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INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

The effectiveness of active travel initiatives in Irish provincial towns: an evaluation of a quasi-experimental natural experiment

A thesis submitted to Waterford Institute of Technology in fulfilment of the requirements for the Degree of Doctor of Philosophy

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Abstract

Ireland is a car dependent country with low levels of active travel and also low levels of total physical activity. There is a paucity of studies, internationally, that have evaluated active travel initiatives in a real world setting. This thesis contributes new knowledge to the evidence base on the implementation, effectiveness and design of active travel initiatives at the community level and their impact on physical activity.

This thesis is comprised of a series of quasi-experimental designed intervention studies that adopted a mixed methods approach to assess the impact of community-wide active travel initiatives (funded demonstration projects) in two Irish towns from 2011 to 2013. The review of literature critically analyses the correlates and determinants of active travel in both school-children and adults. The impact of the active travel initiatives is described across four studies. Two of these studies describe the impact of the community-wide intervention on primary and secondary school-children using a repeat cross-sectional design and self-report surveys. This research design was also utilised to evaluate the impact of an intensive multi-component active travel intervention in one all-girls school (the third impact study). Qualitative data were also collected as part of a process evaluation to help explain the intervention effect. The fourth impact study was a cohort study with adults using self-report surveys. The final study in the thesis was a qualitative study that examined the processes and mechanisms that shaped the implementation of active travel policy in both towns.

There was no overall intervention effect detected for active travel behaviour in school-children or adults. Community-wide changes in active travel and physical activity are unachievable without significant investment and a high intensity mix of hard (community and infrastructural design) and soft (pricing, programming and policy) measures that target the entire population and specific stakeholder groups.

Declaration

I hereby declare that this submission is my own work and that it contains no material previously published or written by another person, nor material which has been accepted for an award in any other university or institute of higher learning, except where due acknowledgement has been made in the text.

Signed: ________________________ Date: ______________________________

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CHAPTER 1. INTRODUCTION

1.1. 'Smarter Travel' policy measures in Ireland

The Irish population are extremely reliant on cars as a mode of transport (Central Statistics Office, 2012). There was a 140% increase in the number of private cars in the country between 1990 and 2013. During the same period there was a 108% increase in CO_2 emissions which was in stark contrast to the energy-related emissions in other sectors of the Irish economy (SEAI, 2014). The road transport sector is responsible for approximately one fifth of all CO_2 emissions in the European Union (European Commission, 2015). Ireland is obligated to reduce these emissions under the Kyoto agreement and European Union legislation. In 2011, the Irish Minister of State for Public and Commuter Transport stated that;

> *the main drivers of what you would call the 'green transport agenda' are the increasing urbanisation of society, EU directives that will force dramatic reductions in CO_2 in the near and long-term future, the development of 'smart systems' whereby transport technology will be integrated with consumer electronics so that real-time communication is possible and government policy that drives a more sustainable policy agenda.* (Kelly, 2011)

The 'green transport agenda' being referred to was the publication of two documents in 2009; the National Cycle Policy Framework (Department of Transport, 2009a) and 'Smarter Travel', the National Sustainable Transport Policy (Department of Transport, 2009b). The 'Smarter Travel' policy contained 49 actions that can be grouped into four overarching goals; to reduce the distance travelled by private car, to provide alternatives to car travel, to improve the fuel and energy efficiency of cars, and to build capacity in institutions to deliver targets.

The 'Smarter Travel' programme, under the auspices of the Irish Sustainable Transport Division, provided funding for the establishment of a national cycle network, provided tax free loans for purchasing new bicycles, created a 'Smarter Travel' Workplaces programme and a 'Smarter Travel' Campus programme. Funding was also allocated, on a competitive basis, for the establishment of three 'Smarter Travel Areas' outside of the greater Dublin area. A total of €21.7 million was divided between the three 'Smarter Travel Areas' over five years (2012-2016) to implement comprehensive projects to reduce private car travel and to encourage more sustainable modes of travel such as walking, cycling, public transport and car-sharing. These towns were to be demonstration projects serving as a template for the expansion of the 'Smarter Travel Area' concept across the country. Many of the unsuccessful bids were awarded smaller amounts of funding predominantly for specific infrastructural measures for walking and cycling. These towns (n=12) were referred to as 'Active Travel Towns' and €4.5 million was divided between them.

