A tale of two New Zealand cities: Cycling to school among adolescents in Christchurch and Dunedin

Jillian Frater PhD[a], John Williams PhD[b], Debbie Hopkins PhD[c], Charlotte Flaherty BCom[d], Antoni Moore PhD[e], Simon Kingham PhD[a] , Roeline Kuijer PhD[f], Sandra Mandic PhD[g]

[a] Department of Geography, University of Canterbury, Christchurch, New Zealand

[b]Department of Marketing, University of Otago, Dunedin, New Zealand

[c]School of Geography and the Environment, University of Oxford, England

[d]Dunedin City Council, Dunedin, New Zealand

[e]School of Surveying, University of Otago, Dunedin, New Zealand

[f]Department of Psychology, University of Canterbury, Christchurch, New Zealand

[g]Active Living Laboratory, School of Physical Education, Sport and Exercise Sciences, University of Otago, Dunedin, New Zealand

Corresponding author:

Dr Jillian Frater

Department of Geography

University of Canterbury

Private Bag 4800

Christchurch 8140

New Zealand

email: jillianf@clear.net.nz

Postal Addresses and emails of all other authors:

Dr John Williams, University of Otago, Commerce Building, 60 Clyde St, Cnr Clyde St & Union Pl East, PO Box 56, Dunedin 9054, New Zealand. Email: john.williams@otago.ac.nz

Dr Debbie Hopkins, School of Geography of the Environment, Oxford University Centre for the Environment, South Parks Road, Oxford, OX1 3QY, UK. Email: debbie.hopkins@ouce.ox.ac.uk

Mrs Charlotte Flaherty, Dunedin City Council, 50 The Octagon, PO Box 5045, Moray Place, Dunedin 9058. Email: charlotteflaherty@xtra.co.nz

Dr Antoni Moore, School of Surveying, University of Otago, 310 Castle Street, Dunedin, New Zealand. Email: tony.moore@otago.ac.nz

Professor Simon Kingham, Department of Geography, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand. Email: simon.kingham@canterbury.ac.nz

Associate Professor Roeline Kuijer, Department of Psychology, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand. Email: roeline.kuijer@canterbury.ac.nz

Dr Sandra Mandic, Active Living Laboratory, School of Physical Education, Sport and Exercise Sciences, University of Otago, PO Box 56, Dunedin 9054, New Zealand. E-mail: sandra.mandic@otago.ac.nz

A tale of two New Zealand cities: Cycling to school among adolescents in Christchurch and Dunedin

Abstract

This study examined intrapersonal factors related to cycling to school among adolescents in two New Zealand cities based on the Theory of Planned Behaviour and the Prototype Willingness Model. Data were collected from 803 adolescents (Christchurch: n=373, Dunedin: n=430; age 13-18 years; living ≤4 km from school; non-boarders). Despite similar attitudes towards cycling to school, Dunedin adolescents had lower prevalence of cycling to school (2% versus 18% in Christchurch) and also scored lower for all measures of injunctive norm, descriptive norm, self-perceived cycling capability and autonomy, and behavioural intention with respect to cycling to school compared to their Christchurch counterparts. The dominant influence on the intention to cycle to school was subjective norm in Christchurch and attitude in Dunedin. Future initiatives for encouraging adolescents to cycle to school should consider the contributions of intrapersonal factors and the social needs of adolescents, and the need to increase adolescents' cycle skills.

Keywords: Adolescent; teenage; cycling to school; Theory of Planned Behaviour; Prototype Willingness Model

1 Introduction

Since 1960 developed countries, including New Zealand, have seen an increase in the kilometres travelled using private motor vehicles and a decrease in the use of other forms of transport such as walking, cycling and public transport, with the rates of cycling decreasing significantly both for the wider population (Ministry of Transport, 2015b; Tin Tin, Woodward, Thornley, & Ameratunga, 2009) and for children travelling to school (Black, Collins, & Snell, 2001; Buliung, Mitra, & Faulkner, 2009; McDonald, 2007a; Ministry of Transport, 2015b; van der Ploeg, Merom, Corpuz, & Bauman, 2008). The increased use of motor vehicles has many adverse consequences including increases in transport emissions with subsequent increases in the quantity of greenhouse gases in the atmosphere and climate change, adverse health effects due to increases in air pollutants, increased number of road accidents and traffic congestion, reduction in physical activity, decreased levels of social capital, and reduced children's rights due to limits placed by adults on their travel choices (Newman & Kenworthy, 1989).

As adolescence is a time when identity, self-esteem and peer relationships are very important (Aldous, 1983), these factors can influence adolescents' choices regarding travel including cycling to school. Lower rates of cycling to school have been reported for girls (Horspool, 2006; Ministry of Transport, 2013, 2015b; Panter, Jones, van Sluijs, & Griffin, 2009; Timperio et al., 2006), older adolescents (Carver, Watson, Shaw, & Hillman, 2013; Horspool, 2006) and adolescents from high socioeconomic status (SES) families (Davison, Werder, & Lawson, 2008; Evenson, Huston, McMillen, Bors, & Ward, 2003) compared to their counterparts. However, some studies reported higher rates of cycling can be associated both with low SES and high SES (Rice, 2008; Steinbach, Green, Datta, & Edwards, 2011).

Peers and parents also influence whether adolescents cycle to high school and parents continue to influence older children's travel choices throughout adolescence (Hunter & Youniss, 1982; Mitra & Buliung, 2015). Compared to peers, parents can have greater influence on the rates of cycling to high school (Emond & Handy, 2012). In addition, adolescents may be less likely to cycle if they are not comfortable having different views to their peers, and have not developed strong defence mechanisms against peer pressure (Orsini, 2005).

Other factors such as the media (Penalosa, 2011; Rimano et al., 2015) and the physical environment (i.e. distance (Centers for Disease Control and Prevention, 2005; McDonald, Deakin, & Aalborg, 2010; Sirard & Slater, 2008; Thornton, 2010), traffic safety (including bike infrastructure, traffic volume and speed) (Centers for Disease Control and Prevention, 2002; Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2003; Thornton, 2010; Villanueva et al., 2012), and continuity and connectedness of the streets (Pikora et al., 2003)) have also been shown to affect whether children and adults cycle. Finally, factors such as having too much to carry to school, after-school schedules (e.g. sports practices, part-time work), not having a bicycle or a 'nice' bicycle, lacking cycle skills and/or skills to cycle on the road, facilities provided at school (such as cycle stands and lockers), the existence of cycle teams and encouragement by school policies or practices may also influence whether students cycle to school (Frater, Kuijer, & Kingham, 2017; Hopkins & Mandic, 2016; Mandic, Hopkins, et al., 2017; Mandic et al., in press).

