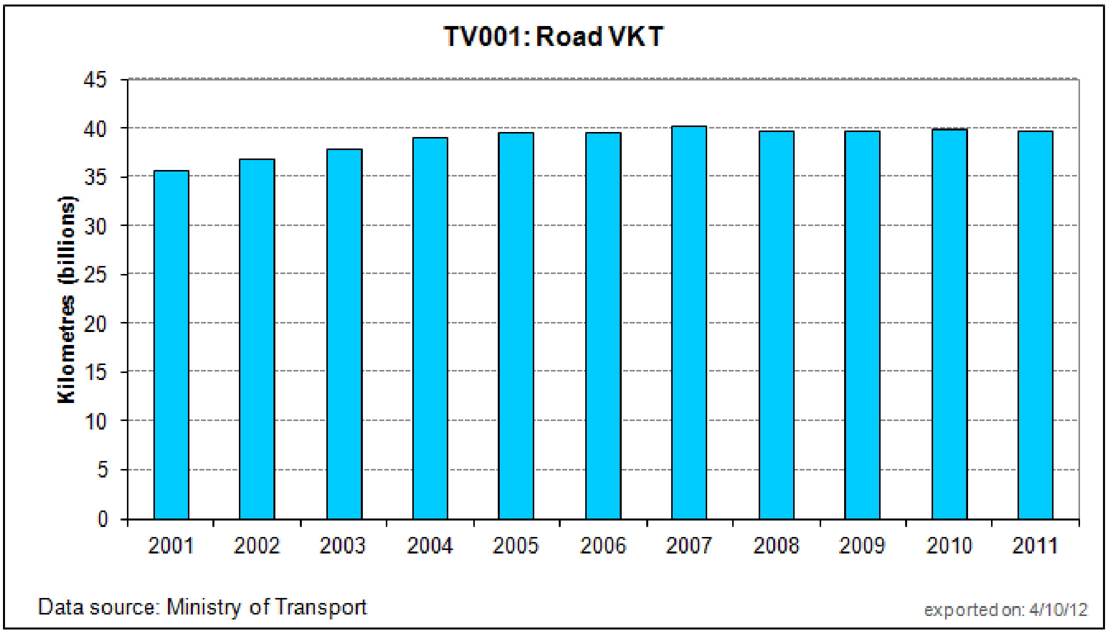

Figure 3: Total vehicle kilometers travelled on New Zealand roads from 2001 to 2011. Source of image: Ministry of Transport (2013b).

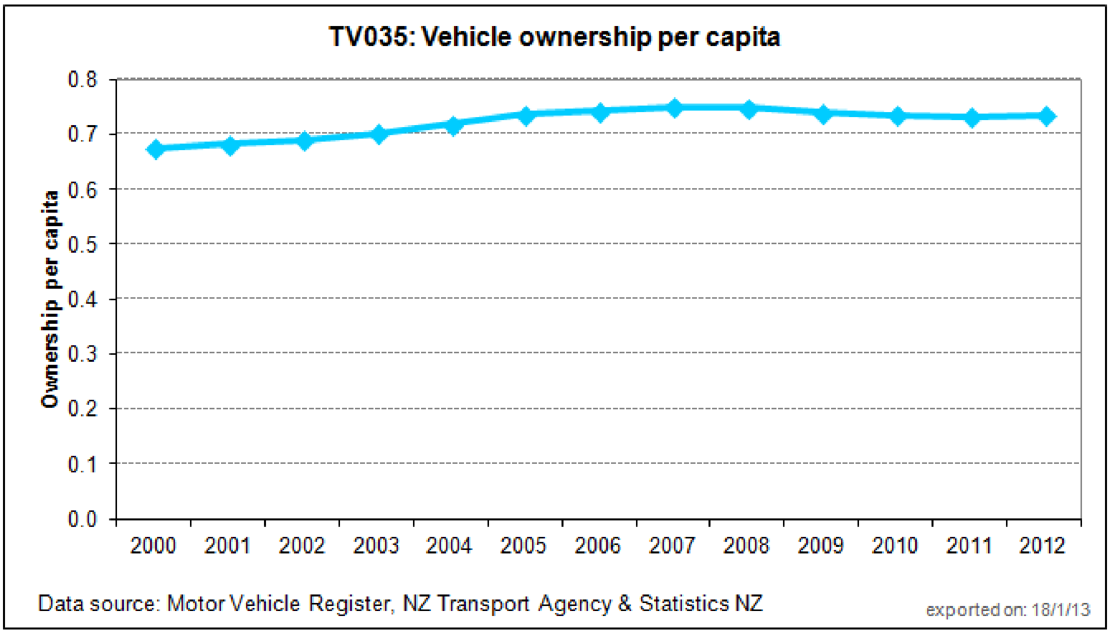

Figure 4: Motor vehicle ownership per capita in New Zealand from 2001 to 2011. Source of image: Ministry of Transport (2013b).

Millard-Ball and Schipper (2010) argue that the start of the plateau in car use came before rising global oil prices and therefore this cannot be treated as the sole causal factor. Puentes and Tomer (2009) conclude that the basis of the decline is that the conditions that created growth in VKT in previous decades no longer apply. For example, they argue that in the USA, vehicle ownership is near saturation and there are limits to the quantity of driving people wish to consume (National Surface Transportation Policy and Revenue Study Commission, 2008; Puentes & Tomer, 2009). Newman and Kenworthy (2011) propose that 'peak car' can be explained by six interdependent factors: people reaching their travel-time limit; growth in the use of public transport; increasing urban densities reversing the trend of urban sprawl; ageing populations driving less; increased demand for urban living; and rising fuel prices.

Additionally, recent research by Sivak and Schoettle (2011) shows that places with high levels of Internet access are associated with lower rates of driver licensing among young people. They theorise that young people may be replacing car travel with social media consumption, and imply that today's youth may not follow the car dependent trend that previous generations have.

A further factor that may affect the consumption of motorised transport is peak conventional oil. Motorised transport is currently highly dependent on the consumption of oil, which is a fossil fuel, and therefore, a finite resource. Road transport accounts for 77 per cent of New Zealand's oil consumption (Ministry for the Environment, 2007). Evidence shows that global conventional oil production may have peaked (Chapman, 2013; Murray & King, 2012; Woodcock*, et al.*, 2007), while global demand for oil continues to grow (Chapman, 2013; International Energy Agency, 2013).We are now witnessing an increase in the exploration and exploitation of what were, until recently, unviable and unconventional extraction options (Chapman, 2013; International Energy Agency, 2013). Such unconventional oil extraction is more costly and more risky (Chapman, 2013; International Energy Agency, 2013; Woodcock*, et al.*, 2007). As such, future oil prices are expected to continue to rise, and forecasts show we can potentially expect oil shortages in the future (Chapman, 2013). Given this, the scope for energy intensive future growth may be limited, and unless managed well, this may produce serious consequences for oil-dependent societies (Chapman, 2013; Murray & King, 2012; Woodcock*, et al.*, 2007).

Millard-Ball and Schipper (2010) caution planners and decision makers that forecasting continued growth in car use, based on trends of the past, "cannot be relied on" (p.373). However, according to Conder (2009) New Zealand has not recognised this, and uses a “simplistic approach” (p.11) to traffic forecasting whereby:

> “*Historical traffic growth rates (in arithmetical terms) are generally considered to provide a sound basis for predicting future traffic demand provided there are no traffic restraints”* The New Zealand Transport Agency Economic Evaluation Manual as quoted in Conder (2009, p. 11).

Puentes and Tomer (2009) assert that if declining car use continues there will be increased demand for car alternatives, especially within cities and in inner suburbs. Newman and Kenworthy (2011) argue that planners and engineers must respond to peak car use through fundamental changes in assumptions and modelling. They also argue that the changing trend provides a rationale for quality urban redesign, and for reducing and reallocating road capacity to provide for car alternatives such as public transport, walking and cycling.

2.4 Sustainable Mobility Paradigm

The magnitude of external costs and urgent problems associated with high levels of private motor vehicle use, combined with recent evidence that suggests car use in many developed cities may have peaked, indicates that ‘predicting and providing’ for future growth in car use may be an unwise strategy. From within this context a paradigm shift toward ‘sustainable mobility’ is occurring in the thinking, planning and practice of urban transport (Banister, 2008; Goodwin, 1999; Newman & Kenworthy, 1999; Saelens*, et al.*, 2003).

This new way of thinking developed in a few European countries several decades ago (Kodransky & Hermann, 2011), and is gaining traction in places around the world. However, only more recently has it begun to influence areas of transport planning in New Zealand, (Ministry for the Environment, 2007; Preval*, et al.*, 2010).

This new approach emphasises a transition to sustainable mobility, which includes two main strands:

1) Travel demand management (Preval*, et al.*, 2010)

- Reducing the need to travel;
- Encouraging use of car alternatives (such as public and active transport);
- Reducing trip length (through urban form and land use policy) (Banister, 2008).

2) Increased efficiency in the use of private cars (Preval*, et al.*, 2010)

- Technical innovation that make motorised transport more energy efficient;
- Ensuring the full costs of travel are internalised through appropriate pricing (Banister, 2008).

The sustainable mobility paradigm recognises that new transport technologies will play an important role, but are insufficient on their own, in addressing current transport problems. For example, switching all cars to clean technology will not solve congestion, urban sprawl, or inactivity related public health issues. Therefore, the sustainable mobility approach includes the more comprehensive goals of traffic reduction and behaviour change (Cairns*, et al.*, 2002; Fulton*, et al.*, 2013; Woodcock*, et al.*, 2007).

The focus of this current research is the area of travel demand management, and specifically, encouraging the use of car alternatives. Encouraging the use of car alternatives requires that people make changes to their behaviour (Rajan, 2006).

Approaches that can change peoples' behaviour fall into two broad categories: 'structural/situational' are 'hard' approaches that change the environmental context in which choices are made. 'Cognitive-motivational' are 'soft' approaches that use, for example, information, advertising, or social pressures to encourage behaviour change (Rajan, 2006).

This research focusses on the former 'structural/situational' approach. This approach can employ a range of push and/or pull measures to attempt to change people's travel behaviour. The use of 'push measures' makes car use more difficult by increasing the cost of car use, restricting vehicle use, or reducing the road or parking space available to motor vehicles. 'Pull measures' make the use of car alternatives easier, such as through making them more attractive options or by providing financial incentive for their use (Rajan, 2006).

2.4.1 Road Space Reallocation

Road space reallocation is a form of travel demand management that encourages the use of car alternative(s) through simultaneous push *and* pull measures.

Road space reallocation involves 'reallocating' public road space away from general traffic by restricting motor vehicle access. This public space is then reassigned to provide exclusively for car alternatives, such as bus priority lanes, pedestrianisation, or cycle ways (Banister, 2008).

Reallocation can help to shift perceptions of urban street space being a place solely for cars, to being a public space, such as for recreation, markets, or outdoor dining, or as a space for public transport, walking, or cycling. The way reallocated space is reused can be dynamic and responsive, such as changing for different uses at different time scales (Banister, 2008). Road space reallocation can be planned or unintended, permanent or temporary (Cairns*, et al.*, 2002). For example, in the short term a local disaster may reduce road capacity or roads may be closed for maintenance; in the long term a footpath may be widened or bus lanes may be introduced. The purpose of road space reallocation is to ensure more efficient, or equitable, use of road capacity while simultaneously increasing the attractiveness of car alternatives (Cairns*, et al.*, 2002).

Opposition to Road Space Reallocation

Goodwin (1999) discusses two dominant arguments commonly used against measures to reduce traffic in urban centres. The first comes from retailers who argue that it will reduce trade and send shoppers elsewhere. Experience of quality pedestrianisation shows that, if done well, road space reallocation can actually improve trade and vitality in surrounding retail areas (Goodwin, 1999). The literature on this issue is further explored in section 2.6 of this thesis, which outlines the evidence regarding the role of on-street parking for adjacent retail vitality.

The second common argument against road space reallocation comes from traffic engineers and planners, who believe that displaced vehicles will congest surrounding streets. Although there is only a small quantity of literature on this topic, the literature that does exist makes the case that traffic volumes are not fixed, and that reducing road space for vehicles can 'disappear traffic', just as increasing road space for vehicles has been found to induce traffic (Noland & Lem, 2002).

Disappearing Traffic

A large number of international case studies show that road space reallocation can result in a net reduction of local traffic (Cairns*, et al.*, 2002; Cairns*, et al.*, 1998; Motor Vehicle Association Ltd., 1998), and in a modal shift away from cars (Banister, 2008). Furthermore, when reallocation is part of a wider, more comprehensive programme, for example, increasing the attractiveness of car alternatives, there may be additional traffic reductions (Cairns*, et al.*, 2002). Traffic reduction occurs because some drivers change their travel behaviour in response to the reallocation. Different individuals have different levels of capacity to change their travel habits, for example their travel habits may not be entrenched or their travel routine may be flexible (Cairns*, et al.*, 2002). This suggests that some people may be nearer to the threshold for change, where road space reallocation may be the tipping-point for a change in transport behaviour.

This study is focussed specifically on the reallocation of on-street parking space to an arterial cycle way. Accordingly, this focus now moves to cycling for transport, how people close to this 'tipping-point' can be identified, and what the role of a cycle way might be in encouraging a change to cycling. The next section reviews the benefits and costs of providing on-street parking, and discusses the literature on reallocation of this road space.

2.5 Cycling

2.5.1 Benefits of Transport Cycling

Cycling for transport can produce benefits not only for the individual, but also significant positive externalities for the environment, the economy, and society. These benefits are even greater when cycle use is a result of a modal shift from car use, as such a shift avoids many costs associated with car use (Woodcock*, et al.*, 2009). There is persuasive evidence to support the promotion of active transport, primarily from environmental and public health perspectives (Giles-Corti, 2006; Woodcock*, et al.*, 2007).

Cycling is the most energy efficient form of transport (Woodcock*, et al.*, 2007), and produces no direct carbon emissions or other forms of air pollution. The Intergovernmental Panel on Climate Change recommends that policy is used to encourage a modal shift from fossil fuel based transport to sustainable transport, including cycling, and investment in non-motorised forms of transport as a “key” climate change mitigation area (Pachauri & Reisinger, 2007, p. 60).

Shifting some trips from motorised to active transport is an opportunity to increase public health through increased physical activity (Dill, 2009). Increasing physical activity is a major public health goal in New Zealand (Ministry of Health, 2003) and in many nations worldwide (World Health Organisation, 2004).

Furthermore, neighbourhoods that are designed to encourage active transport have been shown to have a stronger sense of community, higher levels of social engagement and interaction, can build trust, and increase community participation (Leyden, 2003; Lund, 2002; Wood*, et al.*, 2010). Such interaction can develop social capital (Leyden, 2003), which is associated with improvements in physical & mental health, self-reported well-being (Wood & Giles-Corti, 2008), and also in a range of other health related behaviours (McNeill*, et al.*, 2006).

Additionally, active commuting has been associated with increased workplace productivity and performance (Davis & Jones, 2007; Hendriksen*, et al.*, 2010; Pronk &

Kottke, 2009), so there is some evidence to suggest economic benefits accrue from increased cycling. Furthermore, active transport can be cheaper than motorised transport, and as such, may result in savings that can be spent on other goods and services.

2.5.2 Factors Associated with Transport Cycling

To explore how important a cycle way may be in encouraging more cycling, the literature on the factors associated with choosing to cycle is now explored and reviewed. This section finds that a wide range of factors are related to cycling, and that there does appear to be individuals who would like to cycle, and may indeed do so if safer cycle routes existed.

Consistent with social-ecological theories (Giles-Corti, 2006; Pikora*, et al.*, 2003), research has shown transport cycling to be associated with a range of factors that scale from the *individual level* (including demographic and socioeconomic factors), *psychosocial level* (including inter- and intra-personal, social, and cultural factors) and the *external level* (both built and natural environmental factors) (de Geus*, et al.*, 2008; Giles-Corti, 2006; Saelens*, et al.*, 2003; Titze*, et al.*, 2008; Xing*, et al.*, 2010).

This range of factors will now be discussed in more detail. It is important to note that both objective and subjective (or perceived) measures of the environment have been related to transport cycling behaviour (Hoehner*, et al.*, 2005; Moudon*, et al.*, 2005; Saelens*, et al.*, 2003; Troped*, et al.*, 2001). Subjective measures (perceptions) of the environment are discussed here as psychosocial factors, while objective measures are discussed as environmental factors.

Individual Factors

Clearly, transport cycling requires facilitating circumstances, such as that the user has access to a suitable bicycle (Buehler & Pucher, 2012) and is physically able to ride it. Beyond this, research has found other individual factors can be associated with transport cycling. Such factors include age, gender, income, education, and motor vehicle access (Heinen*, et al.*, 2010). Different places have shown varying associations with these individual factors and transport cycling, suggesting that the association is context dependent. For example, in places that have low rates of cycling, cyclists tend to be males; however, in places that have higher rates of cycling, the gender split is more even (Buehler & Pucher, 2012; Garrard*, et al.*, 2008). In both New Zealand, and the Wellington region, cycling for transport is most commonly associated with males and those with higher incomes (Greater Wellington Regional Council, 2012; McKim & Singleton, 2013; Sullivan & O'Fallon, 2006).

Psychosocial Factors

Numerous cognitive and psychosocial factors have been associated with, and may be important determinants of transport cycling behaviour (Giles-Corti, 2006; Titze*, et al.*, 2008). Key factors appear to be attitude (Xing*, et al.*, 2010), and motivation (de Geus*, et al.*, 2008; Ogilvie*, et al.*, 2004; Taylor*, et al.*, 2009). Motivations to cycle, in the Wellington region, are commonly stated to be for health, financial, or time reasons (Greater Wellington Regional Council, 2012).

Additionally, perceived comfort and ability to cycle (de Geus*, et al.*, 2008), as well as knowing people who cycle, having people to cycle with (de Geus*, et al.*, 2008; Titze*, et al.*, 2008), and feeling that cycling is normal (Xing*, et al.*, 2010), all appear to be important. Perceptions of personal and practical barriers to cycling have also been associated with transport cycling.

Perceived Personal and Practical Barriers

Non-cyclists have been found to perceive a greater number of barriers to transport cycling than regular cyclists (de Geus*, et al.*, 2008). Perceived intra-personal barriers to transport cycling include not being interested, feeling incapable (de Geus*, et al.*, 2008), and uncomfortable (Titze*, et al.*, 2008). Other barriers relate to the perception that transport cycling is impractical (Titze*, et al.*, 2008), such as: not having time (de Geus*, et al.*, 2008) or feeling it is too far (Troped*, et al.*, 2001); problems with end use facilities such as bike parking, showering and changing (de Geus*, et al.*, 2008; Taylor*, et* *al.*, 2009); cycling 'gear' issues such as a lack of appropriate cycle clothing, lighting, and helmets (Taylor*, et al.*, 2009); logistical issues such as transporting other people and luggage, and trip chaining (Taylor*, et al.*, 2009); and perceived geographical and climatic obstacles such as steep hills (Troped*, et al.*, 2001) and adverse weather (Taylor*, et al.*, 2009).

In the Wellington region, the most commonly stated barriers to cycling for transport are not having a bicycle and a lack of safety/safe facilities on roads. The percentage of Wellington residents stating the lack of safety as a barrier almost doubled in the period 2003 to 2008. Minor barriers mentioned are hilly terrain, bad weather, and general inconvenience (Greater Wellington Regional Council, 2012).

Perceptions of Barriers in the Urban Environment

Barriers to cycling also exist related to perceptions of the condition of the built environment. In both the United States and New Zealand a major barrier, and perhaps even one of the most significant, has been found to be a perceived lack of safety due to traffic (Pucher & Buehler, 2008; Taylor*, et al.*, 2009) and fear of having an accident (Taylor*, et al.*, 2009). This barrier may lead to further perceptions that transport cycling will not be enjoyable, which in turn may further put people off (Taylor*, et al.*, 2009). In the Wellington region there is evidence that suggests women's level of perceived lack of safety is higher than men's (Greater Wellington Regional Council, 2012).

Interestingly, both Belgian and United States research has found that perceptions of traffic and road conditions do not predict transport cycling behaviour (de Geus*, et al.*, 2008; Xing*, et al.*, 2010). In contrast, other studies, such as Moudon*, et al.* (2005) and Troped*, et al.* (2001) have found perceptions of traffic and road conditions are related to the likelihood of cycling. It is possible that this disagreement reflects the road conditions of the study areas (including safety).

Correspondingly, the perception of having access to safe cycle routes (e.g. cycle lanes) has been positively associated with transport cycling behaviour in some studies (Hoehner*, et al.*, 2005; Xing*, et al.*, 2010). Additionally, the provision of on-road cycle infrastructure, such as cycle lanes and paths, may increase the perceived safety of cycling, and therefore could play a key role in increasing transport cycling behaviour (Xing*, et al.*, 2010).

Objective Contextual Factors

A supportive built environment appears to be necessary for encouraging regular transport cycling (Dill, 2009). However, some part of this association may be due to a selection effect, where people who like to cycle choose to live in places where they can express that preference (Saelens*, et al.*, 2003; Xing*, et al.*, 2010).

Urban Form

The primary relationship between the urban environment and the use of active transport relates to two core factors: proximity (or distance) and connectivity (also, directness or ease of travel) (Dill, 2009; Frank*, et al.*, 2004; Saelens*, et al.*, 2003; Troped*, et al.*, 2001). Revealed preference data in the United States shows there is a higher likelihood of cycling to work if the distance is less than five kilometers (Buehler & Pucher, 2012). Mixed land use and compact urban form reduce travel distances and have been shown to be significant factors associated with the use of transport cycling, both overseas and in New Zealand (Buehler & Pucher, 2012; Dill, 2009; Frank*, et al.*, 2004; Frank*, et al.*, 2010; McKim & Singleton, 2013; Moudon*, et al.*, 2005; Saelens*, et al.*, 2003; Xing*, et al.*, 2010).

En-Route Conditions

The presence of traffic seems to be a very important factor that influences cycling behaviour (Pikora*, et al.*, 2003). A revealed preference study in Portland, in the United States by Dill (2009) found that cyclists tend to avoid routes that have high traffic levels. Additionally, a systematic literature review found that there is some empirical evidence to suggest that the presence of en-route cycle specific infrastructure (cycle ways) can increase the number of cycling trips (Saelens*, et al.*, 2003). A revealed preference study using data from 90 cities in the United States found there is a greater likelihood of transport cycling in areas with cycle paths and lanes (Buehler & Pucher, 2012). Furthermore, transport cycling has been positively associated with cycle way connectivity (Titze*, et al.*, 2008) and continuity (Pikora*, et al.*, 2003).

Pucher and Buehler (2008) use Danish, Dutch, and German cities as 'best practice' examples to make the case that the most effective way to encourage transport cycling in other affluent countries with high car use is through the provision of arterial, separated cycle facilities on main routes and traffic calming in residential areas. Wardman*, et al.* (2007) came to similar conclusions using a comprehensive mode choice model to explore the effect of different en-route measures in encouraging cycle commuting. They found that "of the en-route cycle facilities, a completely segregated cycle way was forecast to have the greatest impact" (Wardman*, et al.*, 2007, p. 339). Similarly, an Australian study found the provision of bicycle paths, separated from motor vehicle traffic was likely to be an especially important factor in increasing transport cycling, particularly for women who tend to be more risk averse (Garrard*, et al.*, 2008). Revealed preference data from Portland, USA, suggests cyclists will travel out of their way to use on-road cycle infrastructure such as lanes, paths, and boulevards (Dill, 2009).

End of Trip Facilities

A United States study using revealed preference travel data found that bicycle parking and showers at work were associated with bicycle commuting after controlling for other determinants of cycling to work (Buehler & Pucher, 2012).

The Natural Environment

Revealed preference data shows that people are more likely to cycle for transport over the summer months in the United States (Buehler & Pucher, 2012). In a review of the literature, Heinen*, et al.* (2010) found that although most studies tend to agree that cycling is generally less common in areas that are hilly, Stinson and Bhat (2005) found that experienced cyclists may actually prefer cycling on hills while new cyclists prefer flatter areas.

2.5.3 Latent Demand for Cycling

While individual and psychosocial factors are clearly important in influencing people's decision to cycle for transport, the literature suggests that, at least in places with high vehicle traffic levels and poor cycling provision, actual and perceived external factors are a key influence on cycling for transport for a number of people. It is evident that there are people whose individual and psychosocial attributes predispose them to cycle for transport, but who are stopped by external factors in the built environment, and by motor vehicle traffic in particular (Frank, 2004; Hopkinson & Wardman, 1996; Landis, 1996; Sælensminde, 2004). The literature identifies such people as having a 'latent demand' for transport cycling.

Latent demand implies a preference, want, or need that cannot be satisfied (Cambridge Dictionaries Online, 2013). The New Zealand Transport Agency defines latent demand for cycling as "potential new cycle trips that are currently suppressed, but that would be made if cycling conditions were improved" (Land Transport Safety Authority, 2005, p. 54).

Individuals with latent demand for transport cycling are the people who are most likely to be encouraged to cycle for transport by investments in cycling infrastructure, such as a cycle way (Hopkinson & Wardman, 1996). When assessing potential investments in such infrastructure, decision makers want to take into account not only current cyclists, but also those who want to cycle but feel they cannot due to external barriers (Barker, 2012).

To assess the preferences of individuals with latent demand for transport cycling, it is necessary to first identify those people (Frank, 2004; Wardman*, et al.*, 2007).

Identifying Individuals with Latent Demand for Transport Cycling

It is common for research into transport cycling to simply compare current cyclists with non-cyclists. However, increasingly, researchers are recognising that important insights can be gained by distinguishing sub-groups beyond this simple binary (Bergström & Magnusson, 2003; Dill, 2009). Those with 'latent demand' for transport cycling are one such sub-group (Gatersleben & Appleton, 2007).

It can be assumed that an intervention will realise some degree of latent demand, based on what has occurred in similar, past interventions (Davies*, et al.*, 1997). Additionally, it is clearly easy to identify those with latent demand that has been realised after an intervention has been put in place, and this may be done when evaluating the impact of an intervention. However, there is only one widely used, formalised, and academically recognised approach for distinguishing individuals with latent demand, or 'readiness to change', in advance, so that their preferences can be explored (Davies*, et al.*, 2001; Davies*, et al.*, 1997; Gatersleben & Appleton, 2007; Shannon*, et al.*, 2006). This is the Transtheoretical Model of Intentional Behaviour Change by Prochaska and DiClemente (1994).

The Transtheoretical Model of Intentional Behaviour Change

Prochaska and DiClemente's Transtheoretical Approach was first proposed in 1984, and by 1994 had been developed into the Transtheoretical Model of Intentional Behaviour Change (TTM) (DiClemente, 2007). DiClemente (2007) describes the TTM as "a model that helps us to view human intentional behaviour change" (p.29) by examining the individual's experience and participation in the new behaviour. The TTM views behaviour change as a process rather than an event (DiClemente, 2007; Prochaska & DiClemente, 1994). Unlike other behaviour models, it does not draw on particluar concepts and theories of change as such, but distinguishes five key indicator phases in the process of behaviour change called the Stages of Change, as described in Table 1. The TTM sees change as dynamic and individuals can progress, regress, relapse, or stagnate in any particular stage (DiClemente, 2007).

Table 1: The Stages of Change as described in Prochaska & DiClemente (1994).

Stage of Change:	Characteristics:
Precontemplation	Unaware of problems, no intention to change
Contemplation	Aware of problems, thinking about change
Prepared for action	Intention to change in next 6 months
Action	Action being taken
Maintenance	Has maintained action for 6 months or more

The TTM was originally developed as a practical tool to help practitioners address behavioural health problems such as addictions and weight loss as the model targeted interventions based on the individual's Stage of Change (Prochaska & DiClemente, 1994).