A concerted effort was also made to promote sustainable travel in the greater Dublin area after the launch of the 'Smarter Travel' policy in 2009. The modal share for cycling in Dublin increased by 10% in some areas of the city from 2006 to 2011, albeit from a low base (Caulfield, 2014). Ireland's first bike sharing scheme was launched in Dublin in 2009 and has since expanded to cater for over 15,000 daily trips in the city (Dublin City Council, 2015). Other measures introduced by Dublin City Council included; 30kph speed limits in the city centre, removal of trucks from the city centre, large scale infrastructural measures (such as segregated cycle lanes, some high quality cycle corridors, on-road cycle lanes, contra-flow cycle lanes and bike parking) and the appointment of a cycling officer. These measures were guided by the publication of a transport strategy for the region in 2010 (National Transport Authority, 2010) and contributed to Dublin being listed as one of the most bike friendly cities in the world in 2011 and 2013 (Copenhagenize Design Co., 2015).

1.2. Prevalence of active travel

The national 'Smarter Travel' policy is relevant for a large proportion of the Irish population. The national prevalence of active travel has decreased dramatically since the 1980's and the country is very much a car dependent society (Central Statistics Office, 2012). Even more recently the Irish census data collected in 2006 and 2011 (Central Statistics Office, 2012) has indicated that active travel to work and education (primary, secondary and tertiary) has decreased further between both time points. The percentage modal share for both cycling and car travel has increased in parallel with reductions in walking and public transport use.

Irish school-children

Our knowledge of the prevalence of active travel in Irish school-children is mostly derived from mode of travel to school. This is a commonly used proxy measure for active travel to all destinations in this population (Herrador-colmenero, Pérez-garcía, Ruiz, & Chillón, 2014). Active travel to school in Ireland has declined steadily since it was first recorded in the 1981 census. Car is now the predominant mode of transport to school for children attending primary (aged 5-12 years) and secondary (aged 13-18 years) schools. According to the 2011 census data over 60% of children are driven to primary school with only 26% walking or cycling (Central Statistics Office, 2012). The slight increase in the numbers cycling to school from 2006 to 2011 is negated by an overall trend towards greater dependence on motorised travel (table 1.1). These percentage modal splits for travel to school are confirmed by several other Irish studies (table 1.2). Data from the 'Growing up in Ireland' study of nine year olds (Williams et al., 2009) indicated that travel mode varies by social class in that children from higher social classes are more likely to travel by car than those from lower social classes. This study also highlighted the potential to increase active travel to primary school in that the majority (70%) of children lived within 1.5 miles of their school.

The 2011 census data (Central Statistics Office, 2012) showed very similar trends for secondary school-children (table 1.1). The only notable exception is that public transport use is more prevalent in this cohort. Nonetheless, car use was identified as the predominant mode of transport in 2011 for the first time ever. Although cycling to school is more prevalent among older children, levels have fallen by 87% since 1981. Of the 3% of students who cycled to secondary school, 92% of these were male. These gender differences in active travel are supported by the findings of the Health Behaviour in School-aged Children (HBSC) data for Ireland (Clarke & HBSC Ireland Team, 2013) and the Children's Sport and Physical Activity Participation (CSPPA) study (Woods et al., 2010). These studies produced conflicting results in terms of age and social class. The HBSC Ireland study (Clarke & HBSC Ireland Team, 2013) reported less active travel with increasing age and in higher social classes. In contrast to this, Woods et al. (2010) found no difference in walking or cycling to secondary school according to age. Furthermore they also found that adolescent girls from higher social classes were more likely to walk or cycle than those from lower social classes.