In New Zealand, rates of walking to school in adolescents have remained relatively stable (26% in 1989/1990; 28% in 2010-2014) while the rates of cycling to secondary school have declined from 19% in 1989/1990 to 3% in 2010-2014 (Ministry of Transport, 2015a). Low rates of cycling to school among adolescents on the South Island of New Zealand have been reported previously (Mandic, de la Barra, et al., 2015; Mandic, Hopkins, et al., 2017).

Dunedin and Christchurch are the two most populated cities in the South Island of New Zealand. Using the data collected as a part of two distinct but coordinated research projects, this study examined intrapersonal factors related to cycling to school using the Theory of Planned Behaviour (TPB) (Ajzen, 1991), and descriptive norm (what people do) as used in the Prototype Willingness Model (PWM) (Gibbons, Gerrard, Blanton, & Russell, 1998) in adolescents from these two cities. The TPB has been used to predict a range of travel behaviours (Abrahamse, 2007; Anable, 2005; Bamberg, Ajzen, & Schmidt, 2003; Bamberg & Schmidt, 2003; Forward, 2004; Lajunen & Räsänen, 2004). The PWM has been used predominantly in relation to risky teenage behaviours such as smoking and alcohol use (Gibbons et al., 1998), and to predict health-promoting behaviours such as exercise and breakfast consumption (Rivis, Sheeran, & Armitage, 2006). This study compared rates of cycling to school, past behaviour, attitudes, injunctive norms (what people ought to do), descriptive norms (parents and friends), perceived behavioural control and intentions with respect to cycling to school among adolescents in Christchurch and Dunedin who lived within 4 km from school.

2 Method

2.1 Locations

The city of Christchurch (population: 348,459) is located in the Canterbury region of New Zealand (Statistics New Zealand, 2015), and has predominantly flat topography and a dry, temperate climate (mean annual temperature 1971-2000, 12.1°C) (Climate Conversation Group, 2016). The city of Dunedin (population: 120,249) is located in the Otago region of New Zealand (Statistics New Zealand, 2015) and has predominantly hilly topography. Due to its higher latitude, Dunedin experiences slightly lower average temperatures than

Christchurch (mean annual temperature 1971-2000, 11.0°C (Climate Conversation Group, 2016)).

2.2 *Participants*

Adolescents from Christchurch and Dunedin were surveyed about cycling to school as a part of two distinct but coordinated research projects: the Christchurch Secondary School Travel Survey (2012) (Frater et al., 2017) and the Built Environment and Active Transport to School (BEATS) Study (2014/15) (Mandic, Mountfort, et al., 2015; Mandic, Williams, et al., 2016), respectively. Adolescents from school years 9, 11 and 13 (13-14, 15-16 and 17-18 years-old, respectively) were selected for this analysis. Adolescents who lived >4 km from school were excluded from the sample, as such distances are considered too far to cycle (Christchurch Cycle Safety Committee & Transit New Zealand, 1991; Schlossberg, Greene, Phillips, Johnson, & Parker, 2006). Additional exclusion criteria were boarding at school, lacking distance to school data, invalid travel to school data, incomplete data for cycling to school questions and multiple modes of transport to school (Dunedin only). A flowchart with details of participants' selection for this analysis is provided in Figure 1. Twenty-seven high schools in Christchurch were invited to participate and seven schools agreed to distribute surveys. Liaison teachers decided the classes and students to whom surveys were distributed (Frater et al., 2017). All twelve high schools in Dunedin were invited and all agreed to participate. Each Dunedin school invited adolescents from two to four classes per school year to complete the survey. Dunedin schools delivered study information packages to all invited students and their parents one to three weeks prior to the scheduled data collection date(s) and advertised the study in school newsletters, as described previously (Mandic, Williams, et al., 2016).