Other social-psychological models are commonly used to study transport behaviour, such as the Theory of Planned Behaviour by Ajzen (1991), and the Norm Activation Model by Schwartz (1977). These use defined constructs to attempt to model current behaviour (Bamberg, 2007). However, as Bamberg (2007) states, these approaches may be inadequate in providing the framework needed to explore potential transport behaviour as an ongoing and dynamic process of change.

Stage based behaviour models, like the TTM, are useful because they allow exploration of the underlying motivation for change, and because they view behaviour change as a process rather than an event (Bamberg, 2007). This level of understanding is considered essential to designing effective transportation behaviour change interventions (Bamberg, 2007).

However, some consider that more research is needed to investigate the use of the TTM in designing effective Stage-matched transport behaviour interventions (Bamberg, 2007).

Strengths, Weaknesses and Limitations of the TTM

The TTM has received mixed reviews based on its theoretical assumptions and its practical application.

The number of stages present in the TTM is not based on a "strong theoretical rationale" (Bamberg, 2007, p. 1759), and the stages are assigned to people based on a few theoretically arbitrary variables (Bamberg, 2007). Sutton (2001) finds that clear delineation between people in each Stage of Change is absent; as such, there may be ambiguity and overlap between the stages. An example of such theoretical critiques can be found in the research of Velicer*, et al.* (1995) who found a range of distinct subgroups within the TTM's Stage of Change groups. Some of these subgroups were even found to require "alternative intervention strategies" (p. 299) to the main group (Velicer*, et al.*, 1995).

Reviews have found mixed evidence to support the application of the TTM to promoting physical activity (Adams & White, 2003; Spencer*, et al.*, 2006), especially in the long term (Adams & White, 2003).

However, despite these criticisms, focussed on its conceptual limitations, a number of studies have used the TTM to investigate the potential for active transport behaviour change. For example, research by Mutrie*, et al.* (2002) identified latent demand groups, and found that targeting active transport interventions to these groups was effective in encouraging these people to walk for transport more often. These researchers point out that the effectiveness of this theory is dependent on the behaviour of interest, and the context in which the behaviour occurs.

The most appealing aspects of the TTM, for both researchers and practitioners, are that it is very useful in exploring the potential for change in individuals, and it is highly practical. It is easily applied to real-world situations, is simple to use, and has straightforward application to decision-making and policy (Davies*, et al.*, 2001; Davies*, et al.*, 1997; Mutrie*, et al.*, 2002; Shannon*, et al.*, 2006; Sullivan & O'Fallon, 2006).

Active Transport Applications of the TTM

One of the first applications of the TTM to transport was in a qualitative study carried out in Britain by Davies*, et al.* (1997). This study proposed the use of a conceptual framework, which the researchers called "a model of contemplation and motivation to change" (p. 1). The purpose of this research was to explore people's stated preference as to what would encourage them to cycle for transport, so that cycling promotional initiatives could be developed and assessed. Although uncredited in this work, this model is actually an application of Prochaska and DiClemente's (1994) TTM.

An application of the TTM by Davies*, et al.* (1997) groups people into five key stages that they defined as follows:

- Pre-contemplation: never thought of it, say they would never consider it
- Contemplation: could conceive of the possibility of change
- Ready for Action: attracted to the prospect, actively considering actions and implications
- Action: has tried or experimented with change, has experienced effects, assessing
- Maintenance: may revert to previous behaviour, will benefit from reinforcement

Davies*, et al.* (1997, p. 20).

Davies*, et al.* (1997) suggest that people in different Stages of Change may perceive differently the motivations for and barriers to transport cycling and propose this as a useful area for further research.

This research was followed up by Davies*, et al.* (2001) using a quantitative, stated preference questionnaire survey of attitude, motivation, and behaviour, which again applied the TTM. This research found the TTM allowed the researchers to gain insight into the readiness of individuals to change and what factors were important to these individuals when considering the uptake of cycling for transport.

In a workplace-based, randomised controlled trial in Scotland Mutrie*, et al.* (2002) tested the TTM's value in predicting increased active commuting (walking and cycling) behaviour for people in the Contemplation and Ready for Action Stages of Change. They found that walking commuting increased twice as much in the intervention group compared to the control group at six months. However, they found no effect on cycling behaviour and concluded that "[t]he environment for cycling must be improved before cycling will become a popular option" (Mutrie*, et al.*, 2002, p. 407). In particular, they commented on the lack of facilities to separate cyclists from general traffic in Glasgow (the study area), as being a barrier to the uptake of transport cycling.

In a study in Surrey, in the UK, Gatersleben and Appleton (2007) explored 'who does and does not cycle and why', using the TTM, in order to investigate the qualities of latent demand for cycling and the preferences of potential cyclists. An online survey was employed to assess respondents' commuting patterns, usual transport cycling behaviour, and attitude, and perceived personal and external barriers to transport cycling. Respondents were also asked to state the conditions under which they would be willing to cycle for transport more often. They found that as people move through the Stages of Change "their attitudes towards cycling become more positive and their perceptions of various personal and external barriers change" (p.302). They confirmed the presence of latent demand for transport cycling; in that there was a group of people who want to cycle for transport and would do so under the right circumstances. This study also found that those who had considered cycling to work, but had not tried it, were more likely to say that it was external barriers (such as a lack of cycle lanes) that prevented them from doing so.

Shannon*, et al.* (2006) also applied the TTM to transport cycling, using a stated preference online survey to assess the barriers, motivations, and potential for active commuting to university, in Perth, Australia. This study found that removing barriers to active transport is more likely to encourage its uptake than promoting its benefits.

In New Zealand, the Land Transport NZ funded a large, nationwide questionnaire study, which included questions to establish respondents' Stage of Change (giving representative regional and national proportions), as well as motivation, and perceived barriers and benefits of transport cycling (Sullivan & O'Fallon, 2006). This study found that contextual barriers, such as heavy traffic and a lack of cycle lanes, may prevent people from even considering cycling for transport.

The Greater Wellington Regional Council uses the TTM's Stage of Change categories as a way of assessing the potential for transport cycling in the region, as well as a measure of success for their active travel promotion programme 'Active a2b' (Greater Wellington Regional Council, 2012).

As this study is focussed specifically on the reallocation of on-street parking space to an arterial cycle way, this literature review now moves on to explore the benefits and costs of providing on-street parking, and the challenges and opportunities of reallocating this space.

2.6 Parking

"[P]arking is desirable, but you can have too much of a good thing"

Shoup (2005, p. 14)

Perhaps until recently, conventional transport planning has seen it as necessary and important to provide ample car parking at all destination points, including on inner-city retail streets. There are a number of benefits of, and assumptions for, providing car parking that have reinforced this idea.

Car parking can provide convenient access to shops and services for those who drive. Additionally, car parking is important for those who are not able to use alternative modes of transport, such as the disabled or elderly.

On-street car parking has been shown to slow the speed of traffic, making streets potentially safer for pedestrians (Marshall*, et al.*, 2008). Additionally, cars parked on the sides of streets provide a physical barrier between pedestrians and moving vehicles, and have been shown to buffer pedestrians' exposure to vehicle pollution (Gallagher*, et al.*, 2011). Reducing convenient parking in inner-city shopping streets may push people to shop in malls, where parking is usually free, abundant, and easy to use (Reimers, 2013). Another important benefit of on-street car parking for councils is that it can be a significant source of revenue.

However, according to Shoup (2005) conventional parking practice "evolved into conventional wisdom without good theory or careful research" (p.11). There are a number of significant costs to providing large amounts of parking on streets in city centres. Ensuring ample parking, when most people have access to a car, results in a huge amount of space and infrastructure dedicated to car parking (Shoup, 2005). This comes with opportunity costs, as this space can no longer be used for other purposes, such as retail, wider footpaths, public transport lanes, cycle ways, or green space etc (Cairns*, et al.*, 2002). A study in Melbourne has shown that car parking is not necessarily the most efficient use of public space, with the amount of trade generated for local shops from car parking being less than that generated from bicycle parking (Lee & March, 2010).

Another example of the space inefficiency of on-street parking is that it encourages urban sprawl, as the extra space required reduces the density of inner urban areas, and pushes people, shops and services further out (Davis*, et al.*, 2010; Shoup, 2005). Associated with this sprawl is the increase in car use that is encouraged with the provision of bountiful on-street parking. If people know they are able to find a car park, they may be happy to live further away from the city centre, compounding urban sprawl (Newman & Kenworthy, 1999; Newman & Kenworthy, 1989).

Relatedly, providing ample, convenient parking reduces the appeal of alternative modes of transport, and reinforces car dependency. An important part of this is that having on-street car parking can increase the danger to walkers and cyclists by reducing the vision of drivers and increasing the number of hazards for street users (Heinen*, et al.*, 2010; Torrance*, et al.*, 2009). Furthermore, public transport networks can be negatively affected as on-street parking significantly contributes to road congestion due to 'cruising for parking' and the performance of parking manoeuvres (Shoup, 2005).

Additionally, parking may detract from urban design values. Compactness is directly diminished by abundant parking, as are the amenity values of narrower streets. High levels of parking can reduce peoples' perception of the safety, sociability, and pleasantness, of a neighbourhood (Mullan, 2003), which is important when a council is trying to attract new residents to the urban centre.

Despite these costs, it is common for retailers to view parking as vital for their business, and consider that the more parking that is provided the more their business can grow. As such, policies to restrain parking, through pricing, time limits, or reducing supply, are often met with resistance from retailers. However, many studies suggest this may not be the case (including Kodransky & Hermann, 2011; Marsden, 2006; Mingardo & van Meerkerk, 2012; Pitsiava–Latinopoulou*, et al.*, 2012; Weinberger*, et al.*, 2010). Additionally, policies that restrain parking are widely accepted, at least academically, to be an effective, and often overlooked, form of travel demand management (Jansson, 2010). The reallocation of road space from on-street parking is one example of this that has been used around the world, especially in Europe, and often comes with significant benefits.

Although studies of shopping expenditure are conflicted about which mode users spend more per trip (probably due to contextual differences between studies), there is general agreement that active and public transport users visit urban shopping areas more frequently than car users, so their contribution to the local economy may be greater overall (Kodransky & Hermann, 2011; Richardson, 2010; Sztabinski, 2009).

If space reallocated from on-street parking is designed well, to make it attractive to people and to provide for and promote alternative modes, retail trade and vitality can increase (Fleming*, et al.*, 2013; New York City Department of Transportation, 2013). Furthermore, reducing the supply of car parks has been shown to be more effective at reducing car trips to an area than increasing the price of parking (Marsden, 2006). It has been shown that these car trips that are reduced are made by other modes, if they are available, rather than being avoided altogether (Hensher & King, 2001). If other modes are made more attractive at the same time, the resulting modal shift from cars, can therefore, reduce the overall demand for car parking. This means that reducing parking can significantly lessen the costs to society of car use, such as congestion, pollution, and physical inactivity (Jansson, 2010).

Many of these reallocation benefits are dependent on how the reallocated space is used. It has been shown that if this is done well, reallocation of on-street parking improves the sense of community and increases social interaction, and makes the area a more attractive place to be (Leyden, 2003; Lund, 2002; Wood*, et al.*, 2010).

In short, a number of studies have shown that the assumption that reducing parking will be bad for business is supported by very little evidence, and in many cases, the opposite effect may occur. The relationship between parking and economic vitality is likely to be highly dependent on the attributes of the specific area, the other transport options available, and the types of retail and other businesses present (Marsden, 2006).

The next section investigates how the issues discussed in this chapter are addressed through policy in the Wellington region, and explores the context of this study.

3 Wellington Policy and Context

As argued in Chapter 2, a shift is occurring in the transport planning paradigm. The need for a shift toward more sustainable mobility is clear, and policies to encourage this are being employed in many cities around the world. This chapter looks at policy on transport, road space, cycling, and parking in Wellington, to establish the decision making context of this study. This, in turn, informs the research questions of this thesis, which are set out at the end of this chapter.

3.1 Road Space and Transport

In New Zealand, central government transport policy, along with Acts of Parliament, principally the Local Government Act 2002, the Resource Management Act 1991, and the Land Transport Management Act 2003, provide a framework for, and guide, local level transport policies and actions. Local-level government in Wellington consists of the regional authority, the Greater Wellington Regional Council (GWRC), and the territorial authority, the Wellington City Council (WCC).

City councils are tasked with creating transport plans and policies for their own local areas. These need to be in line with the city council's long term plan and district plan, as well as with the regional council's long term plan and regional land transport strategy. These in turn need to conform to the national land transport programme, which sets out the national funding for transport activities, and the government policy statement on land transport funding, which states the Government's transport funding priorities for each ten year period, and this all must be in line with the Government's long term transport policy direction (set out in 'Connecting New Zealand') and national legislation (Ministry of Transport, 2011b, 2012b).

Under Section 10, Subparts 1(a) and (b), of the Local Government Act 2002, the purpose of local government is to "…enable democratic local decision-making and action by, and on behalf of, communities…" and includes:

> *"…[T]o meet the current and future needs of communities for good-quality local infrastructure…";*

where 'good-quality' is defined under 10(2)(a, b and c) as:

> *"…[E]fficient; and effective; and appropriate to present and anticipated future circumstances…".*

The GWRC is the local authority that governs the Wellington region, of which Wellington city is a part. Their role in the region's transport system is to "fund bus and train services… plan the roading network and… build public transport infrastructure" (Greater Wellington Regional Council, 2013).

All of the Wellington Regional Council's transport-related plans, projects, and activities come from the Regional Land Transport Strategy (RLTS). The RLTS is a statutory document, prepared under the Land Transport Act 1998 and in accordance with the Land Transport Management Act 2003, which provides the overall strategic framework for investment in the region's land transport network. The vision of the current RLTS 2010 to 2040 is:

> *"[T]o deliver an integrated land transport network that supports the region's people and prosperity in a way that is economically, environmentally and socially sustainable."*

Greater Wellington Regional Council (2010, p. 1)

With the transport policy hierarchy and the Local Government Act 2002 in mind, the WCC has prepared transport plans and policies for Wellington city. The WCC's most recent Transport Strategy acknowledges that road capacity in Wellington city is limited. It states that the city's road space is highly contested, and that the current transport system is not sustainable:

> *"Road space in our CBD is at a premium, and choices need to be made about competition for that space amongst private cars, buses, cyclists and pedestrians. In common with the rest of the developed world, we have challenges regarding the sustainability of our transport system"*

Wellington City Council (2006a, p. 2)

The WCC considers future transport challenges to include both an increase in congestion and an increase in competition for road space between different modes of travel. The Transport Strategy considers that a successful transport system in Wellington will require “making trade-offs between the differing demands for road space by different modes” (Wellington City Council, 2006a, p. 4).

The use and design of public road space is also guided by the WCC Public Space Design Policy. This was adopted in December 2010 and gives direction to the design, delivery, and management of Wellington’s public spaces.

Objective three of this Policy is to improve accessibility for all. This objective states that:

> *“Streets should operate more efficiently than just as traffic channels for vehicles. They should offer a safe and attractive environment for all. The city’s public spaces are experienced at their most intense on foot and by cycle…”*
>
> Wellington City Council (2010b, p. 6)

Under this accessibility objective, policy three states that:

> *“Traffic efficiency and on-street parking requirements should not dominate, and needs to be considered in the context of pedestrian and cycle use and amenity.”*
>
> Wellington City Council (2010b, p. 6)

One recently announced initiative to address Wellington’s future transport challenges, is the construction of an arterial cycle way connecting Island Bay with the city centre. This has been described in the Introduction Chapter and is the focus of this research. It is likely to involve the reallocation of some road space from on-street car parking. As such, local transport polices relevant to transport cycling, and the use of road space for cycling and on-street car parking, are now reviewed.

3.2 Cycling and Lanes Policy

The GWRC RLTS considers cyclist safety to be an area of high concern in the Wellington region, primarily due to dangerous driving, vehicle speed and “a lack of space dedicated for cycle lanes” (Greater Wellington Regional Council, 2010, p. 19).

The vision of this RLTS was mentioned earlier. One of the key aspirations of this strategy is that:

> *“People will generally walk or cycle for short and medium length trips. Pedestrian and cycling networks will be convenient, safe and pleasant to use”*
>
> Greater Wellington Regional Council (2010, p. 2)

In addition to road safety, particularly for cyclists, the RLTS identifies additional regional issues of severe traffic congestion, particularly at peak times, and transport related greenhouse gas emissions (pp. 7 - 20). To address these issues the GWRC has identified several outcomes and key actions as strategic priorities over the period 2010 to 2040. These include:

- Increased mode share for pedestrians and cyclists
    - Related outcomes: improved level of service for pedestrians and cyclists; increased perceived and real safety for pedestrians and cyclists.
        - Key actions: improve walking and cycling facilities; provide cycle lanes on local roads; improve cycling networks.
- Reduced greenhouse gas emissions
    - Related outcomes: reduced private car mode share; reduced fuel consumption; increased private vehicle occupancy.

Greater Wellington Regional Council (2010, pp. 27 - 36)

The WCC’s long-term strategic transport outcomes, relevant to cycling and cycle ways, are in line with the RLTS. These include:

- Making transport more sustainable, including by: increasing the use of low-energy transport options; and continuing modal shift of commuter traffic to public transport, walking and cycling.
- Making transport healthier, including by: promoting walking and cycling and reduced dependence on motor vehicles for short trips.
- Making transport safer (monitored using actual and perceived measures of safety).

Wellington City Council (2006a, pp. 6 - 7)

The WCC also provides for cycling through its Cycling Policy. The strategic intent of this policy is to make cycling in Wellington safer (perceived and actual safety) and more convenient for those who choose to cycle (Wellington City Council, 2008). As the WCC states, it "endorses an interlinked network of on-road lanes and off-road paths" and "emphasises that quality, well-located facilities is key to making cycling safer, more convenient and fun in Wellington" (Wellington City Council, 2008, p. 2).

3.3 On-Street Car Parking Policy

The WCC provides all on-street parking in the city and administers three off-street parking facilities (Michael Fowler Centre, Civic Square, & Clifton Terrace). The WCC regulates and manages privately provided off-street parking through the District Plan and also through the provision of resource consents. The WCC considers that the supply of on- and off- street parking is 'high' in Wellington in comparison to other cities of similar size (Wellington City Council, 2007, p. 2).

The WCC Parking Policy 2007 states that it "provides a direction for how the council can manage the limited resource of on-street parking in order to achieve the best outcome for the city" (Wellington City Council, 2007, p. 2). As such, it "aims to support a better land transport system for Wellington and New Zealand that is integrated, safe, responsive, and sustainable" (Wellington City Council, 2007, p. 14).

The Policy also states that the Council aims for “best use of public road space” and to “support strategic outcomes” of the Council (Wellington City Council, 2007, p. 3). The Council aims to manage on-street parking in such a way as to support the key outcomes of:

- A safe and vibrant city
- Contained urban form with plenty of transport choices
- Promoting the local, national, and international environment
- Promoting strong, cohesive communities with robust social infrastructure
- Retaining and developing Wellington’s cultural identity

Wellington City Council (2007, p. 3)

Principle iii of the WCC Parking Policy acknowledges that “[s]treet space is a scarce resource and priority for use for parking needs to be considered against other uses and depends on the location, type of street, time of day and day of week” (Wellington City Council, 2007, p. 5).

On-street parking in the city centre is described as being “primarily to support retail and entertainment facilities, servicing for commercial and professional activities, community recreational facilities and events. Commuter parking and residents’ parking are not a priority for on-street parking” (Wellington City Council, 2007, p. 10).

As stated in the Introduction Chapter, Tory Street is being considered as a potential route for a proposed cycle way, and is therefore the street of interest to this research. Tory Street runs north to south from the waterfront to the outskirts of the city centre, and is identified by the WCC as a principal road, as it connects the southern suburbs to the city (Wellington City Council, 2013a), although it is not the only road doing so. The WCC Parking Policy states that priority for road space on principal “…roads at peak times should be for the movement of people to, from and through the central area” (Wellington City Council, 2007, p. 10).

3.4 The Reality: Cycling, Driving, and On-Street Parking in Wellington City

The review of policy has shown that increasing the number of people cycling for transport is important to local transport strategy, and considering the removal of on-street parking to allow for this is warranted.

Currently, however, the number of people choosing to cycle for transport in the city is relatively low, with only four per cent of people choosing to cycle their commute to work (Greater Wellington Regional Council, 2012). Additionally, cycling is the second most dangerous transport mode in New Zealand (after motorcycling), and Wellington is the most dangerous city to cycle in New Zealand (Ministry of Transport, 2012a). Additionally, residents' perceptions of how safe it is to cycle in Wellington have become more negative in recent years (Ministry of Transport, 2013b).

Furthermore, the policy review emphasised both councils' strategic objectives include increasing actual and perceived cycle safety in the city though the provision of dedicated cycle lanes. Currently, Wellington is characterised by narrow roads that commonly have cars parked on both sides of the street. There are few dedicated on-road cycle ways, and those that do exist are typically disconnected, narrow, painted lanes, which may be in the car-door or reversing zone of parked vehicles, or may be shared with buses. Examples of cycle facilities provided on some of Wellington's streets are shown in Figures 5 and 6. Off-street cycle paths that do exist are generally shared with pedestrians.

Figure 5: Island Bay Parade cycle lane.

Figure 6: Oriental Parade cycle lane.

Additionally, Wellington households have lower levels of access to motor vehicles than the national average, and Wellington residents increasingly perceive the cost of travelling by private car to be prohibitively high (Ministry of Transport, 2013b). There are, therefore, potentially increasing numbers of people who cannot rely on a car and must use other modes of transport.

WCC expects a population increase of 33,000 people between 2001 and 2026, and 50,000 more people by 2055. The council is expecting an increase in demand for higher density, urban living and a decrease in household size (Wellington City Council, 2006b). The WCC is planning for most growth to be contained by increasing residential density along a north to south 'spine' intersecting the central city (Wellington City Council, 2006b). This higher density would be consistent with less car use, and instead more use of active and public transport. However, if private car use were to continue at recent levels, this population increase may mean that many of the aspirations and goals outlined in the policy section, above, would be unattainable (e.g. increasing sustainability, and reducing congestion and emissions).

There is clearly a gap between policy and practice in regard to the provision of dedicated cycle ways in Wellington. The proposal of the case study cycle way is a step towards closing this gap. However, it is important to know how effective this cycle way is likely to be in attracting new people to cycling and increasing the number of trips made by bicycle. Additionally, the space used for the cycle way must come from somewhere, so it is also important to consider what impact the loss of this space from the current use will be.

It is outside the scope of this research to investigate the whole proposed route from south Wellington to the CBD[1]. This study is, therefore, limited to investigating the current use of on-street parking on Tory St and the demand for a cycle way in the proposed cycle way area. With this in mind, the aim and research questions of this thesis are now presented.

[1] The length of route under examination in this study (Tory Street) is just over 800m, compared to the total distance from the Island Bay coast to the Wellington waterfront of approximately 6km.

3.5 Research Questions

The aim of this research is to explore the extent to which road space reallocation from on-street parking to a cycle way is warranted between Wellington's southern suburbs and city centre, with a case study of Tory Street. This aim has been broken down into four research questions that have been developed from reviewing the literature and policy. These are:

1. What are the qualities of demand, including latent demand, for transport cycling and an arterial cycle way that connects Wellington's southern suburbs and city centre?
2. Would an arterial cycle path in the case study area encourage more cycling? If so, then where would this increase come from?
3. How much public parking is there on and around Tory Street?
4. What contribution does the on-street parking on Tory Street make to the businesses on Tory Street?

4 Methods

4.1 Methodological Approach

This study employs a pragmatic approach, in which the primary concern is how best to understand the research problem and address the research aim. A pragmatic approach appreciates that research occurs within a historical and social context, and therefore should be designed around what works best, and based on the intended outcomes of the study (Creswell & Plano Clark, 2011; Kitchin & Tate, 2000).

The present research investigates the current use of public road space for on-street parking, on Tory Street, and explores the demand for an alternative use, an arterial cycle way. The case study area[2] for this research, the corridor connecting Wellington city and its southern suburbs, has its own particular context based on historical and current use, and the social and political systems built around this reality. To recognise such complexity, a mixed methods strategy was chosen as the best way to explore this topic. Mixing methods allows for the use of both quantitative and qualitative data, and such multiple measurements provide more dynamic data collection options and, therefore, gather additional meaning. This allows the results to be triangulated and corroborated, which in turn provides more robust findings (Creswell & Plano Clark, 2011). This research employs a concurrent mixed methods procedure whereby “the investigator collects both forms of data at the same time and then integrates the information in the interpretation of the overall results” (Creswell, 2008, p. 15).

Accordingly, this research initially uses analysis of academic literature and government policy documents, and case study description, to set the scene, provide the research context, and direct the study’s lines of enquiry by establishing what data needs to be collected and what methods are best used to do this. Then, original data are collected using three methods: an online survey, a street-intercept survey, and local observation. Although this study employs a mixed methods design, it is predominantly quantitative and is supplemented with qualitative elements.

[2] Throughout this report, the “case study area” refers to the north-south corridor connecting Wellington city’s CBD/waterfront with the southern suburbs (Island Bay, Berhampore, Newtown, and Mt Cook).

An online survey was used to collect data to address research questions 1 and 2, using both quantitative and qualitative questions to explore the qualities of demand, including latent demand, for transport cycling and the case study cycle way.

Local observation was used to address research question 3 by manually counting the supply of public parking on and around Tory Street, in the case study area.

Finally, a street-intercept survey was used to address research question 4 by assessing the commercial activity generated on Tory Street by those using the on-street parking.

Victoria University of Wellington Human Ethics Committee granted ethics approval for this research on 28 November 2012 (Appendix A). All statistical analyses were performed using Microsoft Excel 2013 and IBM SPSS (Version 20) software.

4.2 Online Survey

Research question 1 asks 'What are the qualities of demand, including latent demand, for transport cycling and an arterial cycle way that connects Wellington's southern suburbs and city centre?' Research question 2 asks 'Would an arterial cycle path that connects Wellington's southern suburbs and city centre encourage more cycling? If so, where would this increase come from?'

To address research questions 1 and 2 information was needed from individuals who travel within, or through, the case study area. This naturally includes residents of the case study area, and also those who live elsewhere and travel into, or through, the case study area for work, school, shopping or other purposes. The researcher cannot readily identify these individuals in advance. As such, it became apparent that a data collection method that allowed individuals to identify themselves as being a member of the targeted sub-population was necessary. Given this, it was decided that an online survey, which could be sent to a wide range of people, was the best option. People could then choose to participate if they self-identified as part of the group of interest.

The data requirements of this study also fit well with an online survey; these requirements had been identified in advance based on analysis of academic and government literature. Additionally, online surveying was preferred as it has the ability to capture large amounts of specific data in a short timeframe and with low cost (Creswell, 2008; Madge & O'Connor, 2003).

4.2.1 Online Survey Design

The survey was designed to address research questions 1 and 2. It contained initial questions that allowed respondents to be assigned to Stage of Change groups, based on criteria adapted from similar work by Gatersleben and Appleton (2007), and designed to be comparable with similar New Zealand work (Sullivan & O'Fallon, 2006).The remainder of the survey was designed to gather information on individuals' preferences, perceptions, and opinions on transport cycling and on the case study cycle way. Additional questions captured frequency of travel in the case study area, and demographic information to allow comparison with Census data. See Appendix B for the complete survey.

4.2.2 Online Survey Deployment

The online survey was launched on 28 November 2012 and closed on 28 February 2013. The survey was hosted by an independent survey company, regularly used by Victoria University researchers, Qualtrics. The survey was linked to Victoria University through the URL "vuw.qualtrics.com" and, displayed official Victoria University of Wellington branding such as its colours and logo. Survey links were emailed to major employers, organisations, community groups, and places of education[3] identified within the case study area. Internet links were also sent to identified interest groups and organisations, such as local government bodies, and cycling groups (both recreational and advocatory).