Table 1.1 *Percentage modal split for travel to primary and secondary schools in 2006 and 2011*

	Walk (%)	Cycle (%)	Car (%)	Public Transport (%)
Primary				
2006	25.4	1.0	57.5	15.8
2011	24.5	1.3	61.4	12.6
Secondary				
2006	25.0	2.5	34.0	38.2
2011	23.2	3.0	41.6	32.0

(CSO, 2011)

Table 1.2 *Studies reporting the proportion of Irish school-children that walk or cycle to school*

Source	n	Age (yrs)	Prevalence
GUI (Williams et al., 2009)	8,570	9	26% (25% walk, 1% cycle)
CSPPA (Woods et al., 2010)	5,397	10-18	Primary 31% (30% walk, 1% cycle) Secondary 40% (37% walk, 3% cycle)
CSO (Central Statistics Office, 2012)	National census	5-18	Primary 25.8% (24.5% walk, 1.3% cycle) Secondary 26.2% (23.2% walk, 3% cycle)
HBSC (Clarke & HBSC Ireland Team, 2013)	12,661	10-17	26.5%
CIM (O'Keefe & O'Beirne, 2015)	2,228	7-15	Primary 24.6% (22.1% walk, 2.5% cycle) Secondary 13.8% (12.6% walk, 1.2% cycle)

Abbreviations: GUI, growing up in Ireland study; CSPPA, children's sport participation and physical activity study; CSO, central statistics office; HBSC, health behaviour in school-aged children; CIM, children's independent mobility on the island of Ireland

Irish adults

The census data (Central Statistics Office, 2012) in table 1.3 show that third level (tertiary) students are the group most likely to use active modes of travel to college. Nonetheless the data for both third level students and adult commuters mirror the trends reported in the CSO data in table 1.1 above. Car is the dominant mode of travel for both groups. The increase in cycling to work (10% increase nationally & 26% increase in Dublin) is outweighed by the decrease in those walking to third level education and work. Indeed the percentage of people walking or cycling to work has almost halved between 1981 (24.8%) and 2011 (12.9%). Mode of travel to work varies considerably by location and gender. Active commuting is most prevalent in Ireland's main cities (especially Dublin) and least prevalent in smaller provincial towns. Only 54.7% of commuters use the car or motorcycle in Dublin compared with over 70% in Cork, Waterford and Limerick. In terms of gender, women are more likely to walk, drive a car and use public transport while men are more likely to cycle or to drive a van or lorry. These same variations by location and gender are reported when studies have measured mode of travel for all trips (Irish Sports Council, 2014). This study found that 10.5% of people regularly cycle for transport (at least once a week) while 40% regularly walk for transport (figure 1.1). Active travel, particularly walking, has decreased considerably since 2009 and while there has been a 0.9% increase in cycling for transport from 2011 to 2013, the proportion of adults walking for transport has remained relatively static. These trends are also comparable with those reported in the National Household Travel Survey 2012 (National Transport Authority, 2013). This survey of more than 6,000 Irish households found that 50% of people had walked for transport and 8% had cycled for transport in the week before completing the survey. Most of these trips were for commuting to leisure or sport and all trips over 50m were included.

Table 1.3 Percentage modal split for travel to tertiary education and work in 2006 and 2011

	Walk (%)	Cycle (%)	Car (%)	Public Transport (%)
Tertiary				
2006	30.7	4.3	31.2	32.8
2011	28.1	4.6	37.9	28.4
Work				
2006	11.7	2.1	67.5	9.7
2011	10.5	2.4	69.7	8.9

(CSO, 2011)