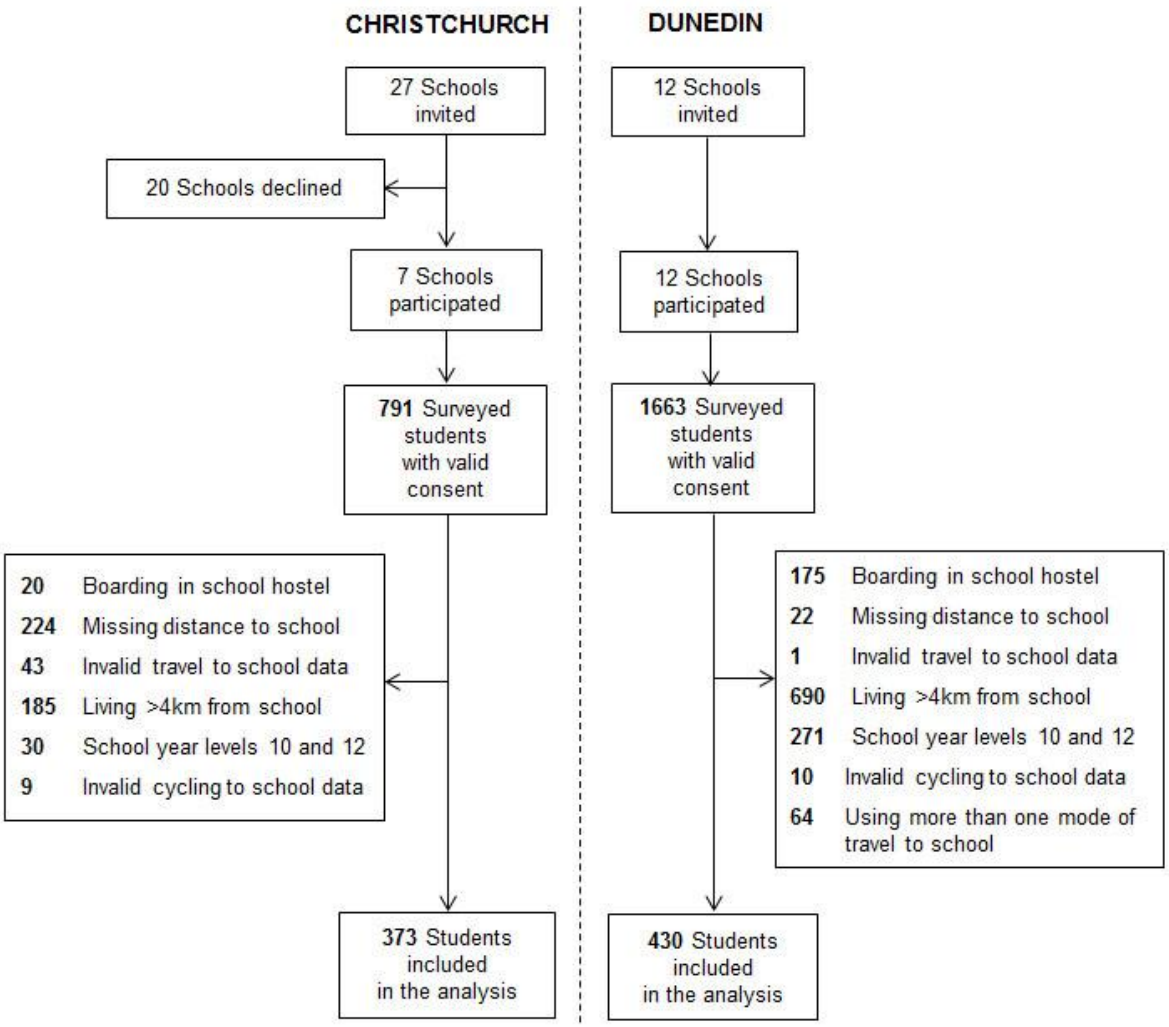

Figure 1: Study recruitment and study sample selection process for Christchurch and Dunedin

2.3 Procedures

In Christchurch, written consent was obtained from the Board of Trustees at each school. Christchurch adolescents were informed that by completing the questionnaire they had consented to participate in the research. The Christchurch study was approved by the University of Canterbury Ethics Committee. In Dunedin, all adolescents gave their written consent to take part in the study, as described previously For those under 16 years of age,

parents signed either parental opt-out or parental opt-in consent depending on the school's preference. The Dunedin study was approved by the University of Otago Ethics Committee.

2.4 Questionnaires

Christchurch adolescents completed the online or paper-based survey at school (96.7%), or online in their own time (3.3%) without supervision. If participants failed to answer more than 66% of items within a given subscale, their score was treated as missing. Dunedin adolescents completed the online survey at school under supervision of research staff. The questionnaires from both studies included information about demographics, travel to school and questions informed by the TPB and Prototype Willingness Model.

Questions about *demographics* included age, gender, school year and school. Information concerning school decile was also recorded. In New Zealand, every school is given a decile rating where a low decile indicates low socio-economic communities and a high decile indicates high socio-economic communities (Ministry of Education, 2015). School deciles were recoded into low (deciles 1-3), medium (deciles 4-7) and high decile (deciles 8-10). In Christchurch, adolescents reported the closest intersection to home. In Dunedin, adolescents reported their home address. For both samples, distance to school was calculated based on the distance via the road network using Geographic Information Systems analysis, as described previously (Mandic, Williams, et al., 2016). .

Transport to school was assessed in Christchurch using the question "How did you usually get to school this year?" with response categories being "car (passenger)", "car (drive yourself)", "bike", "skate, rollerblade or scooter", "motorbike or motor scooter", "walk", "bus" and "other". Adolescents were asked to choose only one response. Surveys with multiple responses were considered invalid. In Dunedin, adolescents were asked "How do you usually travel to school?" for individual transport modes. For each transport mode "by

car (driven by myself)", "by car (driving myself)", "by school bus", "by public transport", "on foot", "by bike", "other") adolescents chose one of five response categories: "never", "rarely", "sometimes", "most of the time" and "all of the time". The rates of cycling to school were determined from the number of Christchurch adolescents who selected cycling as their usual transport to school and Dunedin adolescents who reported cycling "most of the time" or "all of the time".

Questions were also asked based on the TPB to assess past behaviour, attitudes, subjective norm, perceived behavioural control and behavioural intentions related to cycling to school. These variables were all measured with standard items and were the same for both samples. Most questions were derived from Armitage (2005) and all had good internal reliability. *Past behaviour,* was measured in both studies with questions about how many times students cycled to school in the last two weeks. *Attitudes towards cycling* were determined by questions of students in relation to six sets of adjectives: "dull"-"interesting", "unpleasant"-"pleasant", "boring"-"stimulating", "unhealthy"-"healthy", "bad"-"good", "useless"-"useful" (Armitage, 2005). *Subjective/perceived norm* (injunctive (i.e., what people ought to do) and descriptive (i.e., what people do) were assessed using respectively items concerning what they thought parents/guardians and friends thought about them cycling to school and whether parents/guardians and friends cycled. Questions to determine descriptive norm in relation to friends and parents were derived from the Prototype Willingness Model (Gibbons, Gerrard, Lane, Suls, & Wallston, 2003). *Perceived behavioural control* was measured using four items related to ability, confidence, capability, and perceived control (autonomy). Perceived control was measured in relation to how much personal control adolescents thought they had over whether or not they rode a bicycle to school. Given the conceptual similarities, the scores for ability/capability/confidence items for cycling to school were summed and then averaged to create a *cycling capability* composite score (Cronbach's $\alpha = 0.91$ for both cities). *Behavioural*

intention was measured using two items concerning how often adolescents intended to ride a bicycle to school. Details of all questions are provided in related articles (Mandic, Flaherty, et al., 2016). To present the results, items assessed using 7-point Likert-type scale responses (e.g. attitudes, norms, perceived behavioural control and intentions) were also recoded into 3 categories ("disagree" (responses 1 to 3), "neutral" (response 4) and "agree" (responses 5 to 7)).

2.5 Statistical analysis

All data were analysed using descriptive statistics. Data from Christchurch and Dunedin samples were analysed using Chi-square test for categorical variables. Items related to past behaviour, attitudes, injunctive and descriptive norms, perceived behavioural control and intentions were compared between the cities using Linear Mixed Models with school as a cluster variable and age and gender as covariates. P-value <0.05 was considered statistically significant. Descriptive data were reported as frequencies (percentage) for categorical variables and mean±standard deviation for continuous variables. Data were analysed using SPSS Statistical Package version 22.0.

Although we did not intend these data to be a test of how well the TPB could explain the pattern of responses (rather, we used the TPB as a conceptual framework to generate items, which we intended to compare across the cities), we also modelled the data to reflect the hypothesised paths of the TPB. Multi-group structural equation modelling was used to model the data according to the TPB, using the Lavaan package for **R**.

3 Results

Compared to Christchurch, Dunedin's sample was older with more females (Table 1). The distance from home to school was not different between the samples (Table 1). In Christchurch a smaller proportion of adolescents regularly travelled to school as car

passengers, and as car drivers, and a greater proportion walked, cycled and used public transport to school compared to Dunedin (Table 1).