Respondents were requested to forward the link to other parties of interest. The author is aware (via word of mouth and personal respondent contact) that the link passed through numerous additional businesses and organisations around Wellington

[3] Staff at primary and secondary schools, and staff and students at tertiary institutes, as children were not studied in this research

city. The email requested responses from people who 'live, work, or ever travel through' the case study area. It also requested responses from those who 'would never cycle, want to (but don't), or always do' (see Appendix C for recruitment email). A sample of n = 606 responses were generated from these email links.

Thirty posters containing a shortened version of the online survey link (a 'tinyurl') were posted in public spaces in the case study area on notice boards and street-posts, and in medical centres (including Wellington Hospital), cafes, sports clubs, community centres, religious gathering places, and dairies. See Appendix D to view a copy of the posters. Another n = 39 responses were generated by these flyer links.

4.2.3 Data Processing and Analysis

The survey closed with n = 645 responses. Incomplete responses (n=28) were identified and removed. Duplicate responses were checked for using I.P. address and respondent demographic information. No duplicate responses were found. The completion rate of the survey was 96 per cent. Of the remaining n = 617 respondents, n = 10 were unable to cycle due to a physical condition or never having learnt. The remaining n = 607 respondents could be used for the Stage of Change analysis. The n = 10 respondents who were unable to cycle were included in the analysis of 'willingness to lose some on-street parking'.

For all of the following analyses, unless otherwise stated, missing values were excluded pair wise[4].

Respondent Characteristics

To assess the type of people who had taken the survey, respondents' basic demographic characteristics were compared with the most recent (2006) Census results for the Wellington region.

[4] Cases are only excluded if they are missing a value of a variable that is included in the specific analysis, as opposed to list wise exclusion where cases are excluded from all analyses if they have any missing values.

Research Question 1

Research question 1 asks 'What are the qualities of demand, including latent demand, for transport cycling and an arterial cycle way that connects Wellington's southern suburbs and city centre?'

To answer this question, Stage of Change grouping was used to confirm whether there is indeed demand, and latent demand, for transport cycling among the survey respondents. Once that was established, reasons for unrealised latent demand were assessed. This was done by evaluating respondents' opinions and willingness to cycle for transport, and their perceptions of some common external barriers to such cycling. The relative importance of a cycle way in realising this latent demand was then assessed through examining the circumstances under which respondents would be willing to cycle for transport more often. In assessing the demand for the case study cycle way, its design and route characteristics are important. Therefore, respondents' perceptions of these were assessed to determine which characteristics were most important to the different groups. Finally, to bring these analyses together and address research question 1, the stated likelihood of use of the case study cycle way was assessed along with respondents' willingness to give up some on-street parking in the case study area in order to allow for an arterial cycle way. As the specific cycle way characteristics and route are not yet known, this question was worded to assess general attitudes towards losing parking.

Stage of Change Grouping

To identify whether there is demand, and latent demand, for transport cycling in the survey sample, respondents were grouped by Stages of Change, and group frequencies were analysed. Stage of Change grouping identifies individuals with continuing demand for transport cycling (those who already cycle regularly), latent demand for transport cycling (those willing and ready to cycle for transport, but who do not cycle regularly), and those with no demand for transport cycling (those who would not even consider it).

Respondents were therefore grouped, on the basis of recent transport cycling behaviour and readiness to cycle, into one of the Transtheoretical Model's five Stage of Change groups (Prochaska & DiClemente, 1994), using criteria adapted from Gatersleben and Appleton (2007) and Sullivan and O'Fallon (2006). The way respondents answered questions 6, 7, and 8 of the online questionnaire determined the grouping. Questions 6, 7, and 8, along with response options, are as follows:

Q6: "Have you ridden a bicycle for transport at all in the past year?"

1 "Yes"

2 "No"

Q7: "How often have you ridden a bicycle for transport during the last three months?"

1 "Not at all in the last three months"

2 "Less than weekly"

3 "Once or more a week"

Q8: "For a short journey, when the weather is fine and you have nothing much to carry, would you..."

1 "not consider using a bicycle"

2 "possibly consider cycling but wouldn't actually do it"

3 "possibly consider cycling, and rarely or sometimes do it"

4 "often cycle"

5 "almost always cycle"

Each respondent was assigned to one of five Stage of Change groups, using the criteria below:

Precontemplation: Have not cycled for transport in the last year (Q6) and would not consider cycling (Q8)

Contemplation: May or may not have cycled for transport in the last year, have not cycled in the last three months (Q7), may possibly consider cycling for transport but wouldn't actually do it (Q8)

Ready for Action: May or may not have cycled for transport in the last year (Q6), may have cycled not at all, or less than weekly, in the last three months (Q7), and would possibly consider cycling and rarely or sometimes do it (Q8).

Action: Have cycled for transport in the last year (Q6), once or more per week in the last three months (Q7), and often cycle (Q8)

Maintenance: Have cycled for transport in the last year (Q6), once or more per week in the last three months (Q7), and almost always cycle (Q8)

The above descriptions are represented visually in Table 2, below.

Table 2: Stage of Change grouping and grouping criteria based on responses to the online survey.

Group	Q6 response (has cycled in the past year):	Q7 response (cycle frequency over last 3 months):	Q8 response (consider cycling for a short journey):	Number of respondents meeting criteria
Precontemplation	2 (no)	-	1 (no)	58
Contemplation	1 (yes) or 2	1 (not at all) or -	2 (possibly/don't)	74
Ready for Action	1 or 2	1, 2, or - (<wkly)	3 (possibly/rarely or sometimes do)	90
Action	1	3 (> wkly)	4 (often)	117
Maintenance	1	3	5 (almost always)	173

After this initial process, n = 512 respondents were successfully categorised. The remaining ungrouped respondents' (n = 95) answers to questions 6, 7, and 8 were checked in more detail and respondents were assigned to groups based on 'best fit', as shown in Table 3. The respondents' past cycling behaviour determined this 'best fit', when it contradicted their response to the hypothetical situation in Q8.

Table 3: Secondary Stage of Change categorisation criteria for respondents who did not meet the initial criteria shown in Table 2.

Group	Q6 response (has cycled in the past year):	Q7 response (cycle frequency over last 3 months):	Q8 response (consider cycling for a short journey):	Number of respondents meeting criteria
Precontemplation	N/A	N/A	N/A	N/A
Contemplation	1 (yes)	1 (not at all)	5 (almost always)	3
	1	2 (< wkly)	2 (possibly/don't)	7
	2 (no)	-	5	2
	1	1	4 (often)	6
	2	-	4	6
	1	1	1 (no)	9
	1	2	1	3
Ready for Action	1	2	5	5
	1	2	4	26
Action	1	3 (> wkly)	1	4
	1	3	2	1
	1	3	3 (possibly/rarely or sometimes do)	23
Maintenance	N/A	N/A	N/A	N/A

Once all participants were grouped, the Stage of Change group frequencies were compared to those for the Wellington region, as reported in both Sullivan and O'Fallon (2006) and Greater Wellington Regional Council (2012).

To assess what kinds of people were in the different Stage of Change groups, selected characteristics were compared across the groups. The characteristics compared were age, gender, income, level of education, and vehicle and bicycle access. The socio-economic and demographic variables (age, gender, income, and education) were analysed using Multinomial Logistic Regression. This assessed the relative correlation of Stage of Change group membership with these characteristics. Vehicle and bicycle access was assessed using χ^2 Test of Independence and standardised residual analysis.

Perceptions of Cycling for Transport

Next, some of the reasons for unrealised latent demand were assessed by evaluating respondents' opinions of, and willingness to, cycle for transport, and their perceptions of some common external barriers.

These three factors were measured using 11 questions (Questions 9-19) in the online survey, which were then combined to form three composite variables.

Composite Variables

Questions 9 to 19 of the online survey were seven-point Likert scale questions adapted from those used by Gatersleben and Appleton (2007). Respondents selected the extent to which they agreed or disagreed with each statement, as shown in Figure 7. The responses were combined for each individual into three continuous Likert variables: opinion of cycling; willingness to cycle; and perception of external barriers.

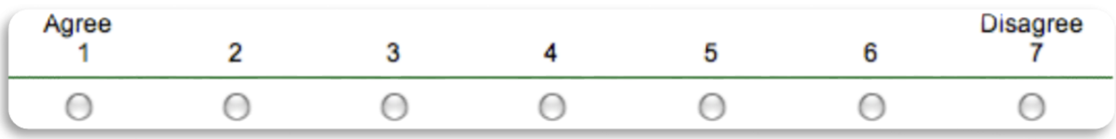

Figure 7: Likert scale used in online survey for questions 9 to 19

Before the responses were combined, missing values were replaced with a neutral '4'. This was chosen because participants were asked to leave the answer blank if they did not know. For these questions 'don't know' is considered to be equivalent to a neutral response. Therefore, replacing missing values with a '4' was appropriate. A total of 81 missing values were replaced.

Next, the responses to questions 12 to 15 were reversed so that a '7' indicated a positive response towards cycling, in line with the other seven questions.

Exploratory factor analysis was conducted on the 11 variables to assess how they could best be reduced into composite variables. The factor loadings for each variable are shown in Table 4. A factor loading of 0.5 or higher indicates that the variable can be included in the corresponding component (Hair*, et al.*, 2006). The factor analysis confirmed that these 11 variables should be combined into three composites as shown in Table 4. These composite variables were calculated by averaging each individual's score across the component variables.

Table 4: Factor loadings generated using exploratory factor analysis for questions 9 to 19.

Rotated Component Matrix[a]

	Component		
	Willingness to cycle	External barriers	Opinion of Cycling
Cycling is good for your health	.152	.014	.834
Cycling is good for the environment	.096	.125	.862
I like cycling	.763	.104	.177
Generally speaking I want to cycle	.834	.075	.059
I am fit enough to cycle	.568	-.086	.111
I would feel comfortable on a bicycle	.751	.016	.112
It would be characteristic for me to use a bicycle for transport	.802	-.020	-.039
In general, there are not enough cycle lanes in Wellington	.128	.629	.323
In general, it is unsafe to cycle around Wellington	-.391	.583	.193
In general, there is not enough secure bicycle parking in Wellington	.050	.822	-.043
In general, there are not enough showering and changing facilities for cyclists in Wellington	.045	.787	-.061

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 4 iterations.

The mean scores of these composite variables were then compared across the Stage of Change groups using One-Way ANOVA and Tukey HSD[5] tests to identify statistically significant differences in these factors between the groups. Additionally, Friedman's Two-Way ANOVA and Wilcoxon's Signed Ranks tests were used to identify statistically significant differences between these perception variables within each Stage of Change group. Prior to conducting these tests, the variables were assessed for normality and found to be not normally distributed. The One-Way ANOVA and Tukey HSD were used for analysis between groups as they are reasonably robust against violations of normality (Schmider*, et al.*, 2010). However, for the within group analyses, Friedman's Two-Way ANOVA and Wilcoxon's Signed Ranks tests were more appropriate as they are designed for use with non-parametric data (Green & Salkind, 2011).

Respondents were given the option to make a written comment below their responses to Q9 to Q19, if they wanted to. Selected responses were used to illustrate and add depth to these findings.

Relative Importance of a Cycle Way

To assess the relative importance of a cycle way in realising latent demand for transport cycling, the range of circumstances under which people stated they would be willing to cycle for transport more often was examined. In the online survey, this was an open question that required a written response, and asked "Under what circumstances would you be willing to cycle for transport (more often)?", adapted from Gatersleben and Appleton (2007). Respondents were not prompted, but free to describe any range of circumstances.

All of the responses were read and analysed for their content, such as key words and ideas. Respondents were placed into the corresponding theme, or themes, based on their written responses. These themes are identified in Table 5.

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[5] Tukey HSD is a post-hoc statistical test used to identify the source(s) of significance found by the One-Way ANOVA, i.e. which means are significantly different to the others.

Table 5: Key ideas and phrases and their corresponding themes, generated through content analysis.

Theme	Key ideas and phrases
None (at present)	Currently, under no circumstances
Personal Changes	Being motivated, fitter, having more experience or training
Lifestyle Changes	"If the people in my life would cycle with me", "If it was shorter/longer distance", "If it was more convenient", "If I did not have to take others/goods or trip chain"
Equipment	"If I had a bicycle, a better bicycle (such as an electric bicycle), or cycling gear"
Geography & Climate	Better weather or flatter terrain/less hills
Road Safety Changes	Separation from vehicles, safer/better roads and traffic conditions (less/slower/more considerate traffic)
General Policy Changes	Secure bicycle parking, showering and changing facilities, public transport integration, if the helmet law was revoked, financial incentive, or a bicycle hire scheme

Hypothetical Route Choice Factors

In assessing the demand for the case study cycle way, its design and route characteristics are important, especially if trying to attract new cyclists.

Accordingly, respondents' perceptions of the relative importance of four route characteristics, identified from the literature review as potentially important, were assessed. These route characteristics are: being the quickest (or most direct) route; being a route through green space; being the safest route; and being the least hilly (flattest) route. Respondents ranked the importance of each characteristic on a scale of 1, unimportant, to 7, important.

The mean scores for each route characteristic were compared across the Stage of Change groups, using One-Way ANOVA and Tukey HSD tests to identify statistically significant differences. Again, Friedman's Two-Way ANOVA and Wilcoxon's Signed Ranks tests were used to explore the relative importance of the four route choice variables for each Stage of Change group.

Case Study Cycle Way: Likelihood of Use

Part of the final analysis addressing research question 1 was to analyse, for those respondents with a frequency of travel in the case study area of once or more per week, if the case study cycle way was built, how likely it would be that they would use it. Respondents ranked their likelihood of use on a scale from 1, unlikely, to 7, likely. Responses 1 to 3 represented an 'unlikely' response, 4 represented a 'neutral' response, and 5 to 7 represented a 'likely' response.

For analyses, 'unlikely' and 'neutral' responses were grouped together and responses were recoded into a binary variable, where 0 represented unlikely and 1 represented likely. These were then compared across Stage of Change groups using χ^2 and standardised residual analysis.

Willingness to Lose Some On-Street Parking

Lastly, respondents who travel once or more weekly in the case study area were asked "Even if it reduced the amount of on-street parking available on some arterial streets, would you support the construction of a cycle path connecting the southern suburbs with Wellington's CBD/waterfront?"

The idea of phrasing this hypothetical question as trading one service for another, and use of 'even if' at the start of the question was adapted from Levine and Frank (2007). This question provided a useful 'reality check', as the demand for the case study cycle way is more robustly assessed through checking how willing people are to trade a current service, in this case some on-street parking, for the service of a potential cycle way. Exploring this trade-off ensures that the evaluation of demand is grounded in reality, as road space is finite and there is not the option to have a cycle way without forgoing a current use.

Respondents could select from 'yes', 'no', 'maybe', or 'don't know' to answer this question. 'Maybe' and 'don't know' were grouped together and the answers were then compared across Stage of Change groups using χ^2 tests and analysis of standardised residuals.

Research Question 2

Research question 2 asks 'Would an arterial cycle path in the case study area encourage more cycling? If so, then where would this increase come from?' Respondents rated their likelihood of use on a scale from 1, unlikely, to 7, likely, in response to the question:

> "If an arterial cycle path, separated from traffic, was constructed connecting Wellington's southern suburbs and the CBD/waterfront, how likely is it that you would cycle more frequently for transport?"

This question was analysed for respondents who travel in the case study area once or more per week. Responses 1 to 3 represented an 'unlikely' response, 4 represented a 'neutral' response, and 5 to 7 represented a 'likely' response. For analysis, 'unlikely' and 'neutral' were grouped together and responses were recoded into a binary variable, with 0 being unlikely and 1 being likely.

The responses were analysed using Binary Logistic Regression to assess correlations between reported likelihood of increased cycling, and Stage of Change group and other respondent characteristics, namely: Gender, Age, Income, Education, Opinion of Cycling, Willingness to Cycle, and External Barrier Perception.

4.2.4 Online Survey Limitations

There are a number of limitations of using an online survey and stated preference, as well as in the sample method used to gather data for this research. These are discussed in detail in section 6.3 of this thesis.

Additionally, as this survey was conducted online and respondents were self-selected, and although great care was taken to provide as many relevant people as possible with a chance to participate, results cannot be said to be representative of any particular population. Therefore, the analysis in this report applies to the response sample only.

4.3 Manual Parking Count

4.3.1 Research Question 3

A manual parking count was used to address research question 3. Research question 3 asks 'How much public parking is there on and around Tory Street?' The purpose of this research question is to assess the relative importance of Tory Street on-street parking by comparing it to the total supply of public parking within a short walking distance.

Figure 8: Area within one street block of Tory St shown in purple shading. Base map and mapping software provided by Google (2013).

Defining the Study Area

A literature search was undertaken in attempt to define the maximum distance people may be willing to walk from a car park to their destination, in a city setting such as central Wellington. No literature could be found that established this. Therefore, a distance of 'one street block' of Tory Street was chosen as a reasonable distance which most people were assumed to be willing to walk, from a car park, to access businesses on Tory Street.

Accordingly, to address research question 3, all public car parking within one street block of Tory Street was counted. The area shaded in purple, in Figure 8, represents one street block from Tory Street, within which the supply of car parking was counted.

Types of Car Parks Counted

There are four types of public car parking available within one street block of Tory Street, and all these types of parking were counted for this study. These are:

On-street parking:

- On Tory Street (paid and free)
- Within one street block of Tory Street (paid and free)

Off-street parking:

- Commercial parking (paid)
- Free customer parking (for businesses and shops on Tory Street).

The types of businesses that provided free customer parking were also recorded.

Data Processing and Analysis

Car parking was tallied for each parking category; then the supply of Tory Street on-street parking was compared to the total supply within one street block and the supply of free, off-street customer car parking on Tory Street.

4.3.2 Parking Count Limitations

Although great care was taken to find and count all car parks as described, it is possible that some were inadvertently missed. To reduce the likelihood of this the parking count was undertaken by two people, independently. If any parking was missed, the parking counts may slightly underestimate the parking supply on and around Tory Street.

4.4 Street-Intercept Survey

4.4.1 Research Question 4

A street-intercept survey was used to gather data to address research question 4, "What contribution does the on-street parking on Tory Street make to the businesses on Tory Street?"

Addressing this research question required gathering data from people using the businesses, shops and services on Tory Street. The information required was: Tory Street footpath users travel and parking type (if any), trip purpose, intention to visit Tory Street, frequency of visiting Tory Street, and money spent (actual and anticipated) in places on Tory Street and elsewhere in the city. The full survey is presented in Appendix E.

The data collection method chosen was footpath-user intercept and request for voluntary participation in the interviewer-administered survey. The interview took about one minute to complete and respondents were given a chocolate fish to thank them for their participation.

This footpath-intercept sampling method captured people who have a trip origin or destination on Tory Street. This included those who had travelled to elsewhere in the city and then walked to access Tory Street, and those who had driven to Tory Street, parked in on-street or off-street parking, and walked along Tory Street to access their destination. However, it did not capture people who move through Tory Street by vehicle, with both trip origin and destination outside the case study area. This exclusion was considered acceptable for the study, as the focus was on on-street car park space reallocation for a cycle way, and not roadway thoroughfare reallocation: those passing through without stopping would not be affected. This sampling method also did not capture people who had driven to a Tory Street destination, used free, off-street customer parking, and left without walking to other destinations on Tory Street. Again this was not considered to be a problem, as free, off-street customer parking would not be affected by the street reconfiguration being considered by this study.

Intercept Survey Site Selection

Survey sites were chosen to give a representative range of Tory Street locations. Flexibility was also employed on the day to move responsively to sites where most people were visible. The 10 survey sites are shown in Figure 9.

Figure 9: Tory Street pedestrian intercept survey sites. Base map and mapping software provided by Google (2013)

Date, Day, and Time Selection

The survey was undertaken during late November 2012 and late January 2013. It was suspended over the Christmas holiday period as this may have given atypical results. Although it would have been ideal to gather data over a range of seasons, this was outside the time constraints of this research project.

The survey was carried out on a range of days of the week, and times of the day, to make sure a range of street users and uses were captured. These are shown in Table 6. The survey was not undertaken during evenings and nights due to personal safety considerations.

Table 6 Survey site descriptions and corresponding survey date, time, and response number. Site numbers correspond to those in Figure 3, above.

Site	Description	Date	Day	Time period	No. of Hours	Response tally	Decline tally
1	Northeast end of Tory St.	21/01/13	Mon	3:15pm to 4pm	0.75	3	6
2	Outside # 8 Tory Street	26/01/13	Sat	11am to 12pm	1.00	36	60
3	East side of Tory near Courtenay Pl.	21/01/13	Mon	2pm to 3:15pm	1.25	30	47
4	Outside #49 – 61 Tory St.	27/01/13	Sun	12:30pm to 3pm	2.50	60	109
		30/01/13	Wed	10:30am to 12:30pm	2.00	68	157
5	Outside #58 Tory St.	27/11/12	Tues	9am to 11am	2.00	35	57
6	Outside #69 Tory St.	27/11/12	Tues	12:00pm to 1:30pm	1.50	45	67
7	Outside #80 Tory St.	26/01/13	Sat	9:30am to 10:15am	0.75	15	30
8	Corner of Tory and Lorne St	27/11/12	Tues	11am to 11:30	0.50	8	25
9	Outside #90 Tory St.	26/01/13	Sat	10:15am to 11am	0.75	10	29
10	Outside #133 Tory St.	30/11/12	Fri	1pm to 4:00pm	3.00	78	136
Total					16 (32 people hours)	388	723

Basic weather observations were also made on the survey days and these are shown in Table 7.

Table 7: Basic weather observations for Tory Street on the street-intercept survey days.

Date	27/11/12	30/11/12	21/1/13	26/01/13	27/01/13	30/01/13
Weather observations	Overcast, moderate wind, cool	Overcast, light wind, cool	Fine, light wind, warm	Fine, light wind, warm	Fine, no wind, warm	Fine, no wind, warm

Response

1111 people were approached to take part in the survey. 723 declined participation and 388 accepted. This gives the survey a response rate of 34.9 percent.

Data Processing and Analysis

The data were manually entered into a Microsoft Excel spreadsheet and double-checked to correct any data entry errors. It was then imported into the IBM SPSS package for analysis.

Respondents who were on Tory Street but reported that they were passing through to elsewhere, and had spent, or anticipated spending, no money on Tory Street, were excluded from the analysis. For all analysis, any cases with missing values were excluded pair wise.

To remove the sample bias toward people using Tory Street as a thoroughfare, those respondents who had not, and were not intending to, spend any money on Tory Street, who had not parked on Tory Street, and whose only purpose for being on Tory Street was to pass through, were excluded from analysis (n = 79). 309 respondents remained.

Bar charts were used to explore the modes of travel respondents used to access the city centre, and their parking requirements (if any). Bar charts were also used to compare total and average spend for the present trip (sum or mean of actual and anticipated) on Tory Street and elsewhere in the city centre, for each parking type (including parking not required). The type of parking used for the *current* visit was then assessed against how frequently respondents visited Tory Street using a bar chart. Lastly, the respondents' parking requirements were compared against their current purpose for visiting Tory Street.

4.4.2 Limitations of the Street-Intercept Survey

Limitations of the sampling methodology have already been discussed in the introduction to this sub-section. An additional limitation is that 'spend' on Tory Street and elsewhere in the city centre included how much respondents had spent, and how much more they anticipated spending. Of course, this anticipated spend creates an additional level of uncertainty. However, while conducting the intercept survey, it was noted that most respondents had a very clear idea of their anticipated spend, and those who said they did not know were recorded as a 'missing value' and therefore excluded from any spending analysis. Further limitations of this survey are discussed in section 6.3.

4.5 Methods Summary

This study employed a pragmatic, mixed methods approach to address the aim, "To explore the extent to which road space reallocation from on-street parking to an arterial cycle way is warranted between Wellington's southern suburbs and city centre, with a case study of Tory Street".

An online survey was used to collect data to address research questions 1 and 2, using both quantitative and qualitative analyses to explore the qualities of demand, including latent demand, for transport cycling and the case study cycle way. Observation was used to address research question 3 by manually counting the supply of parking on and around Tory Street, in the case study area. In addition, a street-intercept survey was used to address research question 4 by assessing the commercial activity generated on Tory Street by those using the on-street parking.

In the next chapter, the results are shown for each research question in order. In the discussion chapter, the results are then tied together and discussed in light of the literature and wider case study context.

5 Results

The results of this research are now presented in the order of the research questions.

Research question 1 enquired about the characteristics of those interested in cycle travel in the research area. First, the results of the Stage of Change grouping of the sample is compared with the Stage of Change profile for the region. Multinomial logistic regression is used to explore the relative associations of socio-economic and demographic characteristics with Stage of Change for the sample. χ^2 (chi^2) tests of independence are used to assess the association of vehicle and bicycle access with Stage of Change. Perceptions of cycling, among the Stage of Change groups are explored using One-Way ANOVA and Tukey HSD tests, and Friedman's Two-Way ANOVA and Wilcoxon Signed Ranks tests. These are further explored through a qualitative analysis of participants' comments. The second part of the analysis of research question 1 follows, with a thematic analysis of the relative importance of a cycle way for increasing transport cycling. This is complemented by an analysis of preferred route characteristics of a cycle way by Stage of Change group, using One-Way ANOVA and Friedman's Two-Way ANOVA once again. The analysis of research question 1 is completed with χ^2 analyses of the likelihood of using the case study cycle way and the willingness to give up on-street car parking for this cycle way, across the Stage of Change groups.

Research question 2 examines the role of the case study cycle way in increasing transport cycling. This is addressed through a Binary Logistic Regression that explores the characteristics of those participants who stated they would be likely to cycle for transport more frequently if the case study cycle way existed.

To address research question 3, the results of the public car parking supply count, on and around Tory Street, are presented.

Finally, research question 4 is addressed by presenting the results of the Tory Street intercept survey, which explores the parking requirements, retail spend, visit frequency, and trip purpose of people on Tory Street to establish the contribution made by on-street parking to the local economy of Tory St.

5.1 Online Survey Results

The online survey had a completion rate of 96 per cent and a sample size of 617 valid responses, as discussed previously in the Methods Chapter.

While great care was taken to publicise the online survey to people who travel within, or through, the case study area, the respondents cannot be claimed to be representative of this sub-population. As such, the results of the online survey apply to the sample population only, but may be indicative of the general opinion of travellers within the case study area.

5.1.1 Respondent Characteristics

Figures 10 through 13, below, compare selected demographic characteristics of the online survey sample with those of the Wellington region population from the 2006 Census. These are provided for reference and to give an understanding of the comparative characteristics of the survey respondents.

As Figures 10 through 13 show, the sample population is not representative of the regional population. This is to be expected as this survey specifically targeted users of the case study area. As the characteristics of the 'users of the case study area' population are not defined, it is not possible to determine whether or not the survey sample is representative of this population of interest.