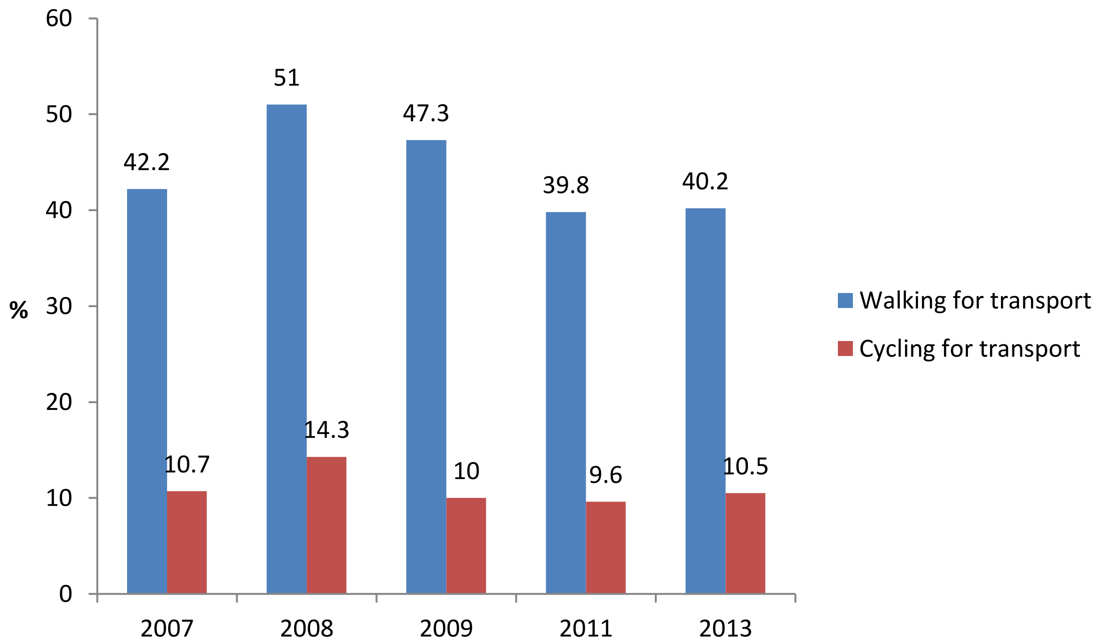

Figure 1.1 Trends in the proportion of Irish adults that engage in active travel at least once a week by time (Irish Sports Council, 2014)

International comparisons

Internationally, rates of active travel to school have decreased significantly since the 1970's (Sirard & Slater, 2008). However, even allowing for differences in measuring active travel, there is considerable variation between countries. For example, the percentage of children actively commuting to school is 70% in Switzerland (Grize, Bringolf-Isler, Martin, & Braun-Fahrländer, 2010), 67% in Sweden (Chillón et al., 2010), 64% in Denmark (Stock et al., 2012), 53% in the UK (Department of Education, 2011) and 10% in the US (McDonald, 2007).

For adults, the use of standardised travel measures in recent Eurobarometer surveys (The Gallup Organisation, 2011; TNS Opinion and Social, 2013) allow comparisons to be made across European Union (EU) member states. According to the 2011 Eurobarometer report (The Gallup Organisation, 2011), the majority (53%) of EU citizens use a car as their main mode of transport, 22% use public transport, 13% walk and 7% cycle. Similar to that reported for school travel, there are major differences between member states. Sixty eight percent of Irish citizens cited the car as their main mode of transport compared with just 29-31% of Latvians, Romanians and Hungarians. A third of respondents from the Netherlands, Romania, Latvia, Belgium and Hungary use active travel as their main mode of daily transport compared with just 12-16% in France, Ireland, UK, Spain and Austria (figure 1.2). Even within these countries the levels of walking and cycling vary considerably. That is, although the levels of active travel are comparable in the Netherlands and Romania, cycling accounts for the majority of trips in the Netherlands while walking is more prevalent in Romania. These trends were replicated in the 2013 Eurobarometer survey (TNS Opinion and Social, 2013) which measured the daily use of each transport mode. Taken together the results confirm that Ireland has one of the lowest levels of active travel across the EU.