In both cities, three quarters of adolescents agreed that cycling to school was healthy, approximately half perceived it as good and useful, and approximately one third perceived it as interesting, pleasant and stimulating (Table 2). Adolescents' attitudes towards cycling to school were not significantly different between the two cities except for cycling to school being perceived as more stimulating among Dunedin adolescents compared to Christchurch adolescents (Table 2). Christchurch adolescents scored higher for all measures of subjective norm, perceived behavioural control and intention in favour of cycling to school compared to Dunedin adolescents (Table 2). For subjective norm, results showed that adolescents in Dunedin had lower scores for subjective norm in relation to both parents/guardians and friends, compared to their Christchurch counterparts (Table 2). This applied both in relation to students' perceptions of what they thought parents/guardians/friends thought they should do and their perceptions of whether parents/guardians/friends cycle. For perceived behavioural control, results showed that adolescents in Dunedin had a lower capability score, and had less autonomy in deciding to cycle to school, compared to their Christchurch counterparts (Table 2).

Multi-group structural equation modelling was used to model the data to reflect the hypothesised paths of the TPB. As a measurement model with acceptable psychometric properties was developed, several items were dropped to achieve acceptable multi-group fit. The final measurement model was parsimonious but retained good face validity as well as reliability. The final model included **Intention** ("I intend to cycle to school" and "I want to cycle to school"), **Attitude** ("Cycling to school is interesting", "Cycling to school is nice" and "Cycling to school is stimulating"), **Subjective Norm** ("Parents say I should cycle to school" and "Friends say I should cycle to school") and **Perceived Behavioural Control** ("I

have the ability to cycle to school" and "I am capable of cycling to school"). Because of the extremely low rate of (self-reported) behaviour, Behaviour was not included in the models.

The results of the multi-group structural equation modelling show a different view of the data, i.e. in terms of the relative strength of the influences on intention to cycle to school. Constraining the factor loadings (i.e. measurement model) to be equal across groups, the model had acceptable fit (CFI = 0.98, NFI = 0.97, RMSEA=0.07, SRMR=0.04) and all paths were significant at the 5% level, except for the path from perceived behavioural control to intention in Christchurch (Table 3). The individual latent variable scales showed acceptable reliability (Cronbach's α=0.94 for Attitude, Pearson correlations for Intention=0.73, Subjective Norm=0.64, Perceived Behavioural Control=0.76). The results show that in Dunedin, attitude had the most influence on intention to cycle to school, with perceived behavioural control and subjective norm having much lower influence (Table 3). However, in Christchurch, the dominant influence on intention to cycle to school was subjective norm, with attitude having a somewhat lower influence, and perceived behavioural control being not significant (Table 3). Comparing the effects across cities, subjective norm was much more influential in Christchurch, and perceived behavioural control was much more influential in Dunedin.

4 Discussion

This study compared the contribution of intrapersonal factors in two New Zealand cities with different rates of adolescents cycling to school. Despite similar attitudes among adolescents towards cycling to school, Dunedin adolescents had lower prevalence of cycling to school and also scored lower for all measures of injunctive norm, descriptive norm, self-perceived cycling capability and autonomy, and behavioural intention related to cycling to school compared to their Christchurch counterparts. The dominant influence on the intention to

cycle to school was subjective norm in Christchurch and attitude in Dunedin. Therefore, future interventions to encourage cycling to school among adolescents in cities where cycling to school is not common (such as Dunedin, New Zealand) should consider the contribution of intrapersonal factors, the social needs of adolescents and adolescents' cycle skills.

Similar attitudes towards cycling to school observed in Christchurch and Dunedin adolescents in the present study could be in part explained by adolescents' exposure to similar information environments with respect to the media in both of those New Zealand cities. Therefore, adolescents in both cities likely adopted the attitudes, beliefs and behaviours of the information environment to which they were exposed (Behm-Morawitz & Mastro, 2008). However, despite distance to school being controlled in both samples (adolescents living >4 km from school were excluded from the analysis) and similar attitudes towards cycling to school, rates of cycling to school were much lower in Dunedin than in Christchurch, suggesting factors other than attitudes contribute to these differences. Combining the structural equation modelling and comparisons of means approaches to understand the survey responses, high perceived behavioural control is necessary for high intention in Dunedin (in addition to positive attitude and subjective norm), but mean perceived behavioural control is low there, which could explain the low rate of behaviour.

In the Christchurch sample where 19% of adolescents regularly cycled to school, adolescents scored higher for all measures of subjective norm, perceived behavioural control and intention in favour of cycling to school compared to those from Dunedin, where rates of cycling to school were low. The contribution of injunctive and descriptive norms on the behaviour of adolescents is consistent with previous research regarding the pressure on adolescents to conform which peaks in mid-adolescence (13–16 years of age) (Youniss & Haynie, 1992). The importance of peer pressure in relation to cycling among adolescents has also been considered by Orsini (2005) who identified the influences and motivators for

teenagers >16 years of age in Vancouver who were eligible to drive, but chose instead to cycle. Orsini (2005) concluded that in countries where the proportion of adolescents cycling was low, adolescents were less likely to cycle if they were not comfortable having different views to their peers, and had not developed strong defence mechanisms against peer pressure. Therefore, the prevalence of cycling to school among adolescents is likely to be inversely related to the contribution of injunctive and descriptive norms to cycle to school, as observed in this study. Lower scores for injunctive and descriptive norms for cycling to school may contribute to lower rates of cycling to school by adolescents in Dunedin versus Christchurch.

Social Identity Theory (Tajfel & Turner, 1979) and the social needs of adolescents may also provide an explanation for the relationship between cycling rates and subjective norms. According to Social Identity Theory, due to the importance of fitting in, and perceived group status differences, adolescents are more likely to associate themselves with the dominant group. Furthermore, the contribution of injunctive and descriptive norms is also likely to be associated with the desire of adolescents to be social. Previous research from the UK showed that social needs in relation to travelling to school were more important than road safety for some teenagers (particularly for girls) (Pooley, Turnbull, & Adams, 2005). Therefore, peer pressure, importance of fitting in, perceived group status differences and the need to be social may have contributed to the differences in subjective norm to cycle to school in Christchurch compared to Dunedin and at least in part explain lower rates of cycling observed in Dunedin adolescents.

In Dunedin where rates of cycling to school were low, adolescents perceived less confidence, ability and personal control to cycle to school compared to their Christchurch counterparts. These findings are consistent with previous research showing that cycling to school in children is associated with the child's confidence in cycling and parental confidence in their

child's cycling skills (Ducheyne, De Bourdeaudhuij, Spittaels, & Cardon, 2012; Trapp et al., 2011). These findings emphasise the importance of offering programmes such as cycle skills training to improve adolescents' cycle skills (Mandic, Flaherty, et al., 2017; Mandic, Flaherty, et al., 2016).