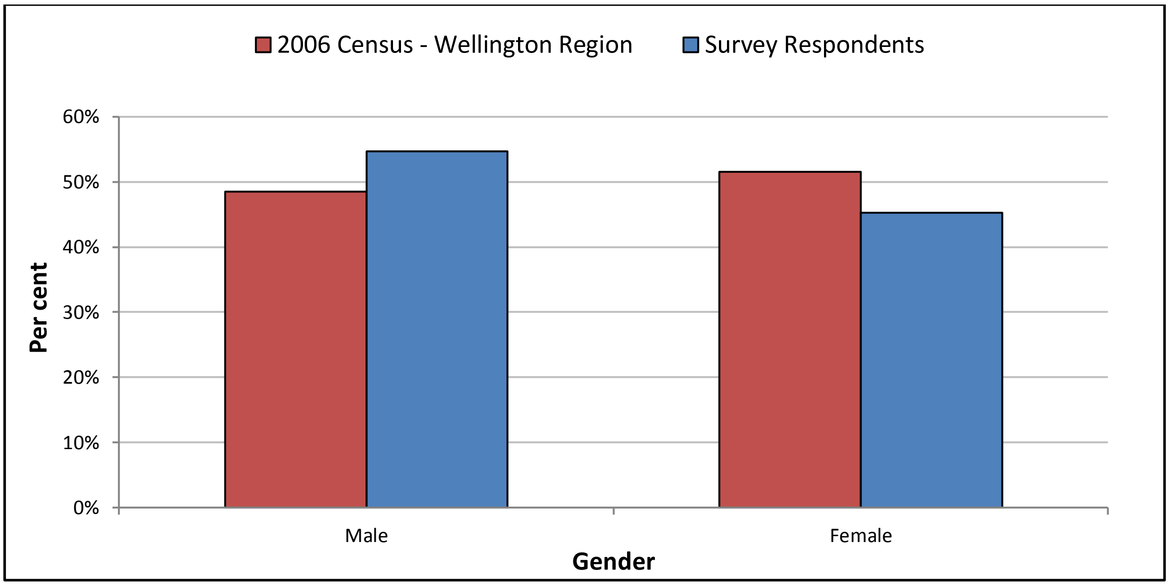

Figure 10: Gender of the online survey sample compared with the Wellington region population (n = 616).

As Figure 10 shows, the survey sample had a slightly lower proportion of females and a slightly higher proportion of males than the Wellington region population.

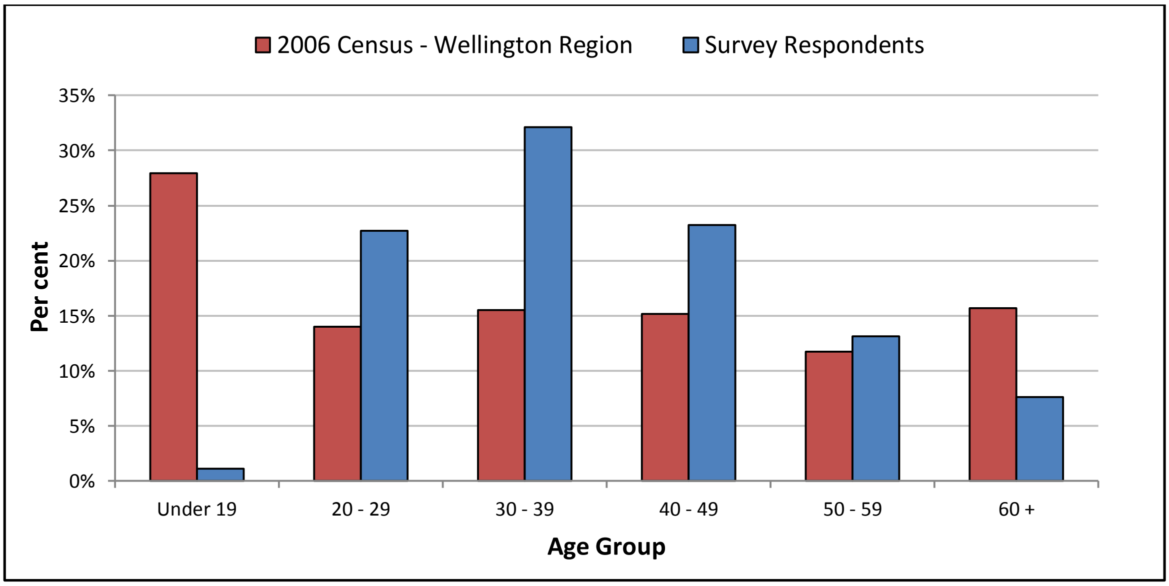

Figure 11: Age of the online survey sample compared to the Wellington region population (n = 616).

As the online survey was aimed at adults 18 years and older, the survey sample contains a lower proportion of people aged under 19 and over 60 than the population of the Wellington region, as shown in Figure 11. Conversely, the survey had a higher proportion of people aged 20 to 59 than the Wellington region population.

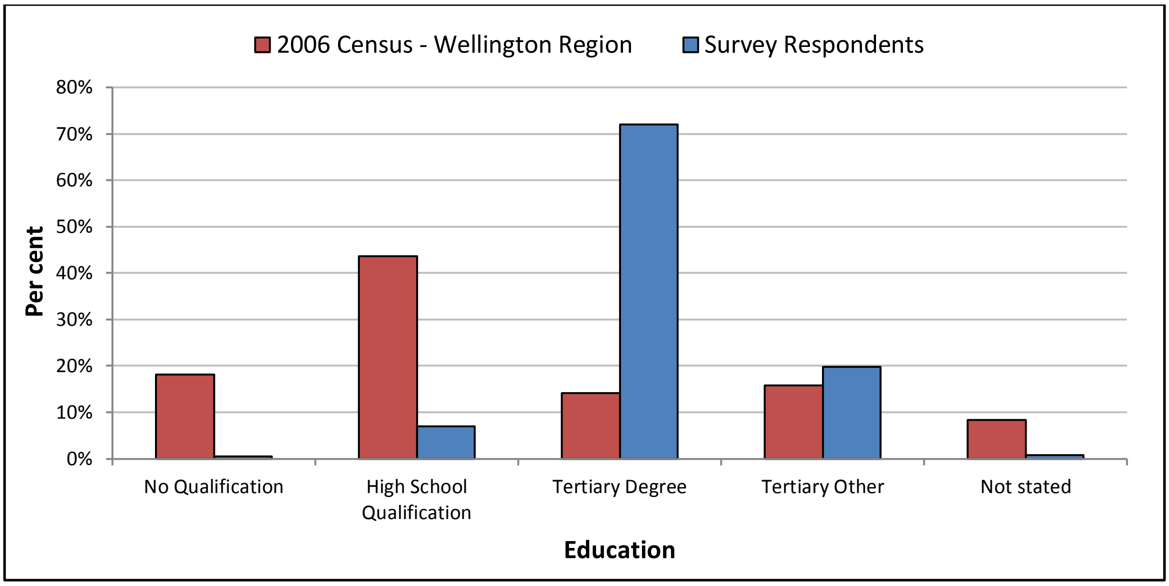

Figure 12: Highest level of education of the online survey sample compared to the Wellington region population (n = 617).

As shown in Figure 12, the survey respondents generally had a higher level of education than the population of the Wellington region.

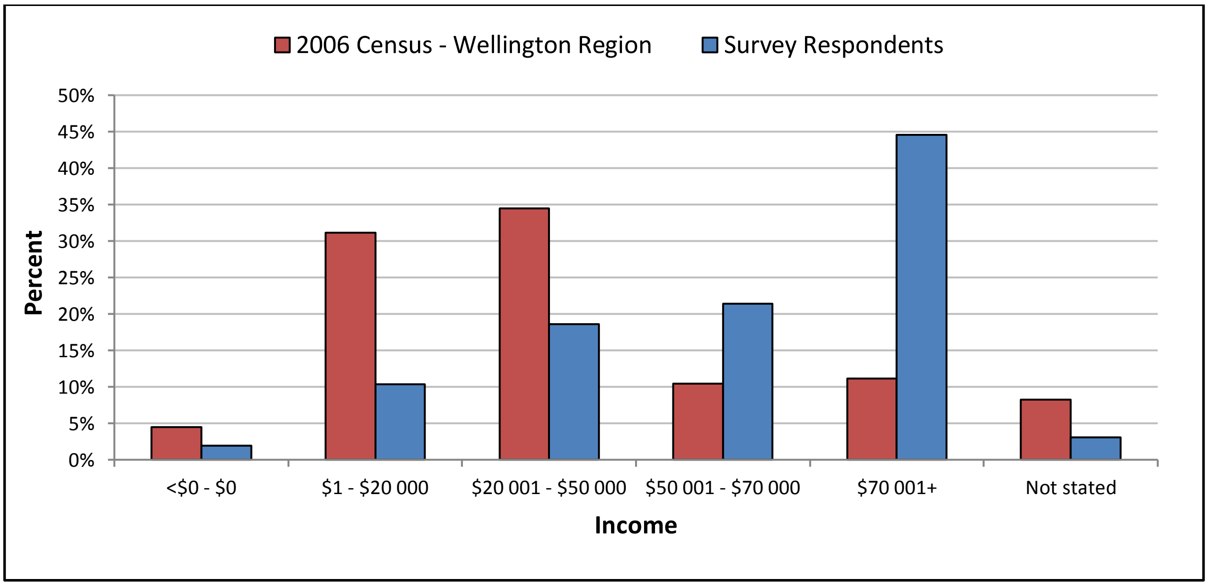

Figure 13: Personal income before tax of the online survey sample compared to the Wellington region population (n = 617).

Additionally, as seen in Figure 13, incomes were generally higher among the survey sample than those among the regional population.

5.1.2 Research Question 1

Research question 1 asks 'What are the qualities of demand, including latent demand, for transport cycling and an arterial cycle way that connects Wellington's southern suburbs and city centre?' This section addresses this question, as explained at the start of this Chapter.

Stage of Change Groups

Table 8 shows the number and per cent of online survey respondents allocated to each Stage of Change group, as per the procedure and criteria discussed in the Methods Chapter. Figure 14 shows this information visually and Figure 15 compares the proportion of the sample in each Stage of Change group with those of the Wellington region.

Table 8: Number and per cent of online survey respondents in each Stage of Change group.

Stage of Change Group	n =	Per cent (%)
Pre-contemplation	70	11.3
Contemplation	98	15.9
Ready for Action	121	19.6
Action	145	23.5
Maintenance	173	28.0
Unable to classify[6]	10	1.6
Total	617	100

[6] People who cannot ride a bicycle, either because they are not physically able or due to having never learnt, were not placed in Stage of Change groups (n = 10). As such, these respondents were not included in any Stage of Change analysis.

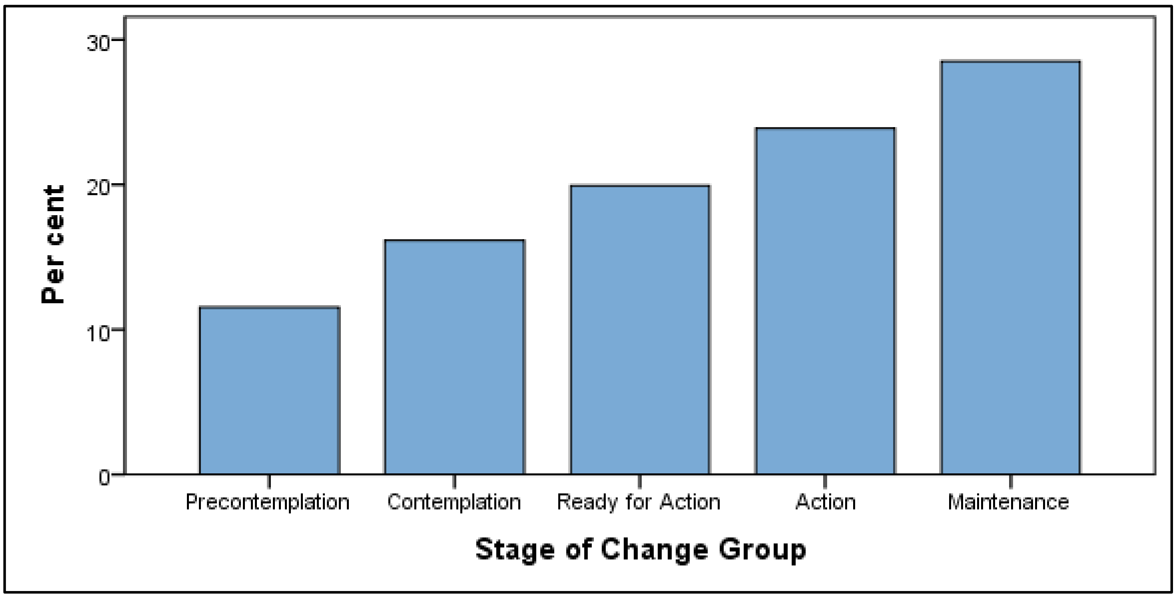

Figure 14: Per cent of online survey respondents in each Stage of Change group (n = 607).

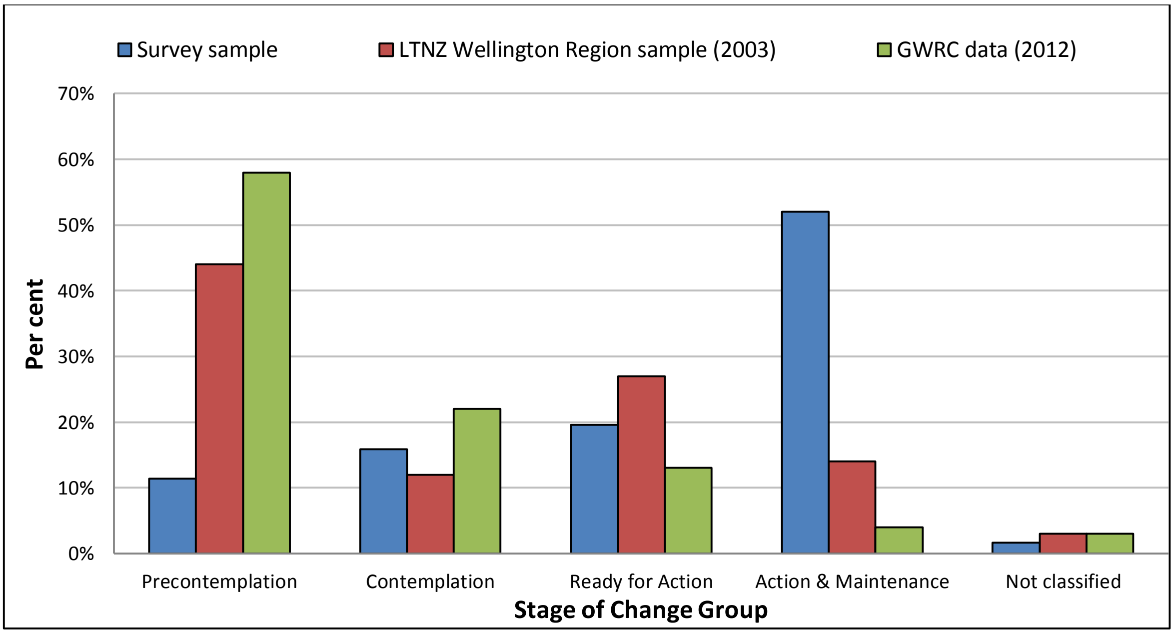

Figure 15: Proportion of the survey sample (n = 607) in each Stage of Change group compared to those in Sullivan and O'Fallon (2006) (LTNZ) and the Greater Wellington regional Council (2012).

As shown in Figure 15, the survey sample contains a higher proportion of current cyclists (those in Action and Maintenance groups[7]) and a lower proportion of people in Precontemplation than found in studies of the Wellington region carried out in 2003[8]

[7] Action and Maintenance groups have been merged here to allow for comparison with Sullivan and O'Fallon (2006) Research Report 294 data

[8] Data for LTNZ Research Report 294 was collected in 2003 and published in 2006 (Sullivan and O'Fallon, 2006)

(Sullivan and O'Fallon, 2006) and 2012 (Greater Wellington Regional Council, 2012). Additionally, a slightly higher proportion of respondents were in Contemplation and a slightly lower proportion were in Ready for Action.

Although the proportions of the Stage of Change groups are not the same as those found for the region, the following analysis accounts for this by comparing responses across Stage of Change groups, with percentages calculated within groups, rather than for the sample as a whole. This reduces the effect of a high proportion of respondents being current cyclists. Furthermore, it is not clear whether the population of interest (case study area users) have the same Stage of Change profile as the Wellington region.

Characteristics of the Stage of Change Groups

To explore the relative associations of socio-demographic characteristics with Stage of Change group a multinomial logistic regression, modelling Stage of Change group with gender, age, income, and education, was used.

Multinomial logistic regression found that Stage of Change group membership had a statistically significantly relationship with both gender ($p < 0.001$), and age ($p = 0.029$), but not with income or education, when controlling for other variables in the model. Standard errors indicate that there were no numerical problems with the model (all were less than 2.0). Additionally, the classification accuracy of the model (35.8 per cent) was greater than the proportional by chance accuracy criterion (27.4 per cent). The model is, therefore, useful in predicting Stage of Change group. The reference categories in the regression were set as the last group for each variable. For Stage of Change group this was Maintenance; for Gender this was Female; for Age this was 60 and over; for Income this was more than $70,000; and for Education this was Tertiary Other. The Model Fit, Likelihood Ratio, Parameter Estimates, and Classification tables can be found in Appendix F.

When all other variables in the model were held constant, males were significantly less likely than females to be in Precontemplation, Contemplation, or Ready for Action over

Maintenance (*OR*[9] (Precontemplation) = 0.183, $p < 0.001$, *CI*: 0.096 – 0.347, *OR* (Contemplation) = 0.273, $p < 0.001$, *CI*: 0.157 – 0.474, *OR* (Ready for Action) = 0.428, $p = 0.001$, *CI*: 0.259 – 0.705). There was no significant differentiation of Action from Maintenance with gender. Figure 16 illustrates this relationship.

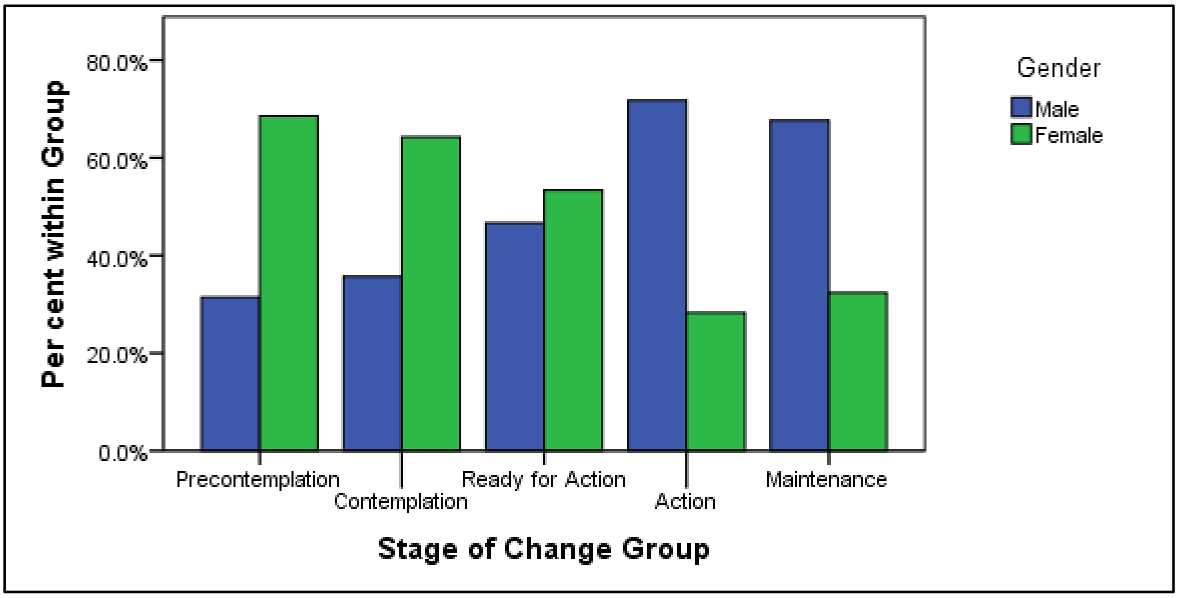

Figure 16: Gender percentages of the Stage of Change groups (n = 606).

The multinomial logistic regression also found that people aged 40-49 were significantly less likely than people aged 60 or more to be in Contemplation over Maintenance, when all other variables in the model were held constant (*OR*= 0.216, $p = 0.012$, *CI*: 0.065 – 0.716). Age was not significant in differentiating between any other groups.

χ^2 tests of independence were used to assess the association between access to a vehicle, or access to a bicycle, and Stage of Change group. No significant association was found between vehicle access and Stage of Change group.

The χ^2 test of independence showed a significant association between Stage of Change group and access to a bicycle (χ^2 (4, 607) = 247.93, $p < 0.001$). Figure 17 shows the percentages of people with access to a bicycle in each Stage of Change group. People with access to a bicycle were underrepresented in Precontemplation (z-score = -4.5) and Contemplation (z-score = -3.6) and overrepresented in Action (z-score = 2.5) and Maintenance (z-score = 2.8). Accordingly, people without access to a bicycle were

[9] *OR* indicates the Adjusted Odds Ratio. *CI* indicates the 95 per cent Confidence Interval.

overrepresented in Precontemplation (z-score = 9.2) and Contemplation (z-score = 7.5) and underrepresented in Action (z-score = -5.1) and Maintenance (z-score = -5.7). The Ready for Action group did not significantly contribute to the χ^2 result.

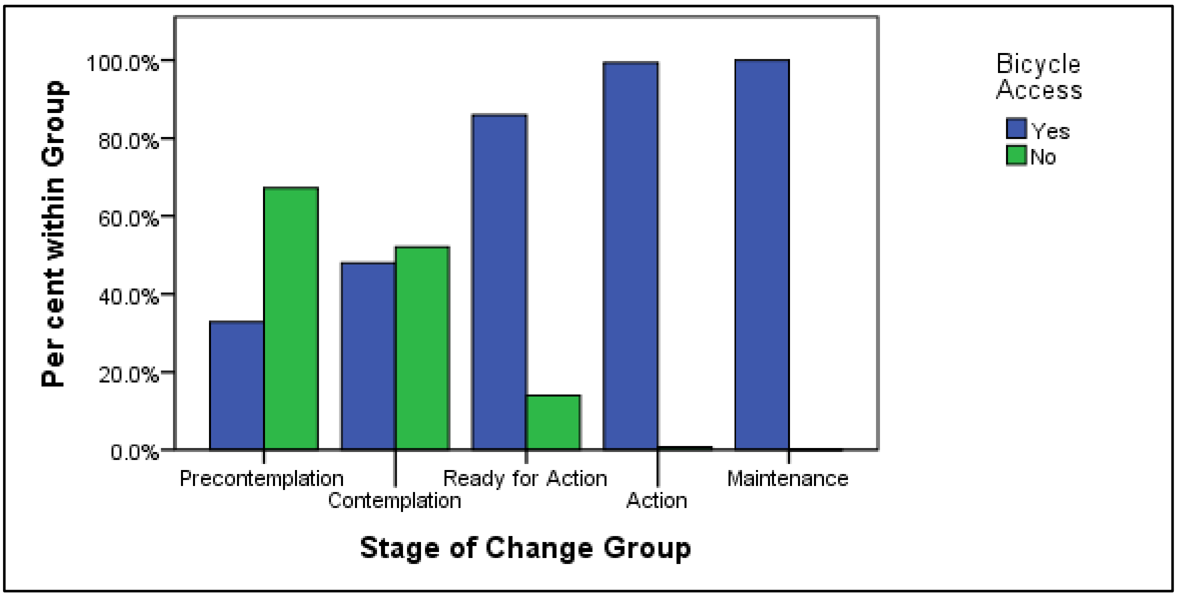

Figure 17: Percentage of individuals with access to a bicycle by Stage of Change group (n = 607)

Perceptions of Cycling for Transport

Mean scores for the composite Likert variables opinion of cycling, willingness to cycle, and perception of external barriers to cycling, were compared across the Stage of Change groups using One-Way ANOVA and post-hoc Tukey HSD tests, in order to examine the differences in perceptions of cycling for transport in Wellington.

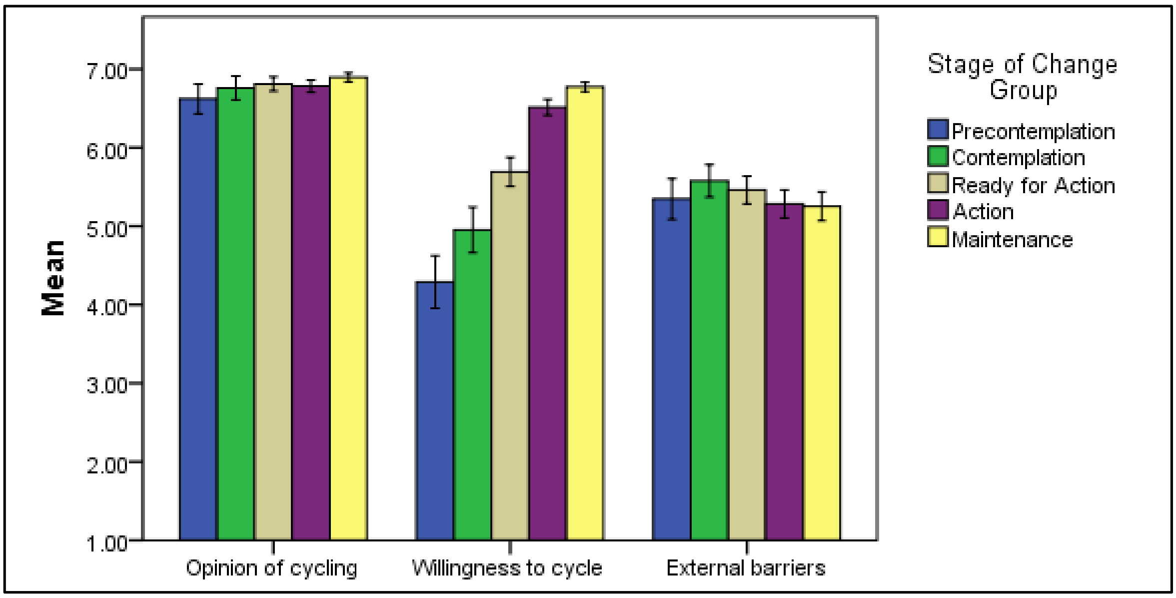

Figure 18: Opinion of Cycling, Willingness to Cycle, and Perceived External Barriers to Cycling, compared across the five Stage of Change groups. Error bars represent 95 per cent confidence interval.

For opinion of cycling, a 7 on the scale in Figure 18 indicates strong stated agreement that cycling is good for one's health and for the environment, while a 1 indicates a strong stated disagreement. For willingness to cycle, a 7 on the scale indicates strong stated agreement that the respondent likes cycling, wants to cycle, is fit enough, would feel comfortable, and that it would be within their character. Again, a 1 on the scale indicates a strong stated disagreement.

Lastly, for external barriers, a 7 on the scale indicates strong stated agreement that in Wellington there are, generally, not enough cycle lanes, it is unsafe, and that there are not enough secure parking, showering and changing facilities. Once more, a 1 on the scale indicates a strong stated disagreement.

Opinion of Cycling

Despite the apparent similarity across Stage of Change groups in their opinion of cycling (Figure 9), the One-Way ANOVA test detected a significant association between Stage of Change group and opinion of cycling [$F(4, 602) = 3.22$, $p = 0.012$]. Similarly, post-hoc analysis using a Tukey HSD test found a statistically significant difference in the mean score for opinion of cycling, between the Precontemplation (M = 6.62, SD =

0.796) and Maintenance (M = 6.90, SD = 0.382) groups. There were no significant differences found between any of the other pairs of groups.

All groups stated a favourable opinion of cycling, with the lowest mean score belonging to the Precontemplation group (6.62).

Willingness to Cycle

Willingness to cycle was much more differentiated across Stage of Change groups than was Opinion of cycling. The One-Way ANOVA test found a significant association between Stage of Change group and willingness to cycle [$F(4, 602) = 126.365, p < 0.001$].