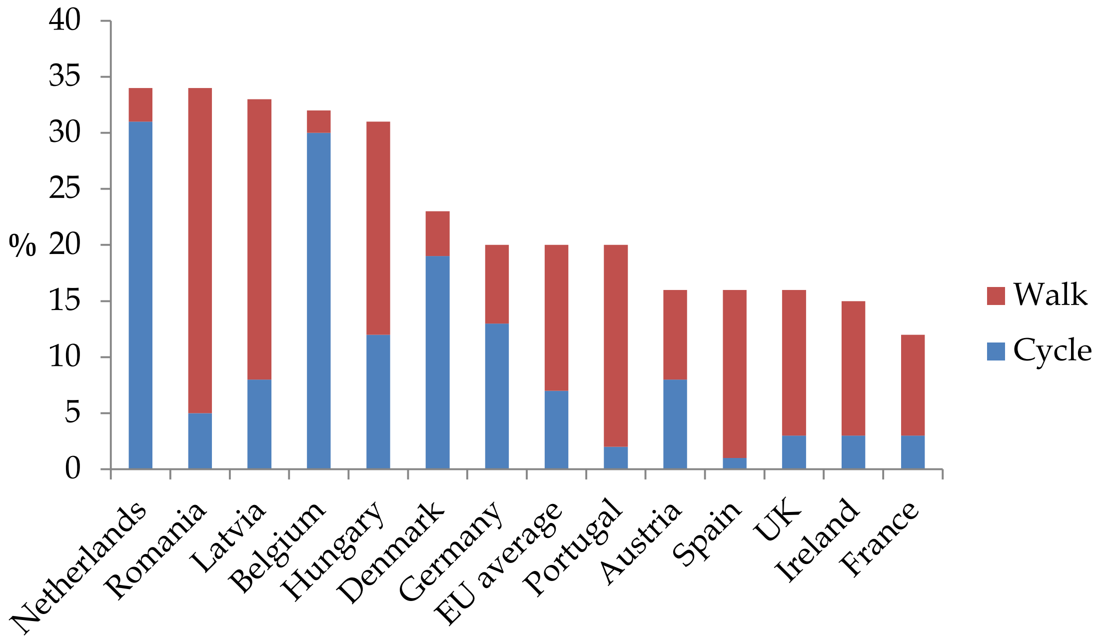

Figure 1.2 The percentage of EU citizens that cycle and walk as their main mode of transport by member state (Eurobarometer, 2013)

The variation in active travel is also evident across continents. The lack of standardised travel survey measures limits the accuracy of international comparisons beyond Europe. That said, walking and cycling for transport are considerably higher in Europe compared with traditionally car dependent countries such as Australia, Canada and the USA (Bassett, Pucher, Buehler, Thompson, & Crouter, 2008). Although quantifying the extent of these differences is difficult, Pucher and Buehler (2010) state that rates of active travel are at least twice as high in Europe compared with the latter group of countries. The authors also state that both walking and cycling for transport has declined considerably in the Organisation for Economic Co-operation (OECD) countries since the 1970's. Pucher and Buehler (2010) postulate that the decline is mostly accounted for by decreases in walking for transport due to the increased size and decentralisation of urban areas. Some countries (Netherlands, Germany and Denmark) with more car restrictive policies have seen much smaller overall declines since the 1970s and possibly even slight increases in cycling for transport. It is possible that these countries have also seen an increase in overall active travel in recent years. Buehler, Pucher, Merom, and Bauman (2011) reported increases in both walking and cycling for transport in Germany from 2002 to 2009 compared with the US where both remained stable.