Dunedin adolescents also reported less intention to cycle to school compared to those in Christchurch. According to the TPB (Ajzen, 1991) behavioural intentions determine behaviour and intentions are influenced by attitude, subjective norms and perceived behavioural control. Previous studies have also shown that cycling to school in children is associated with a child's preference to cycle (Trapp et al., 2011). Therefore, as the contribution of subjective norms and perceived behavioural control for cycling to school by adolescents was high in Dunedin, it was to be expected there would also be less intention to cycle to school, and the converse would apply in Christchurch.

The results of the multi-group structural equation modelling show that in Dunedin attitude had the most influence on intention to cycle to school, with perceived behavioural control and subjective norm having much lower influence. However, in Christchurch the dominant influence on intention to cycle to school was subjective norm, with attitude having a somewhat lower influence, and perceived behavioural control being not significant. Comparing the effects across cities, the striking difference is that subjective norm was much more influential in Christchurch, and perceived behavioural control was influential in Dunedin and not in Christchurch. Simplifying these results for a promotional campaign to promote cycling would emphasise capability in Dunedin and the social aspects of cycling to school in Christchurch, perhaps by a "nudge" approach (Hansen & Jespersen, 2013; Thaler & Sunstein, 2009).

In addition to intrapersonal and individual factors (e.g. demographics), other factors may also play a role in explaining the difference in rates of adolescents cycling to school observed in the Christchurch and Dunedin. For example, focus groups with Dunedin adolescents and parents identified a complex range of factors that contribute to perceptions of cycling safety, including features and perceptions of the built environment, traffic safety, previous cycling experiences and adolescents' cycling skills and on-road experiences (Hopkins & Mandic, 2016). Several other studies have examined the effects of the physical environment on the physical activity of children and adolescents using socio-ecological models (Aibar et al., 2015; Van Kann et al., 2014). The ecological model of active transport (Sallis et al., 2006) acknowledges the role of intrapersonal factors but also the role of the perceived environment, built and natural environment, information environment, socio-cultural factors and policy factors, and interactions between these factors. A recent study showed that compared to walking, cycling to school among Dunedin adolescents was less common, perceived as less safe and received less social and infrastructure support, suggesting that factors other than intrapersonal factors may contribute to low rates of cycling observed in Dunedin (Mandic, Hopkins, et al., 2017). Further research would be required to determine whether socio-cultural, environmental or policy factors such as different topography and school zoning policies contribute to regional differences in the rates of cycling to school among adolescents observed in Christchurch versus Dunedin.

Taken together, these findings suggest that future initiatives to encourage adolescents cycling to school in cities where rates of cycling to school are currently low should consider the contribution of intrapersonal factors, the social needs of adolescents and may also need to aim to increase adolescents' perceived capability to cycle to school through cycle skills training. However, for norms to change in favour of cycling, changes are required at multiple levels targeting individuals, social environments, physical environments, and policies, as

previously suggested (Garrard, Crawford, & Hakman, 2006; Sallis et al., 2006). The findings from this study suggest that future studies examining associations between the built environment and travel behaviours should take into account intrapersonal factors.

This study has several limitations. The results have potentially limited generalisability to other cities and countries. Findings from the Christchurch sample may also not be generalisable to the city of Christchurch as participation was limited to from 7 out of a total of 35 high schools in the city (20% of schools). This issue was not present in Dunedin as adolescents from all 12 high schools in the city were surveyed (100% school participation rate). Different question format was used to assess transport to school habits and differences in supervision of students completing the survey in Christchurch versus Dunedin samples could also have influenced our results. Finally, all information regarding behaviour was provided by participants via self-report and is therefore subject to social desirability bias.

5 Conclusions

Despite similar distance to school and mostly similar attitudes towards cycling to school among Christchurch and Dunedin adolescents in the present study, Dunedin adolescents who had lower rates of cycling to school also scored lower for all measures of injunctive norm, descriptive norm, perceived behavioural control and intention with respect to cycling to school compared to adolescents in Christchurch. In Christchurch the dominant influence on the intention to cycle to school was subjective norm. In contrast, in Dunedin the dominant influence on the intention to cycle to school was attitude. Taken together, these findings suggest that intrapersonal factors are related to travel behaviours such as cycling to school among adolescents and should be examined in the local context to inform the design of effective interventions. Understanding contributions to behaviour in a local context should be used to inform the design of the interventions to change behaviours to enhance the

environment and people's health and well-being. Therefore, efforts to increase cycling to school in adolescents in cities where cycling to school is not common should recognise the contribution of what parents and friends do, what parents and friends think adolescents should do, and the contribution of self-perceived cycling capability and autonomy in relation to cycling to school. Future studies examining associations between the built environment and travel behaviours should take into account intrapersonal factors as these factors are necessary to change behavioural intentions and subsequently behaviour.

Acknowledgements

The BEATS Study is a collaboration between the Dunedin Secondary Schools' Partnership, Dunedin City Council and University of Otago. The authors would also like to acknowledge the members of the BEATS Study Advisory Board and research personnel. We also appreciate the contributions of the school boards, teachers, school principals, and students who assisted with this research in both cities.

The BEATS Student Survey was funded by National Heart Foundation of New Zealand (1615), Lottery Health Research Grant (Applic 341129), University of Otago Research Grant (UORG 2015), Dunedin City Council and internal grants from the School of Physical Education, Sport and Exercise Sciences, University of Otago. The Christchurch research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Abrahamse, W. (2007). Energy conservation through behavioral change: examining the effectiveness of a tailor-made approach. (Dissertation/Thesis). S.l. : Groningen : s.n. ; University Library of Groningen] [Host. Retrieved from http://irs.ub.rug.nl/ppn/305280643

Aibar, A., Bois, J. E., Generelo, E., Bengoechea, E. G., Paillard, T., & Zaragoza, J. (2015). Effect of weather, school transport, and perceived neighborhood characteristics on moderate to vigorous physical activity levels of adolescents from two European cities. Environment and Behavior, 47(4), 395-417.

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179-211.

Aldous, J. (1983). Family careers: Developmental change in families. New York: Wiley.

Anable, J. (2005). 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. Transport Policy, 12(1), 65-78.

Armitage, C. J. (2005). Can the theory of planned behavior predict the maintenance of physical activity? Health Psychology, 24(3), 235.

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of Travel Mode in the Theory of Planned Behavior: The Roles of Past Behavior, Habit, and Reasoned Action. Basic and Applied Social Psychology, 25(3), 175-187.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students car use for university routes with the models of Ajzen, Schwartz, and Triandis. Environment and behavior, 35(2), 264.