Post-hoc analysis using Tukey HSD showed that each Stage of change group's stated willingness to cycle was significantly different from the others, with the exception of Action and Maintenance (M = 6.51, SD = 0.626 and M = 6.77, SD = 0.399 respectively). These two groups were not significantly different from each other, but were significantly different from Precontemplation, Contemplation, and Ready for Action (M = 4.29, SD = 1.41; M = 4.95, SD = 1.45 and M = 5.69, SD = 1.03 respectively).

This analysis shows that, perhaps not surprisingly, willingness to cycle increases sharply across the Stage of Change groups. Interestingly, even the group with the lowest willingness to cycle, Precontemplation, had a mean score of 4.29, which is slightly above a neutral score of '4'.

Perception of External Barriers

The One-Way ANOVA test did not find a significant association between Stage of Change group and the perception of external barriers to cycling [$F(4, 602) = 1.789, p = 0.129$].

However, all groups perceived the external barriers to cycling as being reasonably high, with mean scores ranging between 5.25 (for the Maintenance group) and 5.58 (Contemplation). A rating of between 5 and 6 represents a fairly substantial level of agreement that in Wellington there are, generally, not enough cycle lanes, it is unsafe to cycle, and that there are not enough secure parking, showering and changing facilities.

Perceptions of Cycling within Groups

The three Likert scale variables (Opinion of Cycling, Willingness to Cycle, and Perceived External Barriers to Cycling) were compared within Stage of Change groups using Friedman's Two-Way ANOVA and Wilcoxon's Signed Ranks tests. Although these three variables are not complete measures of opinion, willingness, and external barriers, and they were not designed to be directly comparable, patterns in the data give an interesting indication of how these three variables may interact which warrants further investigation. Figure 19 shows the three variables grouped by Stage of Change group. The scale for this Figure (19) is the same as for Figure 18, above.

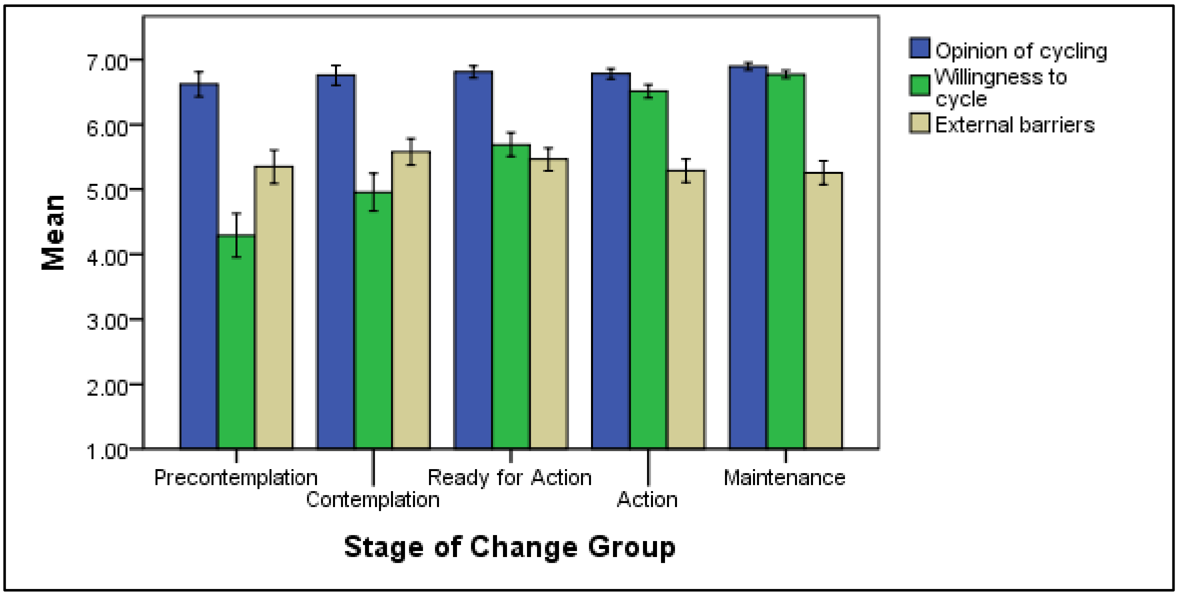

Figure 19: Opinion of Cycling, Willingness to Cycle, and Perceived External Barriers to Cycling, compared within the five Stage of Change groups. Error bars represent 95 per cent confidence interval.

Friedman's Two-Way ANOVA showed statistically significant relationships were present between the three variables for all five Stage of Change groups (all $p < 0.001$). The follow-up Wilcoxon's Signed Ranks Test showed that the three variables were significantly different from each other for all groups except for Ready for Action (again all $p < 0.001$, except for Contemplation and Ready for Action Willingness – External Barriers which were $p = 0.001$ and $p = 0.055$ respectively). In the Ready for Action group Willingness to Cycle was not significantly different from Perceived External Barriers (p = 0.055). What is interesting is how Willingness to Cycle varied relative to External Barrier Perception across the five groups. For both Precontemplation and Contemplation, Willingness to Cycle was significantly lower than External Barrier Perception, but was significantly higher than External Barrier Perception for Action and Maintenance (those who are current cyclists), while for Ready for Action there was no significant difference between these two variables.

The key pattern that stands out is that Willingness to Cycle varies across the Stage of Change groups, while the other views on cycling do not vary much by group. Full details of these statistical tests have not been reported here, as they are quite extensive. The tables giving full details of these statistical tests can be found in Appendix G.

Qualitative Responses

To add insight and depth to the perception of cycling analysis, respondents were given the opportunity to comment on their responses if they wished. 91 people chose to leave a comment. 16 were in Precontemplation, 18 were in Contemplation, 18 were in Ready for Action, 15 were in Action, and 24 were in Maintenance. By far the predominant comment, by people in all Stage of Change groups, was that they would cycle, or cycle more frequently, if it was safer. Respondents in the Action and Maintenance groups tended to comment on more specific safety issues (such as specific intersections or road conditions), while those in the 'early' stage groups made more general safety comments. It was reasonably common for people in the earlier Stages of Change to mention they had been a regular cyclist in the past, and they liked cycling, but were not willing to cycle in Wellington due to concerns for their safety.

Relative Importance of Cycle Ways

Survey respondents were asked the open question "under what circumstances would you be willing to cycle for transport (more often)?" The written responses were qualitatively analysed using content analysis and thematic coding. The resulting themes generated from the responses, and the per cent of respondents who mentioned each theme, are shown in Figure 20 below. A detailed list of the key words and phrases included under each theme can be found in Section 4.2.3, Table 5.

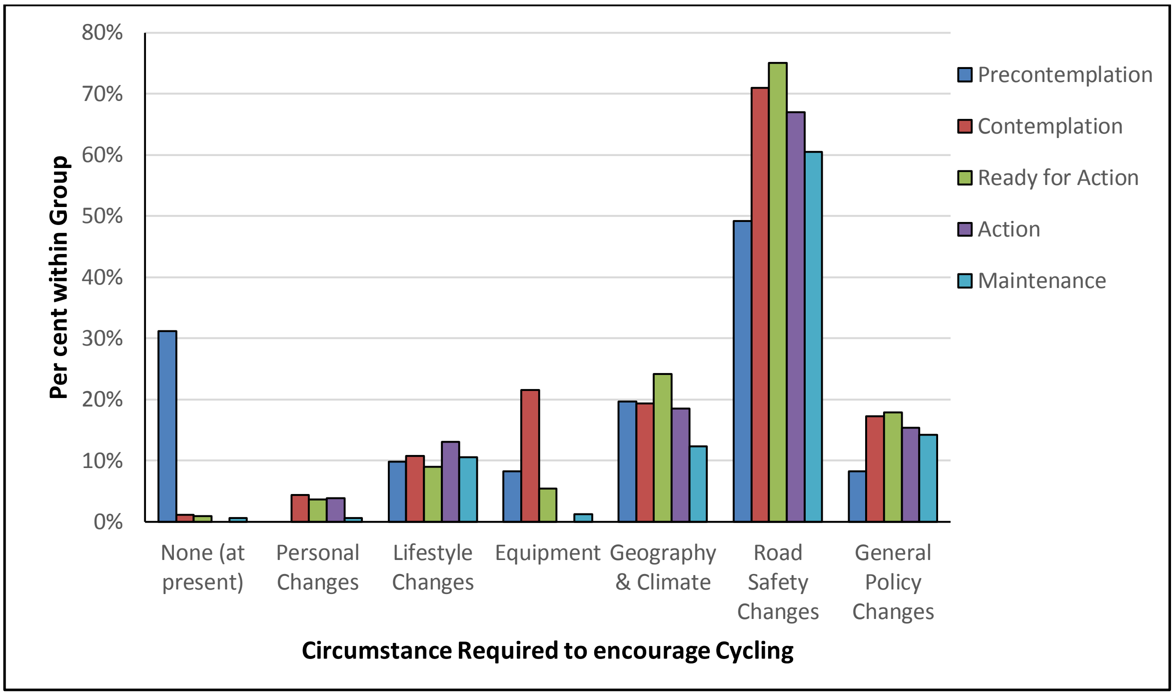

Figure 20: The stated circumstances required to encourage respondents to cycle for transport more often, by Stage of Change group (n = 558).

As shown in Figure 20, respondents most frequently stated that road safety changes would be required to encourage them to cycle for transport more often. This pattern existed for all Stage of Change groups, and was highest for the Contemplation and Ready for Action groups.

The second most frequently mentioned barrier to cycling was Geography and Climate. Interestingly, many people mentioned weather as a barrier in terms of its effects on safety. For example, a number of people stated that they do not cycle when it is wet or windy as this makes the road slippery or could blow them into the path of traffic. Of course, very little can be done at a policy level to mitigate geography and climate as barriers, although safety interventions can in some cases mitigate some of the dangers associated with wet or windy weather.

Also of note is the number of people mentioning policy changes. The most common policy changes required were provision of more secure bicycle parking, showering and changing facilities, and better integration with public transport. Many people commented that it should be the responsibility of workplaces to provide showering and changing, rather than having public facilities. The most commonly mentioned issue under Lifestyle barriers was not being able to cycle with friends and family, usually with regard to cycling with children or their partner due to safety concerns.

The Contemplation group mentioned a lack of equipment as a barrier more often than any other group. As perhaps could be expected, the Precontemplation group most frequently stated that nothing could encourage them to cycle. Even so, this was only the case for just over 30 per cent of this group.

Of the respondents who stated that road safety changes would encourage them to cycle more, 79 per cent specifically mentioned cycle paths or lanes that separated cyclists from general traffic. Some of these people mentioned the required characteristics of such a cycle way (n = 203). These are shown in Table 9 below, and fall into three broad categories: generally better cycle ways; cycle ways with certain network qualities (such as arterial or continuous); and cycle ways with certain safety features (such as being generally safer, or dedicated to cyclists).

Table 9: The desired cycle way characteristics mentioned by respondents (n = 203).

		Pre-contemplation (n = 16)	Contemplation (n = 33)	Ready for Action (n = 43)	Action (n = 48)	Maintenance (n = 63)	All (n = 203)
Generally Better Total		**25%**	**18%**	**26%**	**33%**	**25%**	**26%**
Network Options	Continuous/ Connected	13%	9%	7%	15%	5%	9%
	Arterial	13%	15%	7%	10%	13%	11%
	Central	6%	9%	5%	13%	10%	9%
	Direct	0%	6%	12%	8%	3%	6%
	Total	**19%**	**27%**	**21%**	**35%**	**21%**	**25%**
Safety	Generally safer	50%	39%	40%	27%	44%	39%
	Separated	31%	27%	28%	23%	40%	31%
	Dedicated/not shared	25%	27%	33%	25%	32%	29%
	Total	**75%**	**79%**	**86%**	**56%**	**89%**	**78%**

As Table 9[10] shows, overall, safety improvements were the most important cycle way characteristic, and especially important for Contemplation, Ready for Action, and

[10] Totals in this table do not add to 100 per cent as some people mentioned more than one characteristic.

Maintenance groups. Being generally safer, separated from traffic, and being solely for use by cyclists, were characteristics highly desired in cycle lanes by all five Stage of Change groups.

Route Choice Factors

Respondents were asked to imagine themselves cycling for a short trip that they regularly make (for example their commute to work or education, or trip to the shops). They were then asked to rate how important four factors would be in their choice of route for this trip. These were: being the safest route; being the least hilly (flattest) route; being a route through green space; and being the quickest (most direct) route.

Mean scores for these Likert-type variables (Safety, Flat Gradient, Green Space, and Directness) for each Stage of Change group can be seen in Figure 21. A '1' on the scale means 'unimportant' while a '7' on the scale means 'important'.

Mean scores for each variable were compared across the Stage of Change groups using ANOVA and post-hoc Tukey HSD tests, in order to examine the relative importance of these route characteristics when cycling for transport in Wellington. These variables were also compared within groups using Friedman's Two-Way ANOVA and Wilcoxon's Signed Ranks tests to determine the relative importance of these variables for each group.

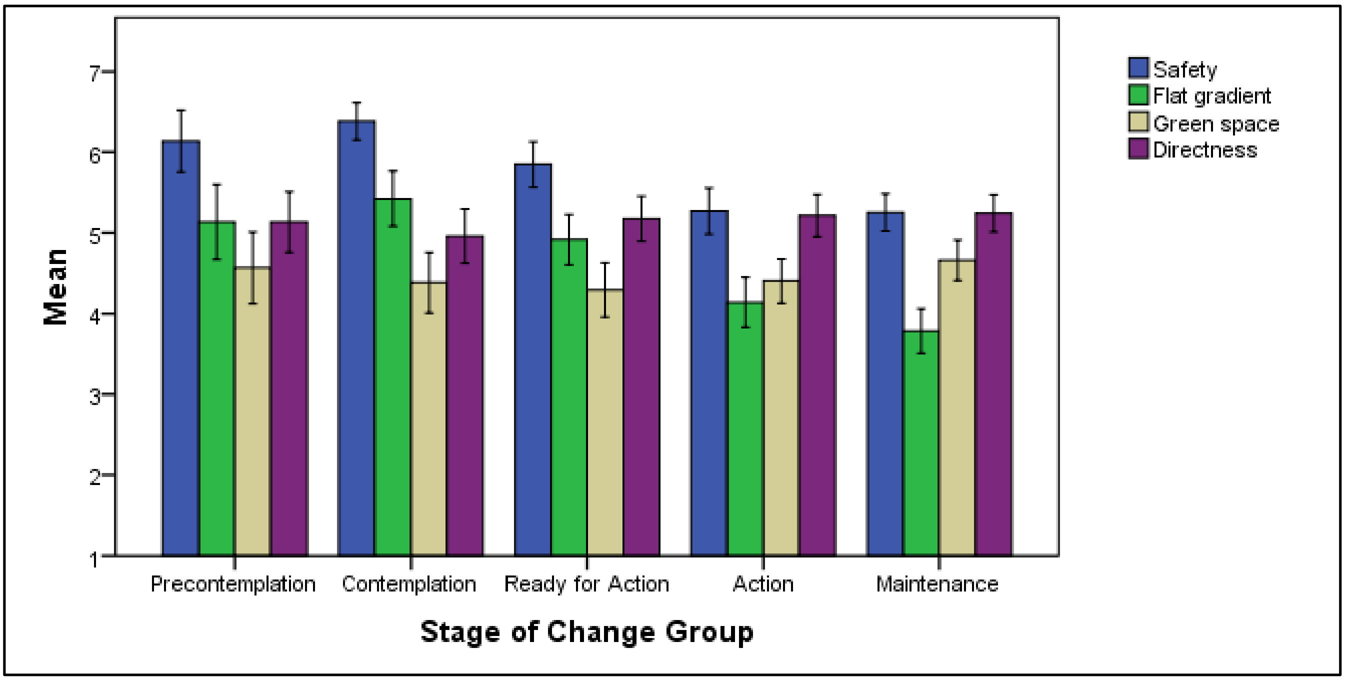

Figure 21: Mean scores of route choice variables by Stage of Change group. Error bars represent 95 per cent confidence interval.

Route Choice Factors between Groups

The one-way ANOVA test found a significant association between Stage of Change group and both Safety [$F(4, 606) = 12.77, p < 0.001$] and Flat Gradient [$F(4, 605) = 18.35, p < 0.001$], but not Green Space or Directness. In other words, groups varied in their ratings of safety and flatness, but did not vary significantly in ratings of green space and directness. For example, the Action and Maintenance groups were less concerned about flatness.

Post-hoc analysis using Tukey HSD tests found the mean scores for Safety for Precontemplation (M = 6.60, SD = 1.55) and Contemplation (M = 6.39, SD = 1.15) were significantly higher (more important) than those for Action (M = 5.27, SD = 1.74) and Maintenance (M = 5.25, SD = 1.54). Ready for Action's mean safety score was not significantly different from any other group (M = 5.82, SD = 1.60).

Tukey HSD tests also found the mean score for Flat Gradient was significantly higher (more important) for Precontemplation (M = 5.13, SD = 1.89), Contemplation (M = 5.44, SD = 1.69), and Ready for Action (M = 4.91, SD = 1.74) than for the Action (M = 4.14, SD = 1.87) and Maintenance (M = 3.79, SD = 1.84) groups.

Route Choice Factors within Groups

The statistical tables for the Friedman Two-Way ANOVA and Wilcoxon Signed Rank tests, summarised below, are very large and can, therefore, be found in Appendix H.

Precontemplation

The Friedman Two-Way ANOVA found a significant difference between route choice characteristics within Precontemplation (χ^2_F (3, 67) = 41.61 (corrected for ties), $p <$ 0.001). The Wilcoxon Signed Rank Test found that Safety was significantly more important than all other variables. Flatness and Gradient were not significantly different from each other, and were both significantly more important than Green Space.

Contemplation

The Friedman Two-Way ANOVA found a significant difference between route choice characteristics within Contemplation (χ^2_F (3, 97) = 72.94 (corrected for ties), $p < 0.001$). The Wilcoxon Signed Rank Test found that Safety was significantly more important than Flat Gradient, which was significantly more important than Directness, which in turn was significantly more important than Green Space.

Ready for Action

The Friedman Two-Way ANOVA found a significant difference between route choice characteristics within Ready for Action (χ^2_F (3, 119) = 46.71 (corrected for ties), $p <$ 0.001). The Wilcoxon Signed Rank Test found that Safety was significantly more important than all other variables. Flatness and Gradient were not significantly different from each other, and both were significantly more important than Green Space.

Action

The Friedman Two-Way ANOVA found a significant difference between route choice characteristics within Action (χ^2_F (3, 144) = 44.08 (corrected for ties), $p < 0.001$). The Wilcoxon Signed Rank Test found that Safety and Directness were not significantly different, but were significantly the most important. Flat Gradient and Green Space were not significantly different from one another and were the least important.

Maintenance

The Friedman Two-Way ANOVA found a significant difference between route choice characteristics within Maintenance (χ^2_F (3, 173) = 74.60 (corrected for ties), $p < 0.001$). The Wilcoxon Signed Rank Test found that Safety and Directness were not significantly different, but were significantly the most important. Green Space was significantly less important than Directness and Safety, but more important than Flat Gradient.

Case Study Cycle Way: Likelihood of Use

Those survey respondents who travelled regularly[11] through, or within, the case study area were asked whether they were likely to use an arterial cycle path if it existed in the case study area. Figure 22 shows the likelihood of using the cycle way by Stage of Change group. Overall, 80% of the n=405 respondents indicated that they were likely to use such an arterial path. Importantly, Precontemplation was the only group in which the 'No' responses outweighed the 'Yes' responses.

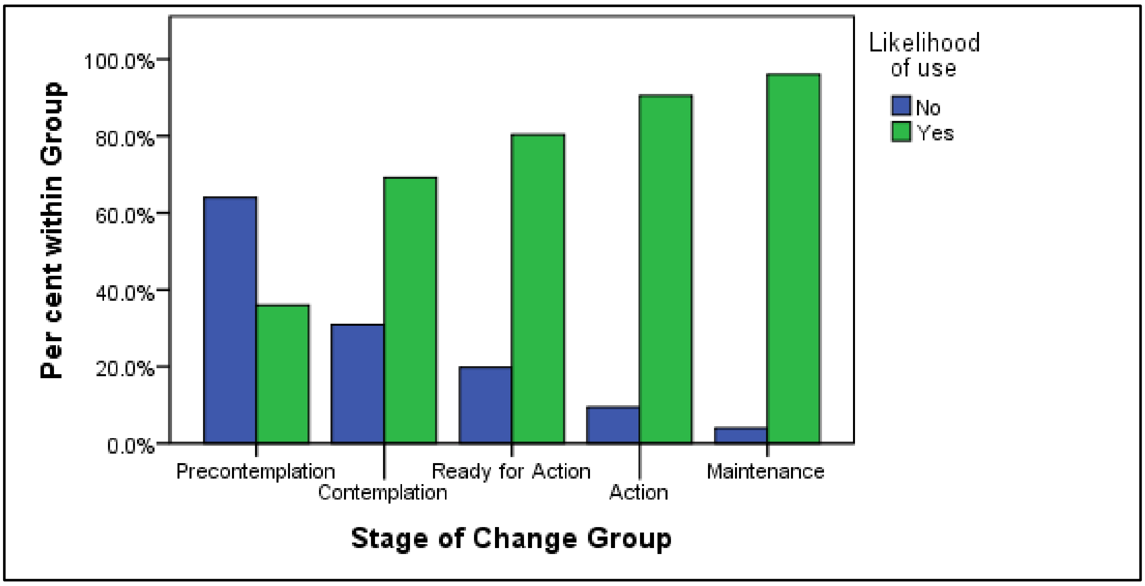

Figure 22: Stated likelihood of using the case study cycle way by Stage of Change group (n = 405).

χ^2 analysis was used to examine the statistical association of likelihood to use the cycle path with Stage of Change group. The results indicate a strong, significant association between these variables (χ^2 (4, 405) = 93.21, p < 0.001). Precontemplation (z-score =

[11] Once or more per week

7.0) and, to a lesser extent, Contemplation (z-score = 2.1) were significantly overrepresented in the 'no' category, while Action (z-score = -2.3) and Maintenance (z-score = -4.0) were significantly underrepresented. In the 'yes' category, Precontemplation (z-score = -3.5) was underrepresented and Maintenance (z-score = 2.0) was overrepresented. No other groups significantly contributed to the χ^2 result.

Willingness to Lose Some Car Parking

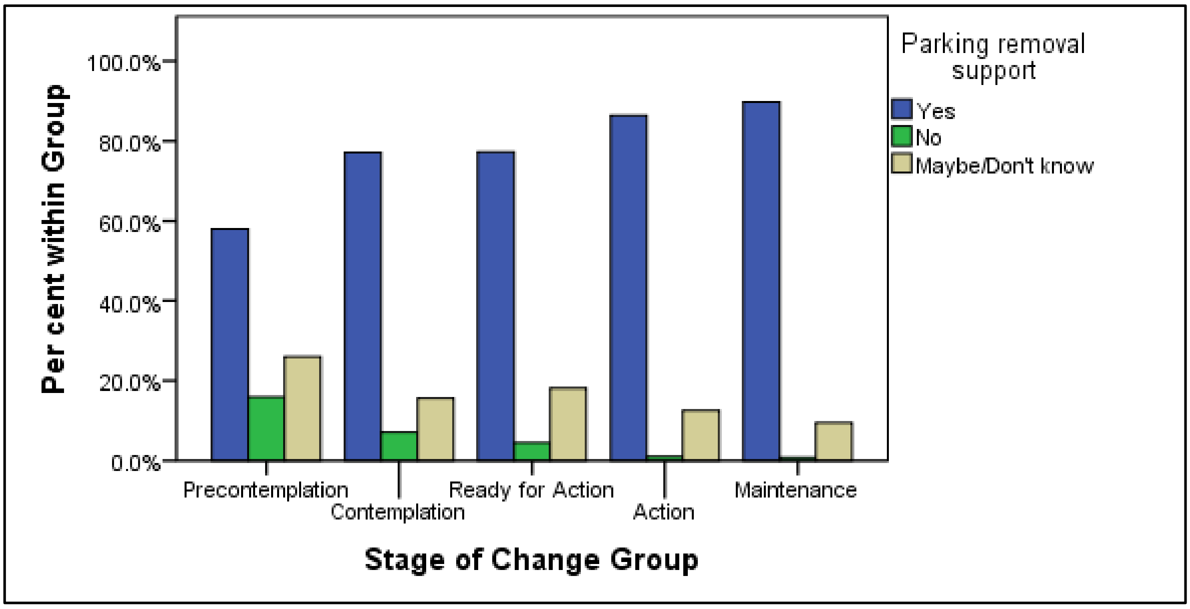

Figure 23: Stated willingness to lose parking for the case study cycle way by Stage of Change group (n = 407).

Overall, 81% of the n=407 respondents indicated a willingness to forgo some parking for the case study cycle way. A χ^2 test of independence found significant association between willingness to lose some on-street car parking for the case study cycle way with Stage of Change group, for people who regularly travel in the case study area (χ^2 (8, 407) = 35.03, $p < 0.001$). The source of this association was an overrepresentation of Precontemplation in the 'no' and 'maybe/don't know' categories (z-score = 3.9 and 2.1 respectively). No other Stage of Change group was significantly over or under represented in any category. Figure 23 shows support for parking removal by Stage of Change group.

Some people chose to comment on their response to this question, and those from car drivers were particularly interesting. Many car drivers who commented indicated they were not interested in cycling, but still supported the construction of an arterial cycle way even if it required the removal of some on-street parking. There were two main reasons for this. Firstly, some responded that they were concerned for the safety of people who cycled. Secondly, some responded that cyclists inhibited the flow of traffic and should have their own lane.

5.1.3 Research Question 2

This section shows the results for research question 2, which asks 'Would an arterial cycle path in the case study area encourage more cycling? If so, then where would this increase come from?

Case Study Cycle Way: Encouraging More Cycling

Again, survey respondents who travelled regularly through, or within, the case study area were asked whether the presence of an arterial cycle path through the case study area would encourage them to cycle for transport more frequently.

Figure 24 shows that many people in all Stage of Change groups, but especially Contemplation (71.6 per cent), Ready for Action (77.3%), Action (68.8%), and Maintenance (61.9%), indicated that the presence of the case study cycle way would encourage them to cycle more frequently for transport. Interestingly, 28.6 per cent of people in Precontemplation indicated that the presence of the case study cycle way would encourage them to cycle more frequently (i.e. start cycling) for transport.

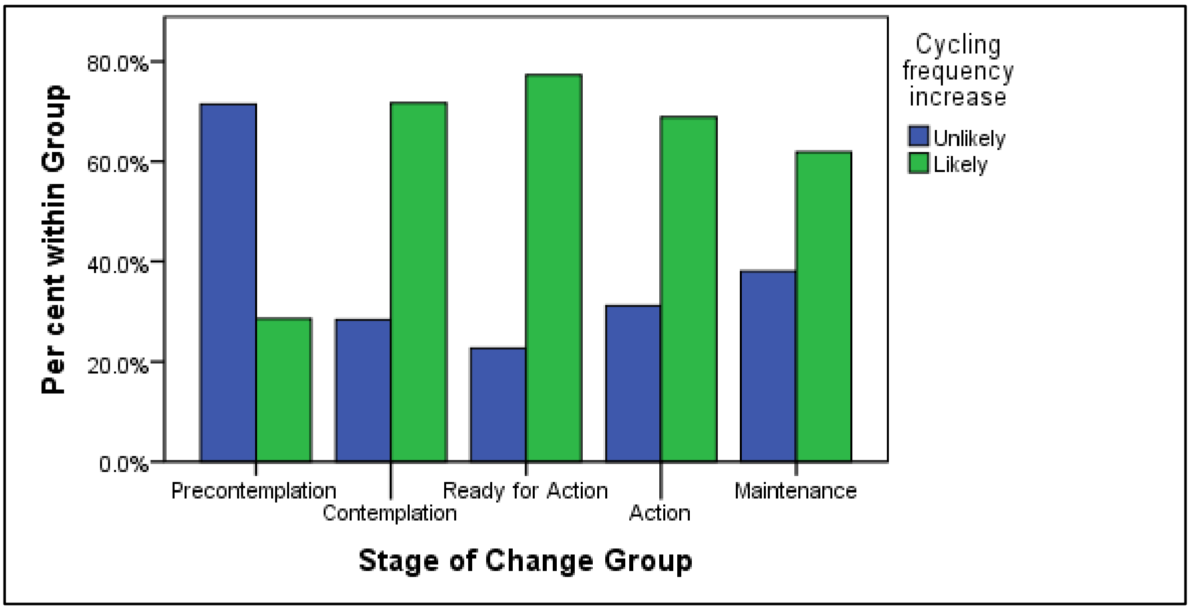

Figure 24: Stated likelihood of cycling more frequently if the case study cycle lane existed, by Stage of Change group (n = 393).