1.3. Adherence to physical activity guidelines

The World Health Organisation (WHO) have developed physical activity guidelines for children and young people (5-17 years), adults (18-64 years) and older adults (>65 years) (World Health Organisation, 2010). The key messages for these groups are as follows. Children and young people should aim to accumulate "at least 60 minutes of moderate to vigorous intensity physical activity (MVPA)" (p. 7) every day. All adults should do at least 150 minutes of moderate intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous intensity physical activity" (p. 8). The physical activity guidelines for Ireland were published a year earlier but mostly mirror these recommendations except that vigorous physical activity is not an explicit element of the adult guidelines and they recommend five days of 30 minutes <u>or</u> 150 weekly minutes (Department of Health and Children & Health Service Executive, 2009).

Globally, approximately 80% of 13-15 year olds do not reach the minimum physical activity guidelines. The problem is particularly pronounced in females given that 95% of adolescent girls do not meet the guidelines (Hallal, Andersen, et al., 2012). Recent trends suggest that physical inactivity is likely to increase in the coming years (Knuth & Hallal, 2009). However, physical activity levels in Irish school-children are relatively stable and have been shown to be higher than many other European and North American countries (Currie et al., 2012). Nonetheless the majority of Irish school-children do not achieve 60 minutes of MVPA per day. According to the HBSC study (Kelly, Gavin, Molcho, & Nic Gabhann, 2012) approximately 65% of children in Irish primary schools (10-11 years) are insufficiently active compared with 78% of those in secondary schools (12-17 years). Being female was also an important determinant of physical inactivity in this study. Other Irish studies support these trends in Irish children and adolescents (Economic and Social Research Institute & Trinity College Dublin, 2012; Williams et al., 2009; Woods et al., 2010). They also reported higher levels of physical inactivity in Irish school-children. Williams et al. (2009) found that 75% of nine year olds were not meeting the guidelines. Equally, Woods et al. (2010) stated that 81% of primary school-children and 88% of secondary school-children were not meeting the guidelines.

Similarly, 31% percent of adults are insufficiently active globally (Hallal, Andersen, et al., 2012). In Ireland, only 32% of adults meet the current physical activity guidelines (Irish Sports Council, 2014). Women, those living in high-income countries and older adults are more likely to be inactive (Hallal, Andersen, et al., 2012). In terms of physical activity trends over time, there is evidence that leisure time physical activity is increasing worldwide but is outweighed by greater decreases in occupational and travel physical activity (Knuth & Hallal, 2009). These trends have also been borne out in Ireland.

Despite the existence of national physical activity guidelines, there is no national physical activity action plan and no physical activity surveillance system in Ireland (Harrington et al., 2014). This, coupled with the error associated with measuring physical activity (discussed in section 2.2.1), makes it difficult to be definitive about the levels of physical activity in Ireland and trends over time. While not definitive, it is clear that like many other countries, physical inactivity is of particular concern in Ireland. Recent efforts to attenuate the decline in energy expenditure associated with technological advancements have had limited success (Hallal, Bauman, et al., 2012). Efforts to change physical activity behaviour should shift from advice giving and focus more on the social and physical environments that influence physical activity (Das & Horton, 2012). In this regard, the introduction of the 'Smarter Travel' initiatives described in section 1.1 could play an important role in increasing population physical activity levels.