Behm-Morawitz, E., & Mastro, D. E. (2008). Mean girls? The influence of gender portrayals in teen movies on emerging adults' gender-based attitudes and beliefs. Journalism & Mass Communication Quarterly, 85(1), 131-146.

Black, C., Collins, A., & Snell, M. (2001). Encouraging walking: the case of journey-to-school trips in compact urban areas. Urban Studies, 38(7), 1121-1141.

Buliung, R. N., Mitra, R., & Faulkner, G. (2009). Active school transportation in the Greater Toronto Area, Canada: An exploration of trends in space and time (1986-2006). Preventive medicine, 48(6), 507-512.

Carver, A., Watson, B., Shaw, B., & Hillman, M. (2013). A comparison study of children's independent mobility in England and Australia. Children's Geographies, 11(4), 461-475. doi: 10.1080/14733285.2013.812303

Centers for Disease Control and Prevention. (2002). Barriers to children walking and biking to school--United States, 1999. JAMA, 288, 1343-1344.

Centers for Disease Control and Prevention. (2005). Barriers to children walking to school--United States, 2004. JAMA, 294, 2160-2162.

Climate Conversation Group. (2016). NZ temperature record - a brief history. Retrieved from http://www.climateconversation.wordshine.co.nz/2011/02/nz-temperature-record-%E2%80%93-a-brief-history/ [Accessed 2/5/2016]

Davison, K., Werder, L., & Lawson, T. (2008). Children's active commuting to school: Current knowledge and future directions. Preventive Chronic Diseases 5 (3). Preventing Chronic Disease, 5(3):A 100.

Ducheyne, F., De Bourdeaudhuij, I., Spittaels, H., & Cardon, G. (2012). Individual, social and physical environmental correlates of 'never'and 'always' cycling to school among 10 to 12 year old children living within a 3.0 km distance from school. International journal of behavioral nutrition and physical activity, 9(1), 142.

Emond, C. R., & Handy, S. L. (2012). Factors associated with bicycling to high school: insights from Davis, CA. Journal of Transport Geography, 20, 71-79.

Evenson, K. R., Huston, S. L., McMillen, B. J., Bors, P., & Ward, D. S. (2003). Statewide prevalence and correlates of walking and bicycling to school. Archives of Pediatrics & Adolescent Medicine, 157(9), 887-892.

Forward, S. (2004). The prediction of travel behaviour using the theory of planned behaviour. Paper presented at the International Conference of Traffic and Transport Psychology, Bern, Switzerland.

Frater, J., Kuijer, R., & Kingham, S. (2017). Why adolescents don't bicycle to school: Does the prototype/willingness model augment the theory of planned behaviour to explain intentions? Transportation Research Part F: Traffic Psychology and Behaviour, 46, 250-259. doi: http://dx.doi.org/10.1016/j.trf.2017.03.005

Garrard, J., Crawford, S., & Hakman, N. (2006). Revolutions for Women: Increasing women's participation in cycling. Victoria, Australia.

Gibbons, F. X., Gerrard, M., Blanton, H., & Russell, D. W. (1998). Reasoned action and social reaction: Willingness and intention as independent predictors of health risk. Journal of personality and social psychology, 74(5), 1164.

Gibbons, F. X., Gerrard, M., Lane, D., Suls, J., & Wallston, K. (2003). A social reaction model of adolescent health risk. Social psychological foundations of health and illness, 107-136.

Hansen, P. G., & Jespersen, A. M. (2013). Nudge and the manipulation of choice: A framework for the responsible use of the nudge approach to behaviour change in public policy. Eur. J. Risk Reg., 3.

Hopkins, D., & Mandic, S. (2016). Perceptions of cycling among high school students and their parents. International journal of sustainable transportation. doi: 10.1080/15568318.2016.1253803

Horspool, B. (2006). Tempting Teenagers to Cycle - Cycling is for everyone. NZ Science, Mathematics and Technology Teacher Fellowship 2006. Auckland, New Zealand.

Hunter, F. T., & Youniss, J. (1982). Changes in functions of three relations during adolescence. Developmental Psychology, 18(6), 806-811.

Lajunen, T., & Räsänen, M. (2004). Can social psychological models be used to promote bicycle helmet use among teenagers? A comparison of the Health Belief Model, Theory of Planned Behavior and the Locus of Control. Journal of Safety Research, 35(1), 115-123.

Mandic, S., de la Barra, S., Garcia Bengoechea, E., Stevens, E., Flaherty, C., Moore, A., . . . Skidmore, P. (2015). Personal, social and environmental correlates of active transport to school among adolescents in Otago, New Zealand. Journal of Science and Medicine in Sport, 18(4), 432-437. doi: http://dx.doi.org/10.1016/j.jsams.2014.06.012

Mandic, S., Flaherty, C., Pocock, T., Kek, C., Chillón, P., Ergler, C., & García Bengoechea, E. (2017). Parental perceptions of cycle skills training for adolescents. Journal of Transport & Health. doi: https://doi.org/10.1016/j.jth.2017.03.009

Mandic, S., Flaherty, C., Pocock, T., Mintoft-Jones, A., Frater, J., Chillón, P., & Garcia Bengoechea, E. (2016). Attitudes towards cycle skills training in New Zealand adolescents. Transportation Research Part F: Traffic Psychology and Behaviour, 42, 217-226. doi: https://doi-org.ezproxy.canterbury.ac.nz/10.1016/j.trf.2016.08.002

Mandic, S., Hopkins, D., García Bengoechea, E., Flaherty, C., Williams, J., Sloane, L., . . . Spence, J. (2017). Adolescents' perceptions of cycling versus walking to school: Understanding the New Zealand context. Journal of Transport & Health, 4(294-304). doi: http://dx.doi.org/10.1016/j.jth.2016.10.007

Mandic, S., Mountfort, A., Hopkins, D., Flaherty, C., Williams, J., Brook, E., . . . Moore, A. (2015). Built Environment and Active Transport to School (BEATS) Study:

multidisciplinary and multi-sector collaboration for physical activity promotion. Retos: nuevas tendencias en educación física, deporte y recreación(28), 197-202. doi: http://recyt.fecyt.es/index.php/retos/article/view/34955/19222

Mandic, S., Sandretto, S., Bengoechea, E. G., Hopkins, D., Moore, A., Rodda, J., & Wilson, G. (in press). Enrolling in the Closest School or Not? Implications of school choice decisions for active transport to school. Journal of Transport & Health. doi: https://doi-org.ezproxy.canterbury.ac.nz/10.1016/j.jth.2017.05.006

Mandic, S., Williams, J., Moore, A., Hopkins, D., Flaherty, C., Wilson, G., . . . Spence, J. (2016). Built Environment and Active Transport to School (BEATS) Study: protocol for a cross-sectional study. BMJ open, 6(5), e011196.