The tapering of likely impact of a cycle way as one moves to the active cyclist groups (Action , Maintenance) indicates that such a cycle way would likely have less effect on such groups' cycling habits.

It is important for policy makers to know who would be encouraged to cycle for transport more frequently. To provide a fuller picture of this, Binary Logistic Regression was used. This explored the connections between whether the respondent stated that they would be likely to cycle more frequently, and various possible explanatory variables including socio-demographic characteristics (age, income, education, and gender), Stage of Change group, and perceptions and opinions of cycling (opinion of cycling, willingness to cycle, and level of external barrier perception).

The model was highly significant (χ^2 (17, 393) = 72.5, $p < 0.001$). The Hosmer-Lemeshow Goodness of Fit statistic indicated no significant difference between the observed results and predicted values of the regression ($p = 0.451$). The overall prediction success of the model was 72.0 per cent (43.1 per cent unlikely and 88.8 per cent likely). This indicates that the strength of the model is not very high, but is significantly better than chance (prediction success of 63.4 per cent).

The regression demonstrated that, when all other variables were held constant, Stage of Change group ($p < 0.001$), willingness to cycle ($p = 0.012$), and external barrier perception ($p < 0.001$) were significantly associated with a likely increase in cycle frequency. Individuals in Contemplation were five times more likely than Precontemplation to indicate that they would cycle more frequently ($OR = 5.03$, $p < 0.001$); Ready for Action were almost seven times more likely ($OR = 6.57$, $p < 0.001$); and Action were almost three times more likely ($OR = 2.97$, $p = 0.025$). Individuals in Maintenance were not significantly different from Precontemplation. This last result simply indicates that committed cyclists are about as (un)likely to change their behaviour as those who have not seriously contemplated it – in both cases, they appear committed to current behaviour patterns.

Additionally, when all other variables in the model were held constant, a one unit increase in willingness to cycle corresponded to a 40 per cent increase in the likelihood of cycling more frequently, if the case study cycle path was present ($OR = 1.40$, $p = 0.012$). Also, a one unit increase in external barrier perception corresponded to a 51 per cent increase in the likelihood of cycling more frequently for transport ($OR = 1.51$, $p < 0.001$). No other variables in the model were significant. Please see Appendix I for full regression statistical tables including Model Summary Statistics, and Classification and Variable Tables.

5.2 Manual Parking Count Results

5.2.1 Research Question 3

Research question 3 asks 'How much public parking is there on and around Tory Street?' This question is addressed by the manual parking count results.

All public car parks within one street block of Tory Street were counted. This included all on-street car parking, owned by Wellington City Council, and off-street commercially provided public parking. Non-public parking was excluded.

This count found that there are around 897 on-street public car parks, and approximately 2857 off-street, commercially operated, public car parks within one street block of Tory Street.

However, 899 of the 2857 off-street commercially operated public car parks had signs saying they were 'reserved' for exclusive use. Many of these 'reserved' car parks appeared to have been rented by local businesses (including hotels and short-stay apartments), local residents, and commuters. This shows that there is an established private market for the parking needs of local businesses and residents. While these reserved car parks were not fully available to the public, they were still part of the total stock of parks (their absence would contribute to parking pressure for example).

Permission to count car parks at off-street, commercially operated premises was granted provided that no particular operator and their parking supply were individually identified.

Of the 897 on-street car parks within one street block of Tory Street, 819 were paid-parking during business hours (but free, even though time-limited at night and on weekends), 26 were free with a time restriction (ranging 5 to 60 minutes), 42 were coupon parks (the first two hours are free), and 10 were free with no time limit. Additionally, it was noted that a number of businesses reserved public, on-street parking spaces outside their premises by placing traffic cones around them.[12] This did not occur on Tory Street, but was seen in a number of side streets.

This count also found six on-street motorbike parking zones (each roughly the size of one car park).

Tory Street contained 112 of the on-street parks, with all of these paid during business hours (free, time-limited at nights and on weekends) except for 4 that were free but time-limited. Of Tory Street's car parks, 59 are located on the Eastern side of the Street, while 53 are located on the Western side.

[12] It is questionable whether this practice is legal or ethical.

Customer Parking on Tory Street

Businesses, shops, and services with their main access located on Tory Street were observed to see how many supplied their own customer parking.

15 out of the 69 (24.6 per cent) commercial businesses, shops, and services with their main access on Tory Street provided customer parking. There was a total of 206 free off-street car parks for customers. Two additional businesses also provided free customer-only parking but these were not countable (in secure garages). Of the 206 free customer car parks counted, 146 were available to the public as paid parking at all times, and an additional 42 were available as paid public parking outside of business hours. The remaining 50 businesses on Tory Street did not provide their own off-street customer car parking.

It was observed that most of the businesses that provided their own customer parking were large retailers that specialised in bulky items such as furniture, appliances, and hardware. Shops that did not provide customer parking tended to be retailers that specialised in services and small goods, such as cafes, restaurants, and convenience stores.

This count did not include Moore Wilson's supermarket, as it does not have shop access on Tory Street, but it should be noted that it does also have a substantial car park of its own.

Summary

Table 10 shows a summary of the type and quantity of public parking available within one street block of Tory Street. On-street parking on Tory Street accounts for 12.5 per cent of on-street parking, and 2.8 per cent of the total public parking, available within one street block.

Table 10: Type and quantity of public parking available within one street block of Tory Street.

On-street parking	Off-street public parking	Off-street customer parking	Total
897 (Incl. 112 on Tory Street)	2857 (Incl. 899 reserved)	206 (Incl. 146 available to public at all times, and 42 public in evenings)	3960

5.3 Street-Intercept Survey Results

5.3.1 Research Question 4

Research question 4 asks 'What contribution does the on-street parking on Tory Street make to the businesses on Tory Street?' This was assessed by a street-intercept survey of Tory Street users[13]. The results of this are presented here.

Respondents were asked how they travelled into the city centre for their current trip. The results of this question are shown in Figure 25, below.

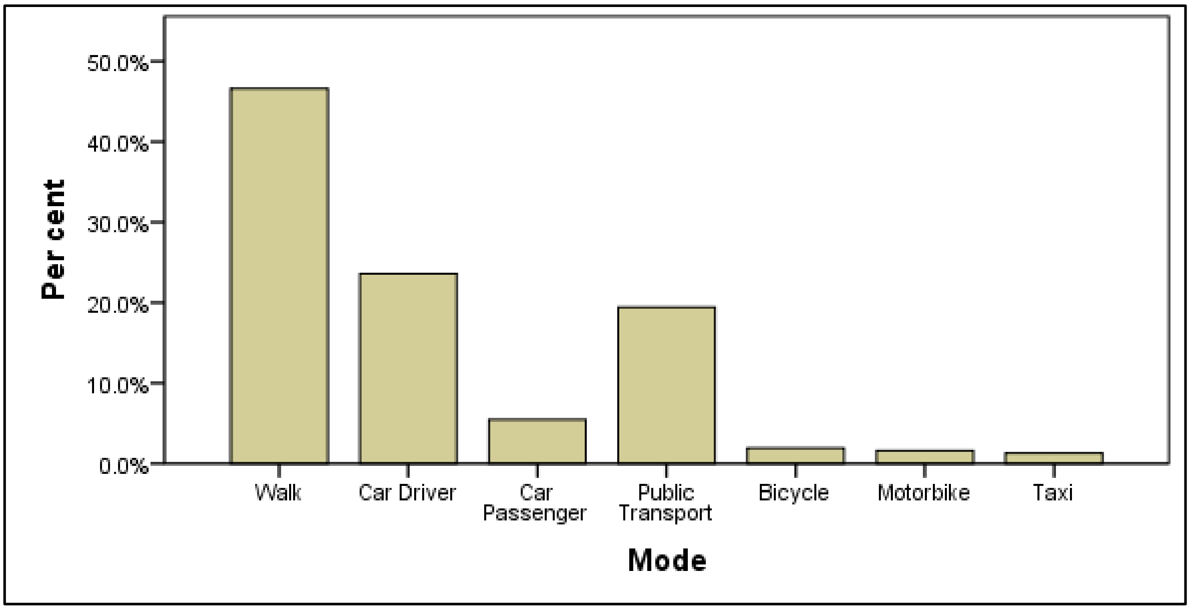

Figure 25: Mode of transport into the city centre, of Tory Street survey respondents (n = 309).

[13] People on the footpath of Tory Street

Most (46 per cent) of the survey respondents had walked into the city. People who came by car (drivers and passengers) accounted for 29 per cent, while public transport users made up 19 per cent.

The current parking requirements of respondents were also assessed. These are shown in Figure 26.

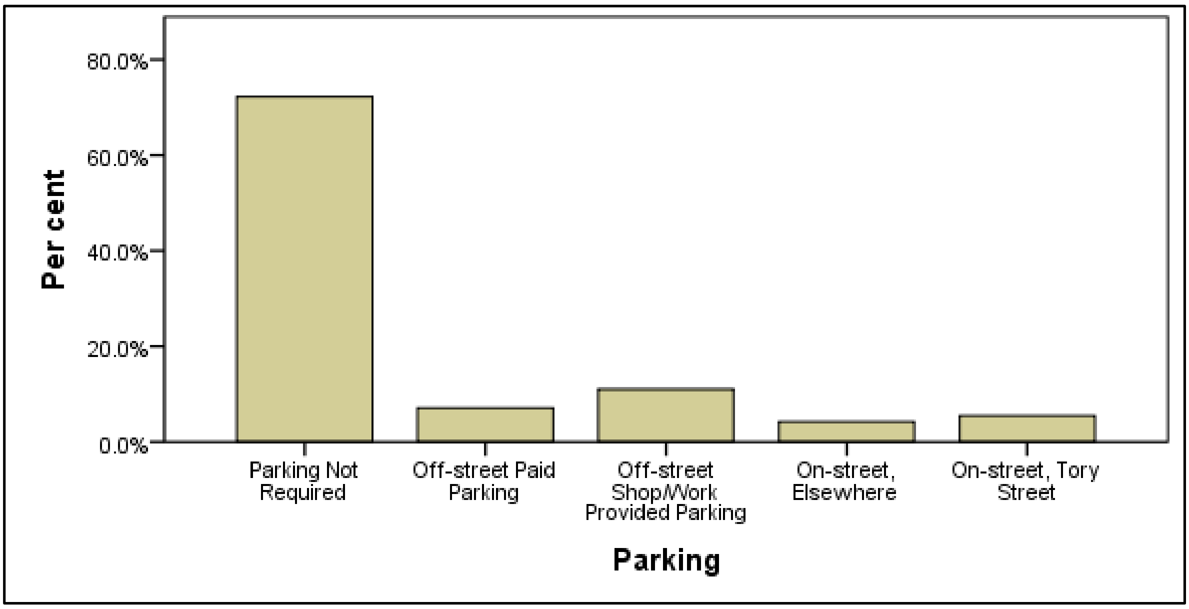

Figure 26: Parking requirements in the city centre, of Tory Street survey respondents (n = 309).

As seen in Figure 26, by far the majority of respondents (72 per cent) did not require parking in the City centre. Of those surveyed, only 6 per cent used on-street parking on Tory Street. 18 per cent of respondents used off-street parking, while 4 per cent parked on-street elsewhere in the city centre (not on Tory Street).

Figures 27 and 28 show the total, and mean, expenditure (what respondents estimated they were spending that trip) on Tory Street and elsewhere in the city of respondents to the survey.

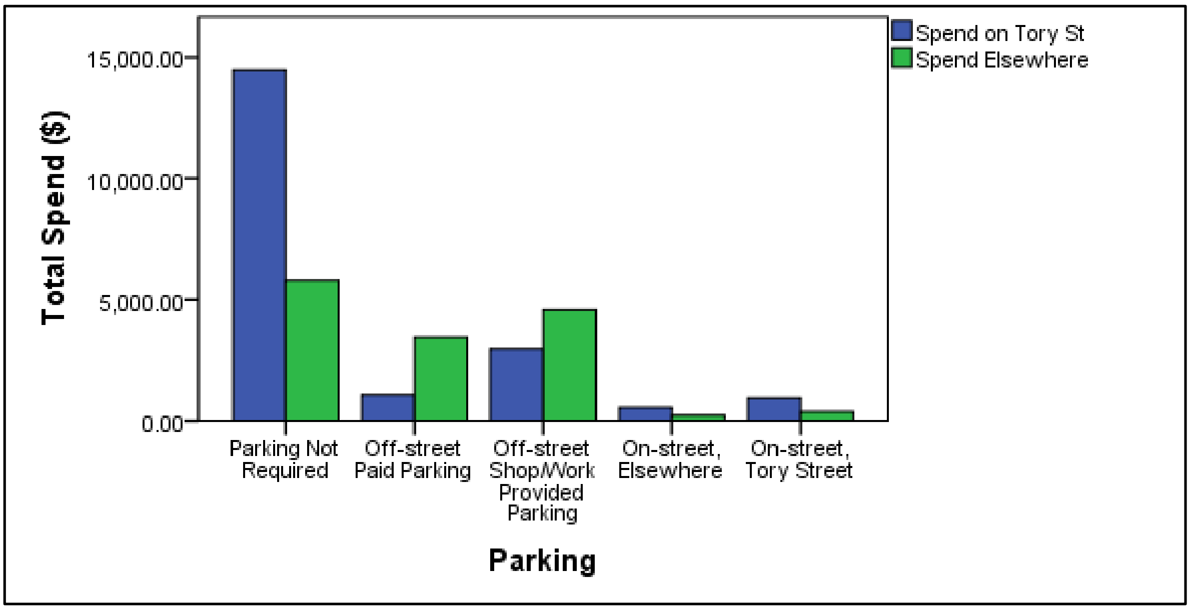

Figure 27: Total spend of Tory Street respondents on Tory Street, and elsewhere in the city (n = 297).

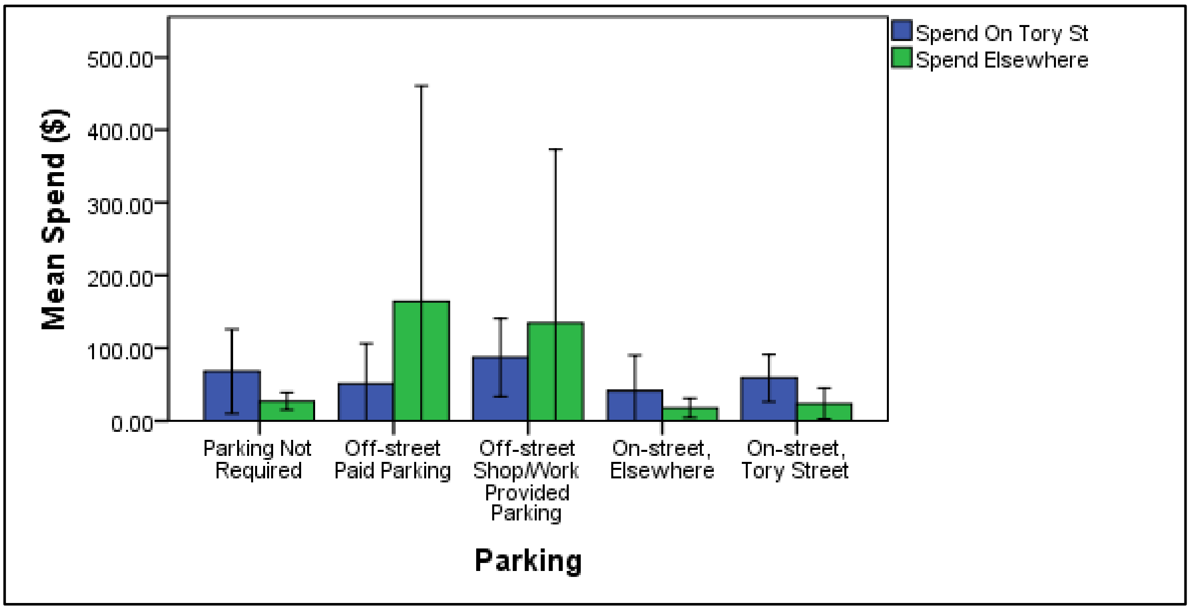

Figure 28: Mean spend of Tory Street respondents on Tory Street, and elsewhere in the city (n = 297). Error bars represent 95 per cent confidence interval.

People who did not require parking had a lower mean spend (but not significantly different) than those who parked off-street, and a very similar to those who parked on-street, both on Tory Street and elsewhere (see Figure 28). However, because the proportion of people who do not require parking is larger, their total expenditure was the greatest contribution to the Tory Street local economy (see Figure 27).

As seen in Figure 29, 49 per cent of respondents did not require parking and were regular visitors to Tory Street (weekly or more), while three per cent of respondents parked in Tory Street on-street parking and were regular visitors to Tory Street.

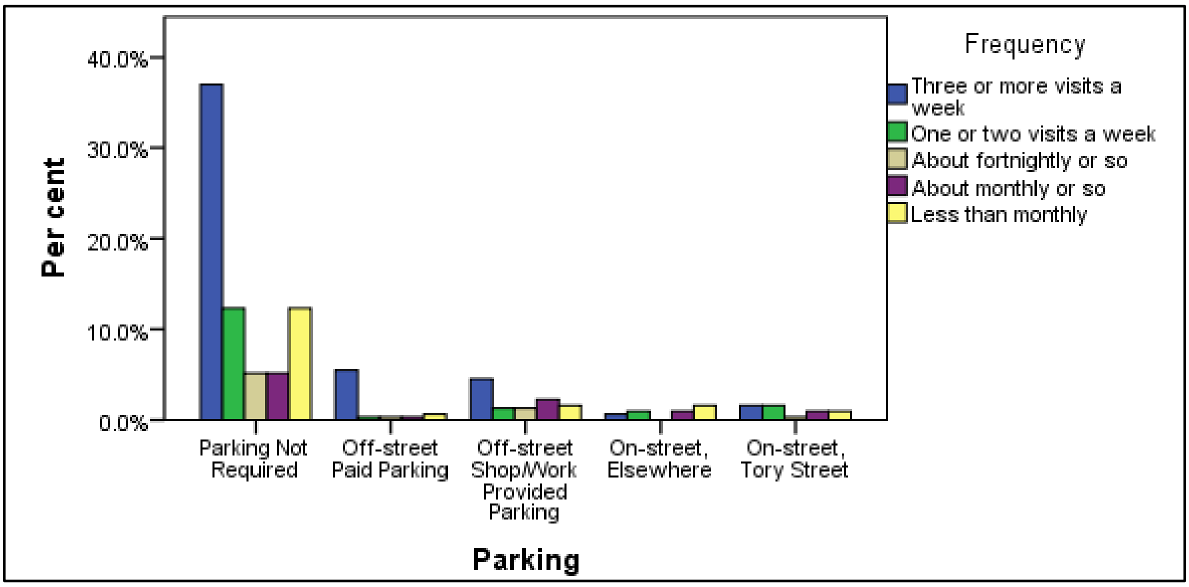

Figure 29: Frequency of visits to Tory Street by parking requirements for the current trip, for Tory Street survey respondents (n = 308).

Parking requirements were then compared with respondents' visit purpose on Tory Street (for those purposes that directly relate to Tory Street business). This was to see if any particular business sector was highly dependent on on-street parking. Business from on-street parking was found to be minimal for the four sectors shown in Figure 30. The work/trade sector was the most dependent on on-street parking, with two per cent of respondents using on-street parking for work or trade purposes.

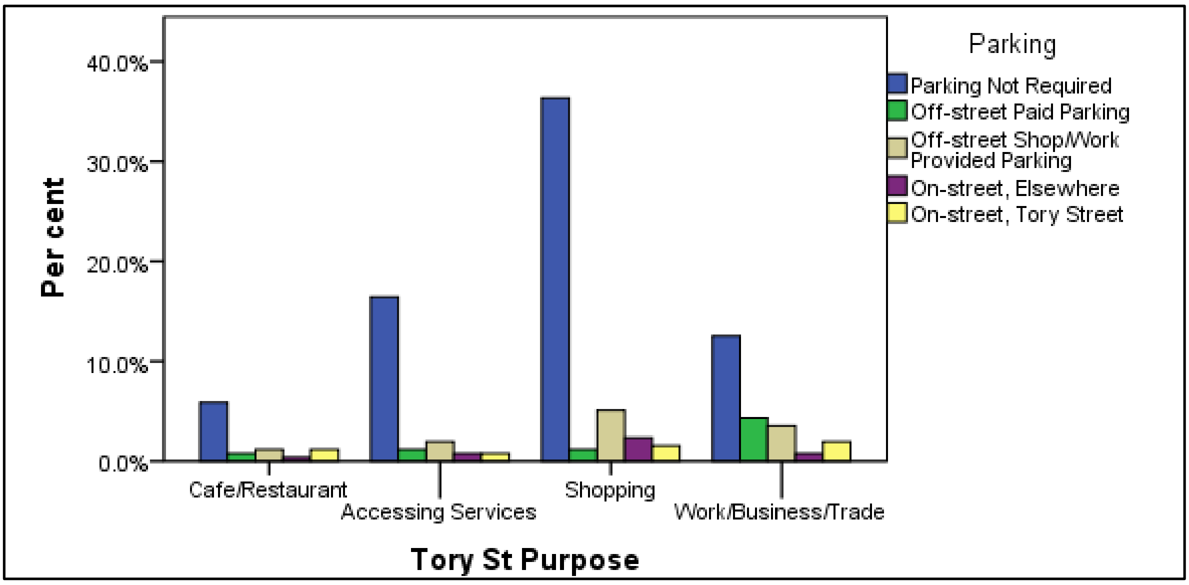

Figure 30: Purpose of visit to Tory Street (for those purposes that directly relate to Tory Street businesses), for Tory Street survey respondents (n = 309).

6 Discussion and Conclusion

This research employed a pragmatic, mixed methods design to explore the research aim and finds that:

> *Road space reallocation from on-street parking to a cycle way between Wellington's southern suburbs and city centre does appear to be warranted, at least in the city centre portion of the route on Tory Street.*

In this chapter, the main findings of this research, supporting this bold statement, are firstly discussed, and their meaning considered in light of the local context and body of literature. Second, the key findings are summarised and discussed in terms of the implications of this research for policy and decision making in Wellington city. Third, the strengths and limitations of this research are addressed, and avenues for further research are explored. Finally, a concluding statement is made.

6.1 Findings Discussion

Theory and evidence suggest that the transport context is changing as a range of social, economic, and environmental pressures converge and compound (Banister, 2008). This means it may be unwise for transport planners and decision makers to assume that car-focussed trends of the past are reliable indicators for the future (Millard-Ball and Schipper, 2010).

Places with the highest demand for alternatives to the private car are likely to be cities and inner suburbs (Puentes and Tomer, 2009). Some people have more capacity than others to change their transport behaviour, and it is likely this capacity will vary over an individual's life (Cairns et. al., 2002). Both theory and evidence suggest that, in places with poor provision for cycling, there are likely to be people who are ready to cycle for transport but feel prevented from doing so (Frank, 2004; Hopkinson & Wardman, 1996; Landis, 1996; Sælensminde, 2004).

Accordingly, road space reallocation that simultaneously makes it less convenient to drive and more convenient to cycle may bring about a tipping-point, where a significant number of individuals change their transport behaviour and begin to cycle (Pucher & Buehler, 2008).

6.1.1 Latent Demand for Cycling in Wellington

The results of this research strongly indicate the presence of latent demand for transport cycling in Wellington. This means that there are people in Wellington who have the preference to cycle for transport more often, but do not express that preference, primarily because they do not perceive it to be safe to cycle on Wellington's roads.

This latent demand is present among both current cyclists and non-cyclists. Many current cyclists state that they would cycle more often if the conditions for cycling were improved. Many non-cyclists in Wellington city should actually be seen as 'potential cyclists', as they would like to cycle for transport, but do not, largely because they feel that the external conditions are not safe.

The 'Stage of Change' groups with the most potential to cycle more for transport are Ready for Action, followed by Contemplation, and Action. Regional level studies indicate that these three groups may account for just under half of the population (Greater Wellington Regional Council, 2012; Sullivan & O'Fallon, 2006), implying that the level of latent demand for transport cycling in Wellington city is significant.

6.1.2 The Role of Safe Cycle Ways in Wellington

Consistent with the literature, and with the view of local authorities, this research identified that the major barrier to cycling in Wellington city is a perceived lack of safety. The <u>single most important</u> change identified to encourage more cycling in Wellington city is the provision of safer road conditions. It seems that without road improvements that make people feel safe while cycling there is unlikely to be a significant uptake of transport cycling in Wellington city. This does not imply that every road must have a cycle lane or cycle way. But people in Wellington want a connected and continuous network of cycle ways that are separated from traffic and are for the exclusive use of cyclists. These findings are supported by a body of literature and experience, which suggest that the perceived lack of safety is a major barrier to cycling and, "*if you build it (well), they will come*" (See, for example Hoehner*, et al.*, 2005; Pikora*, et al.*, 2003; Pucher & Buehler, 2008; Titze*, et al.*, 2008).

Figure 31: Oriental Parade cycle lane.

People stated that they wanted cycle ways that are 'better' and 'safer' than those currently provided, indicating that current cycle ways are seen to be insufficient and inadequate. Figure 31 gives an example of a typical cycle lane in Wellington. As can be seen in this figure, these cycle lanes are not physically separated from moving vehicles and can place the cyclist in conflict with people parking cars.

This research found that for many respondents, the (relatively minor) barrier of adverse weather was due to a perceived increase in the danger of cycling in such conditions. Accordingly, if safer cycle routes were provided this may also reduce the barrier of adverse weather for some people.

Greater Wellington Regional Council (2012) states that not having a bicycle is a major barrier to cycling in the region. However, this research suggests that it may be more indicative of a lack of interest, or willingness, in most cases, rather than being preventative; it is more likely to follow from a lack of safe cycling facilities rather than being a major distinct barrier in itself.

Providing safe cycle routes may increase people's perception of safety, and therefore, their comfort and enjoyment while cycling (Taylor*, et al.*, 2009). This in turn may lead to progression though the Stages of Change. Providing poor quality cycle ways that do not give people a positive experience while cycling may result in some individuals stalling or regressing back to an earlier Stage of Change (Prochaska & DiClemente, 1994).

The present study found evidence of such 'regression' in Wellington city. It was reasonably common for respondents to state that they had been cyclists in the past, often while living elsewhere, and that they enjoyed cycling, but their experience of cycling in Wellington was that it was too unsafe, so they no longer cycle. Such people expressed a strong desire to cycle for transport but were not willing to do so without safety improvements. These findings indicate that the perceived lack of safety of cycling in Wellington may not only prevent people from cycling, but also prevent people from seriously considering it as an option.

Consistent with the literature, this research showed the importance of having a positive attitude toward, and the motivation (willingness) to, cycle for transport (de Geus*, et al.*, 2008). It appears that people who currently cycle for transport in Wellington do so because they like to cycle, despite their perception that it is not safe. Indeed, current cyclists are most likely to be males, which fits with findings in the literature that suggest men are more prepared to risk their safety than women (Garrard*, et al.*, 2008).