McDonald, N. C. (2007a). Active transportation to school: trends among US schoolchildren, 1969-2001. American Journal of Preventive Medicine, 32(6), 509-516.

McDonald, N. C., Deakin, E., & Aalborg, A. E. (2010). Influence of the social environment on children's school travel. Preventive medicine, 50, S65-S68.

Ministry of Education. (2015). School deciles. Retrieved from http://www.education.govt.nz/school/running-a-school/resourcing/operational-funding/school-decile-ratings/ [Accessed 24/08/2015]

Ministry of Transport. (2013). Cycling for transport. Retrieved from http://www.transport.govt.nz/research/Documents/Comparingtravelmodes_2009.pdf [Accessed 24/08/2015]

Ministry of Transport. (2015a). 25 years of New Zealand travel: New Zealand Household Travel 1989-2014. Wellington, New Zealand.

Ministry of Transport. (2015b). Comparing travel modes. New Zealand Household Travel Survey 2001-2014. Retrieved from

http://www.transport.govt.nz/research/travelsurvey/reportsandfactsheets/ [Accessed 9/06/2015]

Mitra, R., & Buliung, R. N. (2015). Exploring differences in school travel mode choice behaviour between children and youth. Transport Policy, 42, 4-11.

Newman, P. G., & Kenworthy, J. R. (1989). Cities and automobile dependence: An international sourcebook. Brookfield, VT USA: Gower Publishing.

Orsini, A., F.,. (2005). Fun, fast and fit: Influences and Motivators for Teenagers who Cycle to High School. (Masters). Royal Roads University, Victoria, Canada. Retrieved from http://www.collectionscanada.gc.ca/obj/thesescanada/vol2/002/mr09422.pdf

Panter, J. R., Jones, A. P., van Sluijs, E. M. F., & Griffin, S. J. (2009). Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children. Journal of Epidemiology and Community Health, 64(01), 41-48.

Penalosa, A. (2011). Representation of urban cycling in media: A case study of London before and after the launch of the Cycle Hire Program. London School of Economics, London.

Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. Social Science & Medicine, 56(8), 1693-1703.

Pooley, C. G., Turnbull, J., & Adams, M. (2005). The journey to school in Britain since the 1940s: continuity and change. Area, 37(1), 43-53.

Rice, B. (2008). How we got to School: A Study of Travel Choices of Christchurch Primary School Pupils. (Masters). University of Canterbury, Christchurch. Retrieved from https://docs.google.com/viewer?a=v&pid=explorer&chrome=true&srcid=0BzrC7HpjeLvRNjNjYmY3NjAtNGRhZC00ZDFjLWJkNTEtMWQxNTFhODQ4NDU3&hl=en_US

Rimano, A., Piccini, M. P., Passafaro, P., Metastasio, R., Chiarolanza, C., Boison, A., & Costa, F. (2015). The bicycle and the dream of a sustainable city: An explorative comparison of the image of bicycles in the mass-media and the general public. Transportation Research Part F: Traffic Psychology and Behaviour, 30(0), 30-44.

Rivis, A., Sheeran, P., & Armitage, C. J. (2006). Augmenting the theory of planned behaviour with the prototype/willingness model: Predictive validity of actor versus abstainer prototypes for adolescents' health-protective and health-risk intentions. British Journal of Health Psychology, 11(3), 483-500.

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. Annu. Rev. Public Health, 27, 297-322.

Sirard, J. R., & Slater, M. E. (2008). Walking and bicycling to school: a review. American Journal of Lifestyle Medicine, 2(5), 372-396.

Statistics New Zealand. (2015). 2013 Census QuickStats about Dunedin. Retrieved from http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-a-place.aspx?request_value=15022&parent_id=14973&tabname= [Accessed 18/4/2015]

Steinbach, R., Green, J., Datta, J., & Edwards, P. (2011). Cycling and the city: A case study of how gendered, ethnic and class identities can shape healthy transport choices. Social Science & Medicine, 72(7), 1123-1130.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. The social psychology of intergroup relations, 33(47), 74.

Thaler, R. H., & Sunstein, C. R. (2009). Nudge: Improving decisions about health, wealth, and happiness. New York: Penguin.

Thornton, A., Bunt, K., Dalziel, D., Simon, A. (2010). Climate Change and Transport Choices, Segmentation Study - Interim Report by TNZ-BMRB. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49971/climate-change-transport-choices-full.pdf [Accessed 9/06/2016].

Timperio, A., Ball, K., Salmon, J., Roberts, R., Giles-Corti, B., Simmons, D., . . . Crawford, D. (2006). Personal, family, social, and environmental correlates of active commuting to school. American Journal of Preventive Medicine, 30(1), 45-51.

Tin Tin, S., Woodward, A., Thornley, S., & Ameratunga, S. (2009). Cycling and walking to work in New Zealand, 1991-2006: regional and individual differences, and pointers to effective interventions. International Journal of Behavioral Nutrition and Physical Activity, 6, 64.

Trapp, G., Giles-Corti, B., Christian, H., Bulsara, M., Timperio, A., McCormack, G. R., & Villanueva, K. (2011). On your bike! a cross-sectional study of the individual, social and environmental correlates of cycling to school. Int J Behav Nutr Phys Act, 8(1), 123.

van der Ploeg, H. P., Merom, D., Corpuz, G., & Bauman, A. E. (2008). Trends in Australian children traveling to school 1971-2003: burning petrol or carbohydrates? Preventive medicine, 46(1), 60-62.

Van Kann, D., Kremers, S., Gubbels, J., Bartelink, N., De Vries, S., de Vries, N., & Jansen, M. (2014). The association between the physical environment of primary schools and active school transport. Environment and Behavior, 1-18. doi: 0.1177/0013916513519644

Villanueva, K., Giles-Corti, B., Bulsara, M., Timperio, A., McCormack, G., Beesley, B., . . . Middleton, N. (2012). Where do Children Travel to and What Local Opportunities

Are Available? The Relationship Between Neighborhood Destinations and Children's Independent Mobility. Environment and Behavior, 45(6), 679-705.

Youniss, J., & Haynie, D. L. (1992). Friendship in adolescence. Journal of Developmental & Behavioral Pediatrics, 13(1), 59-66.