The literature also suggests that knowing people who cycle, having people to cycle with, and feeling that it is normal are all associated with cycling for transport (de Geus*, et al.*, 2008; Titze*, et al.*, 2008; Xing*, et al.*, 2010). As such, if more people cycle when safe routes are provided, it may increase the normality and sociability of transport cycling, and therefore encourage cycling in those who have not been identified as 'ready' in this research.

6.1.3 Cycle Ways: Choosing a Route

The results of this research indicate that the primary consideration when constructing cycle ways that appeal to new cyclists is that it makes them feel safe. Additionally, new cyclists would rather take a flatter route, even if it were not the most direct.

Safety also appeals to current cyclists, but they are less willing to take an indirect route than new cyclists. Additionally, current cyclists are more willing to take hilly routes if they are more direct.

These factors should be taken into account when designing cycle ways. If cycle ways are designed to feel very safe, and are also on a relatively flat and reasonably direct route, it is likely that they will appeal to both new and current cyclists.

These findings are consistent with other research which finds that most cyclists are prepared to take a slightly longer route, if it feels safer (Dill, 2009; Heinen*, et al.*, 2010). Other research has also found that experienced cyclists do not mind, or even prefer, riding on hilly routes, while inexperienced cyclists tend to avoid hills (Stinson & Bhat, 2005).

6.1.4 Additional Considerations for Cycling in Wellington

Supportive policies that address some of the more minor barriers to cycling in Wellington identified in this research may further increase the appeal of cycling. In particular, ensuring secure bicycle parking is made available at destination points, and encouraging workplaces to provide showering and changing facilities appear to be valuable initiatives for facilitating cycling. Additionally, improving the integration of public transport with cycling would make cycling more convenient and attractive.

This is consistent with findings in the literature which indicate that a comprehensive policy approach that targets a range of barriers and motivations is the most effective way to support and encourage the uptake of transport cycling (Pucher & Buehler, 2008).

6.1.5 The Case Study Cycle Way: Build it and They Will Come

Respondents who travelled regularly (once or more a week) through the case study area were asked specifically about the case study cycle path, separated from traffic, which connects the city with the southern suburbs. The results show that for all Stages of Change, except Precontemplation, more people indicated that they were likely to use it than unlikely. People in the Ready for Action Stage were the most likely to indicate that the presence of the case study cycle path would encourage them to cycle for transport more often (77 per cent of this group), followed by those in the Contemplation group (72 per cent), and then Action group (69 per cent). There is much less potential to increase transport cycling in the Precontemplation group, because they are less willing, and in the Maintenance group, because they cycle very frequently already.

More generally, individuals who perceived higher external barriers to transport cycling, as well as those who were more willing to cycle, were more likely to indicate that the case study cycle path would encourage them to cycle for transport more often.

It appears that demographic and socioeconomic characteristics, when modelled with other variables[14], were not associated with indicating that the case study cycle way would encourage more cycling. This implies that there is latent demand for this cycle way across the range of age groups, from both genders, and among people with varying incomes and education levels.

Furthermore, the large majority of people (81 per cent of those surveyed) appear to be willing to lose some on-street car parking in order to provide for the case study cycle way. Even in the Precontemplation group, who were the least likely to use the cycle way, 58 per cent were willing to lose some parking (and 26 percent were unsure). This finding challenges the conventional wisdom that 'most people are opposed to the removal of parking'. It is important to note that this question did not specify what parking, or exactly how much, would be reallocated, and that people's views on this issue might change if they are personally affected by any parking reallocation. But this finding does highlight that there are stakeholders in the use of road space, beyond

[14] Other variables were Stage of Change group, opinion of cycling, willingness to cycle, and level of external barrier perception

those who use the directly adjacent property, their preferences should be taken into account, and they seem to be supportive of road space reallocation.

6.1.6 Contribution of On-Street Parking

The literature, policy, and context reviews highlighted the tension that exists around the provision of on-street parking in inner urban areas. On the one hand, such parking can induce car travel, contribute to sprawl, and prevent alternative uses for this public road space (Cairns*, et al.*, 2002; Kenworthy, 2006; Newman & Kenworthy, 1999; Shoup, 2005). On the other hand, it generates significant revenue for local authorities and, despite most evidence being to the contrary (including Kodransky & Hermann, 2011; Marsden, 2006; Mingardo & van Meerkerk, 2012; Pitsiava–Latinopoulou*, et al.*, 2012; Weinberger*, et al.*, 2010), it can be seen as absolutely vital by adjacent businesses. The findings of this research indicate that, at least on Tory Street, it is not as important for businesses as it might be assumed to be.

This study found that almost three quarters of people surveyed[15] on Tory Street had not travelled to the city in a mode that required car parking. Only six per cent of the people surveyed on Tory Street had parked in Tory Street on-street parking. Because the average amount spent by each of these two groups was very similar, the total amount of money spent by those who did *not* require parking on Tory Street was an order of magnitude higher than the total spent by those who parked on-street on Tory Street. Additionally, of the people who were regular visitors to Tory Street, 49 per cent did not require parking on Tory Street, and only 3 per cent used Tory Street on-street parking.

These findings, combined with the parking count, which found that the on-street parking on Tory Street accounts for only 12.5 per cent of local on-street parking, and just 2.8 per cent of the total public parking available within one street block, suggesting that the on-street parking on Tory Street makes only a small contribution to the businesses on Tory Street.

[15] This study surveyed people on Tory Street, who had a specific purpose on Tory Street (those whose main purpose was *not* 'passing through'), or who had spent/intended to spend money on Tory Street.

Although car users clearly make a significant contribution to Tory Street businesses, there is a wide range of parking options available both on and near Tory Street. It is possible that the method used to survey Tory Street users may have underrepresented those who parked off-street, and yet off-street parkers accounted for a higher proportion of respondents than on-street parkers. This indicates that off-street parkers may be considerably more important to the businesses on Tory Street than on-street parkers. Additionally, it appears that many of the businesses who believe that they require convenient customer parking provide their own. Taken together, these results suggest that the removal of some on-street parking on Tory Street is likely to have a minimal impact on Tory Street businesses.

6.1.7 Summary of Key Findings

- There is a significant latent demand for transport cycling in Wellington city.
- This suppressed demand is primarily due to people's concerns about the lack of safety while cycling in traffic.
- Cycling in Wellington will not become a common mode of transport until actual and perceived lack of safety is adequately addressed.
- Safe cycle routes appear to be the key factor required to encourage people to cycle for transport in Wellington, especially new cyclists.
- Safe cycle ways should be provided on the flattest and most direct route possible, in order to appeal to both current and new cyclists. If this is not possible, a safe cycle way on a flatter route will appeal to new cyclists, while a direct route, even if it is hilly, will appeal to current cyclists.
- Building a cycle path between the central city and southern suburbs is very likely to attract new cyclists, and encourage some current cyclists to cycle more often, if it is designed well.
- A sizeable majority of people appear to be willing to forgo some on-street parking for this case study cycle way.
- Lastly, the on-street parking on Tory Street makes a very minor contribution to the businesses on Tory Street, and as such, does not appear to be an efficient use of public space.

6.1.8 Policy and Context

Both the regional and city councils for Wellington have ambitious policy goals to make transport more sustainable. Specific targets include reducing carbon emissions, severe congestion, and private car use, and also increasing the mode share of cycling by ensuring it is safe, pleasant, and convenient (Greater Wellington Regional Council, 2010; Wellington City Council, 2006a, 2008). The Wellington City Council acknowledges that achieving such goals will require making decisions regarding the use of road space, and that in particular, traffic and on-street parking should not dominate, but should be considered in the context of walking and cycling amenity (Wellington City Council, 2010b).

Additionally, under the Local Government Act (2002)[16] local authorities are required to meet residents' needs for good quality local infrastructure, where good quality means efficient, effective, and appropriate to present and anticipated future circumstances.

Given these policy goals and obligations, and the findings of this research, and considering that:

- The quantity of parking provided in the city centre is considered high (Wellington City Council, 2007);
- Cycling levels in Wellington are currently low; and that
- Cycling is considered to be, and in reality is, dangerous (Greater Wellington Regional Council, 2012);

it does appear that road space reallocation from on-street parking to a cycle way between Wellington's southern suburbs and city centre is warranted, at least in the city centre portion of the route on Tory Street. Such reallocation does seem to be a more efficient, effective, and appropriate use of the scarce public resource of road space.

[16] Sections 10, 1(a) and (b), and 10, 2 (a) (b) and (c)

6.2 Policy Recommendations

In light of the findings discussed above, the policy recommendations of this research are:

- Firstly, it is recommended that decision makers note that the market can, does, and will provide car parking where there is demand, but there is no market to meet the demand for cycle ways or lanes and as such they must be provided publicly, if they are to be provided at all.
- A proposed cycle way connecting Wellington's southern suburbs and city centre appears to be an efficient, effective, and appropriate use of local infrastructure, and should be put in place.
- It is likely that the southern suburbs case study is indicative of latent demand for transport cycling in many other places around the city and this should be investigated. Additionally, it appears that a connected network of cycle ways is necessary to fully realise the latent demand for cycling in Wellington city.
- Encouraging the uptake of transport cycling through the provision of safe cycle routes, such as the southern suburbs cycle way, should be used as a strategy to reduce the demand for parking in the city centre.
- Although Tory Street was used in this research as the case study, other possible routes should be investigated, as they may (or may not) be more suitable. However, the removal of some on-street parking does appear to be justified, at least in the city centre portion of the cycle way on Tory Street.
- This research did not investigate how one street may be (dis)advantaged relative to nearby streets if its on-street parking was removed. It is recommended that the Council investigate running a south-bound cycle lane on one street and a north-bound cycle lane on a parallel street to avoid the complete removal of on-street parking on any particular street, unless further investigation proves this as unnecessary or undesirable.
- In the light of the positive responses to cycle way construction in some other cities, it is possible that Tory Street businesses may be *advantaged* by the reallocation of some road space to a cycle way. The success factors for such an outcome should be investigated.

- This research should be seen as a starting point, and, further engagement and investigation should be undertaken with both current and potential cyclists, as well as with people who work, live, travel and do business in the case study area. This will likely be very important to the success and acceptance of the project.

6.3 Strengths and Limitations

6.3.1 Methodological

The online survey used to collect information on the demand for cycling in Wellington had both strengths and limitations. Although online surveying makes the research process convenient for the researcher, allowing a high response and large sample, it does bias towards those with computer access, and those who were in networks that received the link. Efforts made to reduce this bias included sending the link to a wide range of stakeholders in the case study area, and the use of paper flyers with survey links. Despite this, participation in the survey was self-selected and it is unknown how this may have affected the response.

Additionally, the online survey used stated preference questioning which comes with strengths and limitations. Stated preference techniques are commonly used to explore the demand and preferences for goods and services for which a market does not exist, or does not *yet* exist but may do so in future (Hensher, 1994). As such, it seemed an appropriate technique to use to study cycling and cycle ways in Wellington, as they fit these criteria. The stated preference technique does suffer from an unknown degree of hypothetical and social desirability bias (Murphy*, et al.*, 2005), which means it is possible some people's responses may be overstated, understated, or entirely optimistic. However, the use of this technique when applying the Transtheoretical Model of Prochaska and DiClemente (1994) to the study of transport cycling is a commonly accepted practice in the literature (for example Davies*, et al.*, 2001; Gatersleben & Appleton, 2007).

The street-intercept survey was conducted on the footpath and so most likely underrepresented people who drove, then parked off-street, shopped, and drove away without visiting other places on Tory Street. However, this method *did* capture those who did not require parking, and those who parked on-street, which was of much higher importance to this research. Additionally, as this survey was carried out during summer the validity of these results in other seasons is unknown. However, there is no reason to think that there would be strong seasonality in such results.

All surveys have strengths and limitations, and the ones used in this research are no exception. Commonly, surveys can suffer from strategic and information bias, and survey fatigue. Addressing these issues requires careful design and deployment, and a large sample size, all of which were taken into account when conducting this research (Groves*, et al.*, 2009).

6.3.2 Theoretical

As discussed in the literature review, the Transtheoretical Model does have its criticisms. However, for the applied and practical requirements of this research, it was decided that it had strong merits. It allowed individuals with latent demand for transport cycling to be identified, and their preferences to be examined. Despite any limitations of the theory, the findings appear to be strong enough to provide useful and valid insights into an under-explored topic in Wellington city.

6.3.3 Reflections

Additional overarching limitations of this research are due to constraints of time and resources, as this work had to be completed within the scope of a master's thesis. It would have been ideal to explore the potential for road space reallocation from on-street parking along the whole route in more detail, but this was impossible to do within the research framework. Also, more nuances relating to the exact nature of road space reallocation would have been interesting to explore. For example, it has been argued that it is more important to have a cycle way when cyclists are on an uphill incline, as wobbling can present a safety issue in such circumstances; conversely, a cycle way on a downhill section is less vital as a typical cyclist can generally keep up with vehicle traffic on the downhill, so that there is less need for overtaking.

However, this research aimed to contribute to both the field of knowledge and to a real-world case study, and this has been achieved. Despite its many limitations, its overall strengths are that it provides novel and useful information that is directly useful to decision makers and residents in Wellington city.

6.4 Further Research

Many opportunities exist for further research. Firstly, other potential routes in the city centre should be considered to assess whether Tory Street is the best route to locate the cycle way. Additionally, once the route for the cycle way between Wellington's southern suburbs and city centre is established, the potential for road space reallocation along the whole route should be explored as necessary. If this cycle way is built, its use should be monitored longitudinally (before, during, and in the years after) to assess the degree of latent demand it realises.

Outside the immediate case study, this research found latent demand for cycling and safe cycle routes in Wellington, in general. This warrants further investigation, by either researchers, or local authorities in their resident perception surveys. This finding of latent demand has implications for urban areas around New Zealand and perhaps even in other similar places around the world.

This research found that on-street parking on Tory Street made only a very minor contribution to the retail vitality of adjacent shops. Further research is required in a range of contexts to develop knowledge and understanding around the actual contribution of on-street car parking in inner urban, and other, areas. Such research could have major implications for the conventional view that on-street parking is vital for inner urban businesses, as well as for the case for reallocation of that public space for other uses.

It would also be useful for research to test the ability of the Transtheoretical Model to accurately distinguish latent demand for transport cycling and cycling infrastructure, by testing the model using a quasi-experimental, longitudinal intervention study. This may allow more accurate quantification of the latent demand for cycling that may be realised by other similar interventions.

6.5 Conclusion

The aim of this study was to explore the extent to which road space reallocation from on-street parking to an arterial cycle way may be warranted between Wellington's southern suburbs and city centre. This was done through an assessment of latent demand for transport cycling using Prochaska and DiClemente's (1994) Transtheoretical Model, and a study of the economic contribution of the on-street parking on Tory Street to the adjacent businesses.

The results indicated that there is significant latent demand for transport cycling in Wellington. Transport cycling is suppressed primarily because of a perceived lack of safety when cycling in the city. Road safety improvements were identified as the fundamental changes required to encourage the uptake of transport cycling. In particular, people desire a continuous and connected network of separated and dedicated cycle ways. Potential cyclists indicated that they would be likely to cycle for transport more often if a cycle path connecting Wellington's southern suburbs and city centre was constructed. Additionally, it appears that the majority of people would support the removal of some on-street parking to provide for this cycle way.

Contrary to what might be expected, this study found that the contribution of those who use on-street parking to adjacent retail vitality on Tory Street is minor, compared to the contribution of those who do not require parking and those who use off-street parking.

Accordingly, the conclusion of this research is that the reallocation of road space from on-street parking to an arterial cycle way between Wellington's southern suburbs and city centre may well be warranted. Such a reallocation seems to be a more efficient, effective and appropriate use of public space.

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Appendix A: Ethics Approval

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

MEMORANDUM

Phone 0-4-463 5676
Fax 0-4-463 5209
Email Allison.kirkman@vuw.ac.nz

TO	Jean Beetham
COPY TO	Ralph Chapman
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee

DATE	28 November 2012
PAGES	1

SUBJECT	**Ethics Approval: 19528** **To what extent would road space reallocation to a cycle lane be warranted between Wellington's Southern suburbs and waterfront?**

Thank you for your request to amend your ethics approval. This has now been considered and the request granted.

Your application has approval until 12 March 2013. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with your research.

Allison Kirkman
Human Ethics Committee

Appendix B: Online Survey

Cycling for transport in Wellington

Participant consent

Please read the following consent information, then click on the button below to progress to the survey

Information for Wellington Bicycle Survey participants

Jean Beetham

MEnvStud Student

jean.beetham@vuw.ac.nz

022 678 2384

What is the purpose of this research?

This research is a component of my Master's thesis, and will enable me to assess the extent to which the reallocation of some on-street public parking to a cycle lane would be warranted between Wellington's waterfront and southern suburbs, with a case study of Tory Street.

Who is conducting the research?

Jean Beetham in the School of Geography, Environment and Earth Sciences. Supervised by Associate Professor Ralph Chapman of the School of Geography, Environment and Earth Sciences. The Victoria University Human Ethics Committee has approved this research.

What is involved if you agree to participate?

You would fill out a short questionnaire in which you are asked questions regarding your current bicycle use, your attitude and barriers to, and perceptions of, bicycling for transport in Wellington and of a safe cycle route connecting the southern suburbs with Wellington's waterfront.

I anticipate that your total involvement will take no more than 5 minutes.

During the research you are free to withdraw, without any penalty, at any point.

Privacy and Confidentiality

You will not be individually identified in my research project or in any other presentation or publication. The information you provide will be coded by number only.

A copy of the coded and anonymous data will remain in my custody for up to three years.

All written material will be stored in a locked file, and electronic material will be stored in a password protected file, with access restricted to me.

What happens to the information that you provide?

The overall findings of this study may be submitted for publication in a scientific journal, presented at scientific conferences, or made available via the NZ Centre for Sustainable Cities website.

The overall findings will form part of a Master's thesis that will be submitted for assessment, and made publicly available in the Victoria University library.

If you have any further questions regarding this study, or if you would like a summary copy of the results, please contact me (Jean Beetham) at the above contact details, or my supervisor, below.

Supervisor:
Associate Professor Ralph Chapman
ralph.chapman@vuw.ac.nz
04 463 6153
School of Geography, Environment and Earth Sciences
PO Box 600, Wellington

❍ I confirm I have read and understood the contents above and wish to proceed with the survey. (1)

Q1 If you don't mind, please indicate your gender

- ❍ Male (1)
- ❍ Female (2)

Q2 Please indicate your age

- ❑ Under 18 (7)
- ❑ 18 – 19 (1)
- ❑ 20 – 29 (2)
- ❑ 30 – 39 (3)
- ❑ 40 – 49 (4)
- ❑ 50 – 59 (5)
- ❑ 60+ (6)

Q3 Are you able to ride a bicycle?

- ❍ Yes (1)
- ❍ No, I never learnt to ride properly (2)
- ❍ No, I am not physically able to (3)

If No, I never learnt to ride ... Is Selected, Then Skip To Even if it reduced the amount of on-s...If No, I am not physically abl... Is Selected, Then Skip To Even if it reduced the amount of on-s...

Q4 Do you usually have access to a bicycle that is suitable for transport?

- ❍ Yes (1)
- ❍ No (2)

Q5 Do you usually have access to a motor vehicle for transport?

- ❍ Yes (1)
- ❍ No (2)

Q6 Have you ridden a bicycle for transport at all in the past year?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To For a short journey, when the weather...

Q7 How often have you ridden a bicycle for transport during the last three months?

- Not at all in the last three months (1)
- Less than weekly (2)
- Once or more a week (3)

Q8 For a short journey, when the weather is fine and you have nothing much to carry, would you… (Choose one only)

- not consider using a bicycle (1)
- possibly consider cycling but wouldn’t actually do it (2)
- possibly consider cycling, and rarely or sometimes do it (3)
- often cycle (4)
- almost always cycle (5)

Q9-Q19 Please select the point on the scales below that best indicates the extent to which you agree with the following statements. If you 'don't know', leave the response blank.

	Agree 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Disagree 7 (7)
Cycling is good for your health (1)	❍	❍	❍	❍	❍	❍	❍
Cycling is good for the environment (2)	❍	❍	❍	❍	❍	❍	❍
I like cycling (3)	❍	❍	❍	❍	❍	❍	❍
Generally speaking, I don't want to cycle (4)	❍	❍	❍	❍	❍	❍	❍
I am not fit enough to cycle (5)	❍	❍	❍	❍	❍	❍	❍
I would feel uncomfortable on a bicycle (6)	❍	❍	❍	❍	❍	❍	❍
It would be uncharacteristic for me to use a bicycle for transport (7)	❍	❍	❍	❍	❍	❍	❍
In general, there are not enough cycle lanes in Wellington (8)	❍	❍	❍	❍	❍	❍	❍
In general, it is unsafe to cycle around Wellington for transport (9)	❍	❍	❍	❍	❍	❍	❍
In general, there is not enough secure bicycle parking in Wellington (10)	❍	❍	❍	❍	❍	❍	❍
In general, there are not enough showering and changing facilities for cyclists in Wellington (11)	❍	❍	❍	❍	❍	❍	❍

If you would like to, please comment on your above answers in the box below.

Q20 Under what circumstances, if any, would you be willing to cycle for transport (more often)? (Please type in the box below).

Q21-Q24 Imagine yourself riding a bicycle for a short trip that you regularly make; this may be a commute to work or school, for shopping, or visiting a friend. Please select the point on the scales below that best matches how important the following factors would be in your choice of route:

	Unimportant 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Important 7 (7)
Being the safest route (1)	❍	❍	❍	❍	❍	❍	❍
Being the least hilly (flattest) route (2)	❍	❍	❍	❍	❍	❍	❍
Being a route through green space (3)	❍	❍	❍	❍	❍	❍	❍
Being the quickest (or most direct) route (4)	❍	❍	❍	❍	❍	❍	❍

If you would like to, please comment on your above answers in the box below.

Q25 How frequently do you usually travel within or between Wellington's southern suburbs* and the CBD/waterfront? (*southern suburbs include Island Bay, Berhampore, Newtown, Mt Cook).

- ❍ 4+ days a week (1)
- ❍ 2-3 days a week (2)
- ❍ Once a week (3)
- ❍ Once a fortnight (4)
- ❍ Once a month (5)
- ❍ Less than once a month (6)

Q26-Q27 If an arterial cycle path, separated from traffic, was constructed connecting Wellington's southern suburbs* and the CBD/waterfront... - please indicate your position on the scales below - (*southern suburbs include Island Bay, Berhampore, Newtown, Mt Cook).

	Unlikely 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Likely 7 (7)
...how likely is it that you would use it? (1)	❍	❍	❍	❍	❍	❍	❍
...how likely is it that you would cycle more frequently for transport? (2)	❍	❍	❍	❍	❍	❍	❍

If you would like to, please comment on your above answers in the box below.

Q28 Even if it reduced the amount of on-street parking available on some arterial streets, would you support the construction of a cycle path connecting the southern suburbs* with Wellington's CBD/waterfront? (*southern suburbs include Island Bay, Berhampore, Newtown, Mt Cook).

❍ Yes (1)
❍ No (2)
❍ Maybe (3)
❍ Don't know (4)

Demographics:

Q29 Which suburb do you live in?   (Please type in the box below).

Q30 If you don't mind, please indicate your individual yearly income before tax:

- $0 (1)
- $1-$20,000 (2)
- $20,001-$50,000 (3)
- $50,001-$70,000 (4)
- $70,001+ (5)

Q31 Please indicate your highest level of education:

- No Qualification (1)
- High School Qualification (2)
- Tertiary Degree (3)
- Tertiary Other (4)

Appendix C: Survey Recruitment Email

Dear [*organisation*],

My name is Jean Beetham and I am a Masters student at Victoria University of Wellington. I am conducting an online survey as part of my Masters research project that I believe may be of interest to [*people in your organisation*].

The survey investigates current bicycle use, attitudes and barriers to, and perceptions of, bicycling for transport in Wellington.

It also asks about opinions of an arterial cycle path connecting Wellington's southern suburbs with the CBD/waterfront.

• I am especially interested to hear from people who live, work, or ever travel through Wellington's southern suburbs* and CBD/waterfront (*Island Bay, Berhampore, Newtown, and Mt Cook)

• The survey should take **less than 5 minutes** to complete

• All opinions are important - whether you would never cycle, want to (but don't), or always do.

I would be very grateful if you could take the time to complete my survey and circulate it around [*people in your organisation*]. Please follow this link for further information and to take the survey:

Take the Survey

Or copy and paste the URL below into your Internet browser:
http://vuw.qualtrics.com/WRQualtricsSurveyEngine/?SID=SV_81ucETWxVHnqzmB&RID=MLRP_5d7c60oFxNFmf1b&_=1

Thank you for your time. Please also feel free to forward this email to any interested parties, or contact me with any questions or comments.

Kind regards,

Jean Beetham,

MEnvStud Candidate
Victoria University of Wellington
jean.beetham@vuw.ac.nz, 022 678 2384
School of Geography, Environment and Earth Sciences
PO Box 600, Wellington

Appendix D: Survey Recruitment Flyer

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

What do you think of a cycle path from here to the CBD?

Have your say. Go to the link below for more info and to answer a short survey on cycling in Wellington.

tinyurl.com/wgtn-bike-survey

Jean Beetham | MEnvStud Candidate |
Victoria University of Wellington | jean.beetham@vuw.ac.nz | 022 678 2384 | School of Geography, Environment and Earth Sciences | PO Box 600, Wellington

Wellington cycle survey: **tinyurl.com/wgtn-bike-survey**

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Wellington cycle survey: **tinyurl.com/wgtn-bike-survey**

Appendix E: Street Intercept Survey

Information sheet for Tory Street Survey participants

Jean Beetham

MEnvStud Student

jean.beetham@vuw.ac.nz

022 678 2384

What is the purpose of this research?

- This research is a component of my Master's thesis, and will enable me to assess the extent to which the reallocation of some on-street public parking to a cycle lane would be warranted between Wellington's waterfront and southern suburbs, with a case study of Tory Street.

Who is conducting the research?

- Jean Beetham in the School of Geography, Environment and Earth Sciences. Supervised by Associate Professor Ralph Chapman of the School of Geography, Environment and Earth Sciences. The Victoria University Human Ethics Committee has approved this research.

What is involved if you agree to participate?

- You would fill out a short questionnaire in which you answer questions regarding your visit to Tory Street, including mode of travel, where you parked, trip purpose, frequency of visits, and retail spend of your current trip.
- I anticipate that your involvement will take no more than 2 or 3 minutes.
- During the research you are free to withdraw, without any penalty, at any point.

Privacy and Confidentiality

- You will not be individually identified in my research project or in any other presentation or publication. The information you provide will be coded by number only.
- A copy of the coded and anonymous data will remain in my custody for up to three years.
- All written material will be stored in a locked file, and electronic material will be stored in a password protected file, with access restricted to me.

What happens to the information that you provide?

- The overall findings of this study may be submitted for publication in a scientific journal, presented at scientific conferences, or made available via the NZ Centre for Sustainable Cities website.
- The overall findings will form part of a Master's thesis that will be submitted for assessment, and made publicly available in the Victoria University library.

If you have any further questions regarding this study, or if you would like a summary copy of the results, please contact me (Jean Beetham) at the above contact details, or my supervisor, below.

Supervisor:

Associate Professor Ralph Chapman

ralph.chapman@vuw.ac.nz

04 463 6153

School of Geography, Environment and Earth Sciences

PO Box 600, Wellington

Tory St question set + response key

1) What was the **main** way you travelled into the CBD today?