Table 1. Socio-demographic characteristics of study participants

	Christchurch	**Dunedin**	**p-value**
	n=373	**n=430**	
Age (years)	14.3 ± 1.6	15.0 ± 1.6	<0.001
Gender [n (%)]			
Boys	234 (62.7)	193 (44.9)	
Girls	139 (37.3)	237 (55.1)	<0.001
Year group [n (%)]			
Year 9	210 (56.3)	215 (50)	
Year 11	84 (22.5)	126 (29.3)	
Year 13	79 (21.2)	89 (20.7)	0.081
School decile[a] [n (%)]			
Low (1-3)	61 (16.4)	0 (0)	
Middle (4-7)	169 (45.3)	188 (43.7)	
High (8-10)	143 (38.3)	242 (56.3)	<0.001
Past behaviour			
Frequency of cycling to school in the previous two weeks [n(%)]			
Never	268 (72.6)	402 (93.5)	
Almost never	17 (4.6)	11 (2.6)	
Sometimes	17 (4.6)	8 (1.9)	
Almost every day	21 (5.7)	4 (0.9)	
Every day	46 (12.5)	5 (1.2)	<0.001

Usual transport to school			
[n(%)]			
Car passenger	63 (16.9)	165 (38.4)	
Car driver	17 (4.6)	22 (5.1)	
Walk	190 (50.9)	203 (47.2)	
Bus[b]	19 (5.1)	15 (3.5)	
Cycle	66 (17.7)	8 (1.9)	
Other[c]	18 (4.8)	5 (1.2)	<0.001

Notes:

[a]Every school in New Zealand is given a decile rating by the Ministry of Education. "*School decile indicates the extent to which the school draws its students from low socio-economic communities…Decile 1 schools are the 10% of schools with the highest proportion of students from low socio-economic communities. Decile 10 schools are the 10% of schools with the lowest proportion of these students.*" (Ministry of Education, 2015, p. np)

[b]In the Dunedin sample, travel to school by bus included travelling both by school bus and by public transport (bus). [c]In the Christchurch sample, "other" category for transport to school included "skate, rollerblade or scooter", "motorbike or motor scooter" and "other"

Table 2. Attitudes, subjective norm, behavioural intentions and perceived behavioural control

	Christchurch (n=373)				Dunedin (n=430)				*p*-value
	Total (mean±SD)	Disagree n (%)	Neutral n (%)	Agree n (%)	Total (mean±SD)	Disagree n (%)	Neutral n (%)	Agree n (%)	
Attitudes									
For me, regularly cycling to school would be…									
Experiential beliefs									
Interesting	3.7 ± 1.7	131 (37.8)	111 (32.0)	105 (30.3)	3.8 ± 2.0	151(35.1)	120 (27.9)	159 (37.0)	0.064
Pleasant	3.9 ± 1.7	116 (33.7)	108 (31.4)	120 (34.9)	3.8 ± 1.9	159 (37.0)	119 (27.7)	152 (35.3)	0.578
Stimulating	3.6 ± 1.8	140 (40.5)	102 (29.5)	104 (30.1)	3.8 ± 1.9	151 (35.1)	126 (29.3)	153 (35.6)	0.016
Instrumental beliefs									
Healthy	5.6 ± 1.6	33 (9.6)	51 (14.9)	258 (75.4)	5.4 ± 1.6	37 (8.6)	86 (20.0)	307 (71.4)	0.640
Good	4.6 ± 1.9	71 (20.7)	98 (28.6)	174 (50.7)	4.6 ± 1.9	85 (19.8)	129 (30.0)	216 (50.2)	0.200
Useful	4.5 ± 2.0	87 (25.3)	87 (25.3)	170 (49.4)	4.5 ± 1.9	94 (21.9)	132 (30.7)	204 (47.4)	0.340

Subjective norm									
My parents or guardians think I should cycle to school	4.3 ± 2.0	108 (29.2)	110 (29.7)	151 (41.1)	3.3 ± 1.9	210 (48.8)	118 (27.4)	102 (23.7)	0.006
One or both of my parents or guardians cycle frequently	2.4 ± 2.0	281 (76.6)	19 (5.2)	67 (18.3)	1.8 ± 1.7	365 (84.9)	21 (4.9)	44 (10.2)	<0.001
My friends think I should cycle to school	4.0 ± 1.9	117 (31.6)	135 (36.5)	118 (31.9)	3.3 ± 1.9	196 (45.9)	145 (33.7)	89 (20.7)	0.026
		(None)	(Some)	(Most)		(None)	(Some)	(Most)	
Out of your five friends, how many always or sometimes cycle to school	1.7 ± 1.6	103 (27.8)	160 (43.2)	107 (28.9)	0.3 ± 0.7	352 (81.9)	70 (16.3)	9 (21.9)	<0.001
Behavioural intention									
I want to regularly cycle to school	2.9 ± 2.2	240 (64.3)	43 (11.5)	90 (24.1)	1.9 ± 1.5	371 (86.3)	22 (5.1)	37 (8.6)	0.007
I intend to cycle to school frequently	2.7 ± 2.2	255 (68.7)	26 (7.0)	90 (24.3)	1.5 ± 1.3	392 (91.2)	20 (4.7)	18 (4.2)	0.002

Perceived behavioural control									
Capability									
I see myself as being capable of riding a bicycle to school	5.5 ± 2.1	75 (20.2)	24 (6.5)	272 (73.3)	4.6 ± 2.3	141 (32.8)	52 (12.1)	237 (55.1)	0.059
I am confident I could cycle to school	5.6 ± 2.0	66 (17.8)	29 (7.8)	276 (74.4)	4.6 ± 2.3	150 (34.9)	49 (11.4)	231 (53.7)	0.008
I believe that I have the ability to ride a cycle to school	5.9 ± 1.8	49 (13.2)	22 (5.9)	299 (80.8)	5.0 ± 2.2	125 (29.1)	42 (9.8)	263 (61.2)	0.010
Cycling capability (composite score)	5.7 ± 1.8	58 (15.7)	30 (8.1)	282 (76.2)	4.7 ± 2.1	136 (31.6)	48 (11.2)	246 (57.2)	0.014
Autonomy									
I have complete control over whether or not I cycle to school	5.8 ± 1.7	45 (12.2)	31 (8.4)	292 (79.3)	5.3 ± 2.0	82 (19.1)	55 (12.8)	293 (68.1)	0.016

Data collected using a 7-point Likert scale (1=Strongly disagree to 7=Strongly agree)

Data recoded as 1,2,3=disagree, 4=neutral and 5,6,7=agree to create categorical variables

Table 3. Paths into Intention (multi-group structural equation modelling results results)

City	Attitude	Perceived behavioural control	Subjective norm
Dunedin	0.42 (0.06)	0.14 (0.06)	0.16 (0.06)
Christchurch	0.35 (0.07)	0.05 (0.06)	0.52 (0.08)

Standardised regression weights and standard errors.