CD - Car driver
CP - Car passenger
PT - Public transport
Wk - By foot
Bi - By bicycle
O - Other *(please state)*: ________________________

2) If you came by car, **where did you park**? *(Otherwise, skip to question 3)*

OnST - On-street parking, Tory St
OnSE - On-street parking, elsewhere
Off-PP - Off-street paid parking
OffSP - Off-street business/shoppers-provided parking
O - Other (please state): ____________________________

3) What suburb (or city if from outside Wellington city) did you travel from today?

4) What is the main **purpose** of your visit to Tory Street today?

Pass - Passing through to another destination (not on Tory Street)
Food - Visiting Tory St **restaurant/café**. Which? _________________________
Shop - Visiting Tory St **shops**. Which? _________________________
Service - Accessing Tory St **services** (e.g. bank, gym, hotel, haircut etc). Which? ________
Work - **Working** on Tory St. Where? _________________________
Trade - Making **deliveries/trade/business**. Where? _________________________
School - Going to **school** on Tory St
Live - I **live** on Tory St
Other- Other (please state): ____________________________

5) Before you came to town, did you **intend** to visit Tory Street today?

Y - Yes, **N -** No

6) How **frequently** do you visit Tory Street?

3+ - Several times a week or more
1-2 - About once or twice weekly
FN - About fortnightly
Mth - About monthly
LMth - Less than monthly

7) About how much **money** do you anticipate spending in places **on Tory St** before returning to your vehicle or home? ____________________________________

8) About how much **money** do you anticipate spending **elsewhere** before returning to your vehicle or home? ____________________________________

Appendix F: Multinomial Logistic Regression Tables

Multinomial logistic regression was used to assess the association of gender, age, income, and education with Stage of Change Group, as explained in section 4.2.3 and section 5.1.2. The full statistical tables for this test are shown below.

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	757.212			
Final	638.049	119.163	40	.000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	299.042	316	.745
Deviance	308.860	316	.602

Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	638.049[a]	.000	0	.
Gender	694.734	56.685	4	.000
Age_group	666.379	28.331	16	.029
Income_group	654.698	16.649	12	.163
Edu_group	643.087	5.039	8	.753

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates

Stage of Change Group[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Precontemplation	Intercept	.495	.640	.599	1	.439			
	[Gender=Male]	-1.699	.327	27.068	1	.000	.183	.096	.347
	[Gender=Female]	0[b]	.	.	0	.	.	.	.
	[Age_group=1]	-.898	.656	1.872	1	.171	.408	.113	1.475
	[Age_group=2]	-.741	.603	1.510	1	.219	.476	.146	1.554
	[Age_group=3]	-.825	.620	1.770	1	.183	.438	.130	1.477
	[Age_group=4]	.576	.647	.793	1	.373	1.779	.501	6.322
	[Age_group=5]	0[b]	.	.	0	.	.	.	.
	[Income_group=1]	-.068	.575	.014	1	.906	.935	.303	2.887
	[Income_group=2]	.239	.425	.315	1	.575	1.269	.552	2.922
	[Income_group=3]	-.321	.428	.565	1	.452	.725	.314	1.676
	[Income_group=4]	0[b]	.	.	0	.	.	.	.
	[Edu_group=1]	.816	.612	1.780	1	.182	2.262	.682	7.501
	[Edu_group=2]	-.179	.368	.238	1	.626	.836	.406	1.719
	[Edu_group=3]	0[b]	.	.	0	.	.	.	.
Contemplation	Intercept	.294	.601	.239	1	.625			
	[Gender=Male]	-1.298	.282	21.198	1	.000	.273	.157	.474
	[Gender=Female]	0[b]	.	.	0	.	.	.	.
	[Age_group=1]	-.519	.562	.852	1	.356	.595	.198	1.791
	[Age_group=2]	-.454	.536	.718	1	.397	.635	.222	1.816
	[Age_group=3]	-1.532	.611	6.278	1	.012	.216	.065	.716
	[Age_group=4]	.055	.627	.008	1	.930	1.056	.309	3.610
	[Age_group=5]	0[b]	.	.	0	.	.	.	.
	[Income_group=1]	1.044	.453	5.312	1	.021	2.841	1.169	6.905
	[Income_group=2]	.676	.394	2.947	1	.086	1.966	.909	4.251
	[Income_group=3]	.402	.375	1.148	1	.284	1.495	.716	3.121
	[Income_group=4]	0[b]	.	.	0	.	.	.	.
	[Edu_group=1]	.364	.588	.383	1	.536	1.439	.455	4.554
	[Edu_group=2]	-.125	.345	.132	1	.716	.882	.449	1.733
	[Edu_group=3]	0[b]	.	.	0	.	.	.	.
Ready for Action	Intercept	-.034	.580	.003	1	.954			
	[Gender=Male]	-.850	.255	11.112	1	.001	.428	.259	.705
	[Gender=Female]	0[b]	.	.	0	.	.	.	.
	[Age_group=1]	-.644	.560	1.323	1	.250	.525	.175	1.574
	[Age_group=2]	-.129	.519	.062	1	.804	.879	.318	2.432
	[Age_group=3]	-.258	.534	.233	1	.629	.773	.271	2.200
	[Age_group=4]	.543	.593	.838	1	.360	1.721	.538	5.502
	[Age_group=5]	0[b]	.	.	0	.	.	.	.
	[Income_group=1]	.788	.419	3.542	1	.060	2.199	.968	4.998
	[Income_group=2]	.340	.365	.868	1	.352	1.405	.687	2.871
	[Income_group=3]	.203	.327	.386	1	.534	1.226	.645	2.328
	[Income_group=4]	0[b]	.	.	0	.	.	.	.
	[Edu_group=1]	.177	.572	.096	1	.756	1.194	.390	3.661
	[Edu_group=2]	.133	.315	.179	1	.672	1.143	.616	2.119
	[Edu_group=3]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Maintenance.

b. This parameter is set to zero because it is redundant.

Parameter Estimates Continued

Stage of Change Group[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Action	Intercept	-.561	.577	.945	1	.331			
	[Gender=Male]	.134	.253	.281	1	.596	1.144	.696	1.879
	[Gender=Female]	0[b]	.	.	0	.	.	.	.
	[Age_group=1]	-.063	.549	.013	1	.909	.939	.320	2.755
	[Age_group=2]	.318	.506	.396	1	.529	1.375	.510	3.709
	[Age_group=3]	.216	.517	.174	1	.676	1.241	.450	3.420
	[Age_group=4]	.409	.593	.475	1	.491	1.505	.471	4.811
	[Age_group=5]	0[b]	.	.	0	.	.	.	.
	[Income_group=1]	-.127	.428	.089	1	.766	.880	.381	2.037
	[Income_group=2]	-.541	.374	2.093	1	.148	.582	.279	1.212
	[Income_group=3]	-.106	.297	.127	1	.722	.900	.503	1.609
	[Income_group=4]	0[b]	.	.	0	.	.	.	.
	[Edu_group=1]	.458	.513	.798	1	.372	1.581	.579	4.317
	[Edu_group=2]	.234	.301	.606	1	.436	1.264	.701	2.279
	[Edu_group=3]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Maintenance.
b. This parameter is set to zero because it is redundant.

Classification

Observed	Predicted					
	Precontemplation	Contemplation	Ready for Action	Action	Maintenance	Percent Correct
Precontemplation	14	17	8	7	21	20.9%
Contemplation	10	32	9	11	31	34.4%
Ready for Action	13	17	22	19	44	19.1%
Action	2	12	10	53	65	37.3%
Maintenance	5	20	10	46	89	52.4%
Overall Percentage	7.5%	16.7%	10.1%	23.2%	42.6%	35.8%

Appendix G: Perception of Cycling Analysis Tables

Friedman Two-Way ANOVA and Wilcoxon Signed Ranks tests were used to compare the relative differences between opinion of cycling, willingness to cycle and external barrier perceptions within each Stage of Change Group. The process is described in section 4.2.3 and the results are presented in section 5.1.2. The full data tables are presented below.

Friedman Two-Way ANOVA

Friedman Ranks

Stage of Change Group		Mean Rank
Precontemplation	Opinion of cycling	2.82
	External barriers	1.86
	Willingness to cycle	1.32
Contemplation	Opinion of cycling	2.81
	External barriers	1.78
	Willingness to cycle	1.41
Ready for Action	Opinion of cycling	2.81
	External barriers	1.47
	Willingness to cycle	1.72
Action	Opinion of cycling	2.59
	External barriers	1.20
	Willingness to cycle	2.20
Maintenance	Opinion of cycling	2.57
	External barriers	1.15
	Willingness to cycle	2.28

Friedman Test Statistics

Precontemplation	N	70
	Chi-Square	85.795
	df	2
	Asymp. Sig.	.000
Contemplation	N	98
	Chi-Square	109.008
	df	2
	Asymp. Sig.	.000
Ready for Action	N	121
	Chi-Square	132.614
	df	2
	Asymp. Sig.	.000
Action	N	145
	Chi-Square	168.144
	df	2
	Asymp. Sig.	.000
Maintenance	N	173
	Chi-Square	244.381
	df	2
	Asymp. Sig.	.000

Wilcoxon Ranks

Stage of Change Group			N	Mean Rank	Sum of Ranks
Precontemplation	External barriers - Opinion of cycling	Negative Ranks	58[a]	34.20	1983.50
		Positive Ranks	6[b]	16.08	96.50
		Ties	6[c]		
		Total	70		
	Willingness to cycle - Opinion of cycling	Negative Ranks	64[d]	32.77	2097.50
		Positive Ranks	1[e]	47.50	47.50
		Ties	5[f]		
		Total	70		
	Willingness to cycle - External barriers	Negative Ranks	49[g]	37.20	1823.00
		Positive Ranks	17[h]	22.82	388.00
		Ties	4[i]		
		Total	70		
Contemplation	External barriers - Opinion of cycling	Negative Ranks	84[a]	45.07	3785.50
		Positive Ranks	5[b]	43.90	219.50
		Ties	9[c]		
		Total	98		
	Willingness to cycle - Opinion of cycling	Negative Ranks	85[d]	46.86	3983.00
		Positive Ranks	5[e]	22.40	112.00
		Ties	8[f]		
		Total	98		
	Willingness to cycle - External barriers	Negative Ranks	65[g]	49.13	3193.50
		Positive Ranks	30[h]	45.55	1366.50
		Ties	3[i]		
		Total	98		
Ready for Action	External barriers - Opinion of cycling	Negative Ranks	109[a]	56.56	6165.00
		Positive Ranks	2[b]	25.50	51.00
		Ties	10[c]		
		Total	121		
	Willingness to cycle - Opinion of cycling	Negative Ranks	96[d]	53.49	5135.00
		Positive Ranks	6[e]	19.67	118.00
		Ties	19[f]		
		Total	121		
	Willingness to cycle - External barriers	Negative Ranks	49[g]	59.14	2898.00
		Positive Ranks	71[h]	61.44	4362.00
		Ties	1[i]		
		Total	121		

a. External barriers < Opinion of cycling
b. External barriers > Opinion of cycling
c. External barriers = Opinion of cycling
d. Willingness to cycle < Opinion of cycling
e. Willingness to cycle > Opinion of cycling
f. Willingness to cycle = Opinion of cycling
g. Willingness to cycle < External barriers
h. Willingness to cycle > External barriers
i. Willingness to cycle = External barriers

Wilcoxon Ranks Continued

Stage of Change Group			N	Mean Rank	Sum of Ranks
Action	External barriers - Opinion of cycling	Negative Ranks	133[a]	70.21	9337.50
		Positive Ranks	4[b]	28.88	115.50
		Ties	8[c]		
		Total	145		
	Willingness to cycle - Opinion of cycling	Negative Ranks	68[d]	49.93	3395.00
		Positive Ranks	25[e]	39.04	976.00
		Ties	52[f]		
		Total	145		
	Willingness to cycle - External barriers	Negative Ranks	20[g]	41.70	834.00
		Positive Ranks	122[h]	76.39	9319.00
		Ties	3[i]		
		Total	145		
Maintenance	External barriers - Opinion of cycling	Negative Ranks	155[a]	81.05	12563.00
		Positive Ranks	4[b]	39.25	157.00
		Ties	14[c]		
		Total	173		
	Willingness to cycle - Opinion of cycling	Negative Ranks	56[d]	31.48	1763.00
		Positive Ranks	10[e]	44.80	448.00
		Ties	107[f]		
		Total	173		
	Willingness to cycle - External barriers	Negative Ranks	10[g]	21.30	213.00
		Positive Ranks	153[h]	85.97	13153.00
		Ties	10[i]		
		Total	173		

a. External barriers < Opinion of cycling
b. External barriers > Opinion of cycling
c. External barriers = Opinion of cycling
d. Willingness to cycle < Opinion of cycling
e. Willingness to cycle > Opinion of cycling
f. Willingness to cycle = Opinion of cycling
g. Willingness to cycle < External barriers
h. Willingness to cycle > External barriers
i. Willingness to cycle = External barriers

Wilcoxon Signed Ranks Test Statistics

Stage of Change Group		External barriers - Opinion of cycling	Willingness to cycle - Opinion of cycling	Willingness to cycle - External barriers
Precontemplation	Z	-6.322[b]	-6.701[b]	-4.584[b]
	Asymp. Sig. (2-tailed)	.000	.000	.000
Contemplation	Z	-7.305[b]	-7.790[b]	-3.391[b]
	Asymp. Sig. (2-tailed)	.000	.000	.001
Ready for Action	Z	-9.005[b]	-8.380[b]	-1.917[c]
	Asymp. Sig. (2-tailed)	.000	.000	.055
Action	Z	-9.921[b]	-4.643[b]	-8.641[c]
	Asymp. Sig. (2-tailed)	.000	.000	.000
Maintenance	Z	-10.677[b]	-4.221[b]	-10.723[c]
	Asymp. Sig. (2-tailed)	.000	.000	.000

b. Based on positive ranks.
c. Based on negative ranks.

Appendix H: Route Choice Factor Analysis Tables

Friedman Two-Way ANOVA and Wilcoxon Signed Ranks tests were used to compare the relative differences between opinion of cycling, willingness to cycle and external barrier perceptions within each Stage of Change Group. The process is described in section 4.2.3 and the results are presented in section 5.1.2. The full data tables are presented below.

Friedman Ranks

Stage of Change Group		Mean Rank
Precontemplation	Safety	3.23
	Flat gradient	2.43
	Green space	2.04
	Directness	2.30
Contemplation	Safety	3.27
	Flat gradient	2.56
	Green space	1.93
	Directness	2.24
Ready for Action	Safety	3.07
	Flat gradient	2.39
	Green space	2.03
	Directness	2.52
Action	Safety	2.83
	Flat gradient	2.11
	Green space	2.23
	Directness	2.83
Maintenance	Safety	2.83
	Flat gradient	1.88
	Green space	2.46
	Directness	2.84

Friedman Test Statistics

Precontemplation	N	67
	Chi-Square	41.609
	df	3
	Asymp. Sig.	.000
Contemplation	N	97
	Chi-Square	72.939
	df	3
	Asymp. Sig.	.000
Ready for Action	N	119
	Chi-Square	46.710
	df	3
	Asymp. Sig.	.000
Action	N	144
	Chi-Square	44.078
	df	3
	Asymp. Sig.	.000
Maintenance	N	173
	Chi-Square	74.597
	df	3
	Asymp. Sig.	.000

Wilcoxon Ranks

Stage of Change Group			N	Mean Rank	Sum of Ranks
Precontemplation	Flat gradient - Safety	Negative Ranks	32[a]	22.53	721.00
		Positive Ranks	9[b]	15.56	140.00
		Ties	28[c]		
		Total	69		
	Green space - Safety	Negative Ranks	46[d]	27.70	1274.00
		Positive Ranks	6[e]	17.33	104.00
		Ties	16[f]		
		Total	68		
	Directness - Safety	Negative Ranks	44[g]	25.15	1106.50
		Positive Ranks	7[h]	31.36	219.50
		Ties	17[i]		
		Total	68		
	Green space - Flat gradient	Negative Ranks	30[j]	26.30	789.00
		Positive Ranks	18[k]	21.50	387.00
		Ties	20[l]		
		Total	68		
	Directness - Flat gradient	Negative Ranks	25[m]	24.50	612.50
		Positive Ranks	24[n]	25.52	612.50
		Ties	19[o]		
		Total	68		
	Directness - Green space	Negative Ranks	17[p]	21.32	362.50
		Positive Ranks	29[q]	24.78	718.50
		Ties	21[r]		
		Total	67		

a. Flat gradient < Safety
b. Flat gradient > Safety
c. Flat gradient = Safety
d. Green space < Safety
e. Green space > Safety
f. Green space = Safety
g. Directness < Safety
h. Directness > Safety
i. Directness = Safety
j. Green space < Flat gradient
k. Green space > Flat gradient
l. Green space = Flat gradient
m. Directness < Flat gradient
n. Directness > Flat gradient
o. Directness = Flat gradient
p. Directness < Green space
q. Directness > Green space
r. Directness = Green space

Wilcoxon Ranks Continued

Stage of Change Group			N	Mean Rank	Sum of Ranks
Contemplation	Flat gradient - Safety	Negative Ranks	50[a]	33.54	1677.00
		Positive Ranks	12[b]	23.00	276.00
		Ties	36[c]		
		Total	98		
	Green space - Safety	Negative Ranks	71[d]	41.50	2946.50
		Positive Ranks	7[e]	19.21	134.50
		Ties	19[f]		
		Total	97		
	Directness - Safety	Negative Ranks	59[g]	37.54	2215.00
		Positive Ranks	11[h]	24.55	270.00
		Ties	28[i]		
		Total	98		
	Green space - Flat gradient	Negative Ranks	52[j]	39.91	2075.50
		Positive Ranks	21[k]	29.79	625.50
		Ties	24[l]		
		Total	97		
	Directness - Flat gradient	Negative Ranks	45[m]	37.20	1674.00
		Positive Ranks	27[n]	35.33	954.00
		Ties	26[o]		
		Total	98		
	Directness - Green space	Negative Ranks	27[p]	31.33	846.00
		Positive Ranks	43[q]	38.12	1639.00
		Ties	27[r]		
		Total	97		

a. Flat gradient < Safety
b. Flat gradient > Safety
c. Flat gradient = Safety
d. Green space < Safety
e. Green space > Safety
f. Green space = Safety
g. Directness < Safety
h. Directness > Safety
i. Directness = Safety
j. Green space < Flat gradient
k. Green space > Flat gradient
l. Green space = Flat gradient
m. Directness < Flat gradient
n. Directness > Flat gradient
o. Directness = Flat gradient
p. Directness < Green space
q. Directness > Green space
r. Directness = Green space

Wilcoxon Ranks Continued

Stage of Change Group			N	Mean Rank	Sum of Ranks
Ready for Action	Flat gradient - Safety	Negative Ranks	63[a]	50.38	3174.00
		Positive Ranks	26[b]	31.96	831.00
		Ties	32[c]		
		Total	121		
	Green space - Safety	Negative Ranks	84[d]	51.09	4291.50
		Positive Ranks	16[e]	47.41	758.50
		Ties	19[f]		
		Total	119		
	Directness - Safety	Negative Ranks	62[g]	51.68	3204.00
		Positive Ranks	33[h]	41.09	1356.00
		Ties	26[i]		
		Total	121		
	Green space - Flat gradient	Negative Ranks	56[j]	50.29	2816.00
		Positive Ranks	37[k]	42.03	1555.00
		Ties	26[l]		
		Total	119		
	Directness - Flat gradient	Negative Ranks	44[m]	45.52	2003.00
		Positive Ranks	51[n]	50.14	2557.00
		Ties	26[o]		
		Total	121		
	Directness - Green space	Negative Ranks	35[p]	37.87	1325.50
		Positive Ranks	60[q]	53.91	3234.50
		Ties	24[r]		
		Total	119		

a. Flat gradient < Safety
b. Flat gradient > Safety
c. Flat gradient = Safety
d. Green space < Safety
e. Green space > Safety
f. Green space = Safety
g. Directness < Safety
h. Directness > Safety
i. Directness = Safety
j. Green space < Flat gradient
k. Green space > Flat gradient
l. Green space = Flat gradient
m. Directness < Flat gradient
n. Directness > Flat gradient
o. Directness = Flat gradient
p. Directness < Green space
q. Directness > Green space
r. Directness = Green space

Wilcoxon Ranks Continued

Stage of Change Group			N	Mean Rank	Sum of Ranks
Action	Flat gradient - Safety	Negative Ranks	82[a]	63.52	5208.50
		Positive Ranks	34[b]	46.40	1577.50
		Ties	28[c]		
		Total	144		
	Green space - Safety	Negative Ranks	82[d]	63.93	5242.50
		Positive Ranks	38[e]	53.09	2017.50
		Ties	24[f]		
		Total	144		
	Directness - Safety	Negative Ranks	59[g]	60.69	3580.50
		Positive Ranks	57[h]	56.24	3205.50
		Ties	28[i]		
		Total	144		
	Green space - Flat gradient	Negative Ranks	54[j]	53.97	2914.50
		Positive Ranks	63[k]	63.31	3988.50
		Ties	27[l]		
		Total	144		
	Directness - Flat gradient	Negative Ranks	27[m]	47.57	1284.50
		Positive Ranks	81[n]	56.81	4601.50
		Ties	36[o]		
		Total	144		
	Directness - Green space	Negative Ranks	37[p]	57.76	2137.00
		Positive Ranks	81[q]	60.30	4884.00
		Ties	26[r]		
		Total	144		

a. Flat gradient < Safety
b. Flat gradient > Safety
c. Flat gradient = Safety
d. Green space < Safety
e. Green space > Safety
f. Green space = Safety
g. Directness < Safety
h. Directness > Safety
i. Directness = Safety
j. Green space < Flat gradient
k. Green space > Flat gradient
l. Green space = Flat gradient
m. Directness < Flat gradient
n. Directness > Flat gradient
o. Directness = Flat gradient
p. Directness < Green space
q. Directness > Green space
r. Directness = Green space

Wilcoxon Ranks Continued

Stage of Change Group			N	Mean Rank	Sum of Ranks
Maintenance	Flat gradient - Safety	Negative Ranks	115[a]	77.30	8890.00
		Positive Ranks	29[b]	53.45	1550.00
		Ties	29[c]		
		Total	173		
	Green space - Safety	Negative Ranks	81[d]	74.09	6001.50
		Positive Ranks	53[e]	57.42	3043.50
		Ties	39[f]		
		Total	173		
	Directness - Safety	Negative Ranks	68[g]	68.37	4649.00
		Positive Ranks	68[h]	68.63	4667.00
		Ties	37[i]		
		Total	173		
	Green space - Flat gradient	Negative Ranks	41[j]	55.18	2262.50
		Positive Ranks	89[k]	70.25	6252.50
		Ties	43[l]		
		Total	173		
	Directness - Flat gradient	Negative Ranks	29[m]	48.71	1412.50
		Positive Ranks	111[n]	76.19	8457.50
		Ties	33[o]		
		Total	173		
	Directness - Green space	Negative Ranks	53[p]	66.68	3534.00
		Positive Ranks	87[q]	72.83	6336.00
		Ties	33[r]		
		Total	173		

a. Flat gradient < Safety
b. Flat gradient > Safety
c. Flat gradient = Safety
d. Green space < Safety
e. Green space > Safety
f. Green space = Safety
g. Directness < Safety
h. Directness > Safety
i. Directness = Safety
j. Green space < Flat gradient
k. Green space > Flat gradient
l. Green space = Flat gradient
m. Directness < Flat gradient
n. Directness > Flat gradient
o. Directness = Flat gradient
p. Directness < Green space
q. Directness > Green space
r. Directness = Green space

Wilcoxon Signed Ranks Test Statistics

Stage of Change Group		Flat gradient - Safety	Green space - Safety	Directness - Safety	Green space - Flat gradient	Directness - Flat gradient	Directness - Green space
Precontemplation	Z	-3.800[b]	-5.377[b]	-4.218[b]	-2.089[b]	.000[c]	-1.967[d]
	Asymp. Sig. (2-tailed)	.000	.000	.000	.037	1.000	.049
Contemplation	Z	-4.984[b]	-7.064[b]	-5.734[b]	-4.016[b]	-2.045[b]	-2.339[d]
	Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.041	.019
Ready for Action	Z	-4.847[b]	-6.117[b]	-3.475[b]	-2.440[b]	-1.040[d]	-3.569[d]
	Asymp. Sig. (2-tailed)	.000	.000	.001	.015	.298	.000
Action	Z	-5.033[b]	-4.260[b]	-.523[b]	-1.472[d]	-5.121[d]	-3.719[d]
	Asymp. Sig. (2-tailed)	.000	.000	.601	.141	.000	.000
Maintenance	Z	-7.381[b]	-3.320[b]	-.020[d]	-4.676[d]	-7.376[d]	-2.936[d]
	Asymp. Sig. (2-tailed)	.000	.001	.984	.000	.000	.003

b. Based on positive ranks.

c. The sum of negative ranks equals the sum of positive ranks.

d. Based on negative ranks.

Appendix I: Binary Logistic Regression Tables

Binary logistic regression was used to assess the relationship of gender, age, income, education, opinion of cycling, willingness to cycle, external barrier perceptions and Stage of Change group with the probability of stating that the presence of the case study cycle way was likely to increase one's frequency of cycling for transport. This test is discussed in section 4.2.3 and the results are presented in section 5.1.3. The full data tables are presented below.

Omnibus Tests of Model Coefficients and Goodness-of-Fit

		Chi-square	df	Sig.
Step 1	Step	72.501	17	.000
	Block	72.501	17	.000
	Model	72.501	17	.000
	Hosmer - Lemeshow Goodness-of-Fit Test	7.826	8	.451

Classification Table[a]

Observed			Predicted		
			Cycling increase		Percentage Correct
			Unlikely	Likely	
Step 1	Cycling increase	Unlikely	62	82	43.1
		Likely	28	221	88.8
	Overall Percentage				72.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Gender(Male)	-.079	.264	.090	1	.765	.924	.551	1.549
	Age_group			4.170	4	.384			
	Age_group(1)	-1.127	.655	2.958	1	.085	.324	.090	1.170
	Age_group(2)	-.728	.634	1.318	1	.251	.483	.139	1.673
	Age_group(3)	-1.025	.636	2.602	1	.107	.359	.103	1.247
	Age_group(4)	-1.033	.683	2.289	1	.130	.356	.093	1.357
	Income_group			2.771	3	.428			
	Income_group(1)	-.275	.415	.437	1	.509	.760	.337	1.716
	Income_group(2)	.385	.367	1.099	1	.294	1.469	.716	3.014
	Income_group(3)	.129	.320	.161	1	.688	1.137	.607	2.129
	Edu_group			5.363	2	.068			
	Edu_group(1)	-.012	.474	.001	1	.980	.988	.390	2.504
	Edu_group(2)	.598	.300	3.979	1	.046	1.818	1.010	3.269
	SoC_group			22.630	4	.000			
	SoC_group(1)	1.615	.456	12.545	1	.000	5.027	2.057	12.284
	SoC_group(2)	1.882	.482	15.236	1	.000	6.567	2.552	16.897
	SoC_group(3)	1.088	.486	5.012	1	.025	2.970	1.145	7.701
	SoC_group(4)	.665	.473	1.971	1	.160	1.944	.769	4.914
	Opinion	.489	.252	3.784	1	.052	1.631	.996	2.671
	Willingness	.333	.133	6.317	1	.012	1.396	1.076	1.810
	External	.411	.112	13.440	1	.000	1.509	1.211	1.880
	Constant	-7.496	1.965	14.547	1	.000	.001		

a. Variable(s) entered on step 1: Gender, Age_group, Income_group, Edu_group, SoC_group, Opinion, Willingness, External.