1.4. Physical activity, active travel and health

1.4.1. Health benefits of physical activity

The WHO has identified physical inactivity as the 4th leading cause of death accounting for 6% of annual deaths worldwide (World Health Organisation, 2009). In terms of specific diseases, Lee et al. (2012) estimated that physical inactivity causes 6% of the burden of coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer and 10% of colon cancer. The evidence for the health benefits of physical activity for adults is unequivocal and based on a plethora of systematic reviews and meta-analyses (Reiner, Niermann, Jekauc, & Woll, 2013; Samitz, Egger, & Zwahlen, 2011; Shiroma & Lee, 2010; Warburton, Charlesworth, Ivey, Nettlefold, & Bredin, 2010; Warburton, Nicol, & Bredin, 2006; Woodcock, Franco, Orsini, & Roberts, 2011). The study of sedentary behaviours is a newer research phenomenon. A greater volume of longitudinal studies and randomised controlled trials are required but nonetheless the available systematic reviews and meta-analyses show a strong association between sedentary behaviours and cardio-metabolic risk particularly (Proper, Singh, van Mechelen, & Chinapaw, 2011; Thorp, Owen, Neuhaus, & Dunstan, 2011; Wilmot et al., 2012). In terms of the benefits of domain-specific physical activity, occupational physical activity has been shown to be the least beneficial (Samitz et al., 2011) and a potential health risk (Holtermann, Hansen, Burr, Søgaard, & Sjøgaard, 2012). The simultaneous accumulation of physical activity and avoidance of sitting are likely to be the most beneficial for health. This is based on evidence that even adults who achieve the recommended amount of physical activity can exhibit a detrimental dose response effect between TV viewing and several cardio-metabolic risk factors (Healy et al., 2008).

The evidence for the health benefits of physical activity in school-children is also unequivocal. Janssen and Leblanc (2010) conducted a systematic review of 86 studies that examined the relationship between physical activity, fitness and health in 5-17 year olds. They found that physical activity (particularly aerobic and vigorous) significantly improves health conditions such as high blood cholesterol, high blood pressure, metabolic syndrome, obesity, low bone density, depression and injuries. Positive associations between physical activity and performance at school have also been confirmed (Singh, Uijtdewilligen, Twisk, van Mechelen, & Chinapaw, 2012). Another systematic review of 232 studies examined the association between sedentary behaviour and health. They concluded that watching more than two hours of TV daily is associated with reduced fitness, self-esteem, pro-social behaviour, academic achievement and increased body fat (Tremblay et al., 2011).

1.4.2. Health benefits of active travel

School-children

Much of the research examining the health benefits of active travel in school-children has only focused on cardiorespiratory fitness, body composition and other markers of cardio-metabolic health risk. The evidence from several systematic reviews in this area (Davison, Werder, & Lawson, 2008; Faulkner, Buliung, Flora, & Fusco, 2009; Larouche, Saunders, Faulkner, Colley, & Tremblay, 2014; Lee, Orenstein, & Richardson, 2008; Lubans, Boreham, Kelly, & Foster, 2011; Schoeppe, Duncan, Badland, Oliver, & Curtis, 2013; Xu, Wen, & Rissel, 2013) indicates that there is a strong relationship between active travel and cardiorespiratory fitness. These reviews also indicate that the evidence for an association between active travel and BMI is both weak and inconsistent. Several reviews (Larouche, Saunders, et al., 2014; Lubans et al., 2011) concluded that cycling and not walking was associated with higher cardiorespiratory fitness. This assertion was based on the findings of more robust studies including longitudinal (Andersen et al., 2011; Cooper et al., 2008) and randomised controlled trials (Borrestad, Ostergaard, Andersen, & Bere, 2012; Ostergaard, Børrestad, Tarp, & Andersen, 2012).

Adults

For adults there is strong evidence from recent systematic reviews that active travel (mostly commuting to work) has a positive effect on several cardio-metabolic risk factors and all-cause mortality (Hamer & Chida, 2008; Saunders, Green, Petticrew, Steinbach, & Roberts, 2013; Wanner, Götschi, Martin-Diener, Kahlmeier, & Martin, 2012; Xu et al., 2013). Hamer and Chida's (2008a) meta-analysis of eight prospective studies found that active travel to work confers an overall cardiovascular risk reduction of 11%. A review by Saunders et al. (2013) of 18 prospective studies and interventions drew similar conclusions. The authors concluded that active travel conveys significant reductions in risk of all-cause mortality, hypertension and particularly type 2 diabetes. This review could find no prospective cohort studies examining obesity as a primary outcome factor. Nevertheless several cross-sectional studies have found inverse relationships between obesity and active travel (Bassett et al., 2008; Flint, Cummins, & Sacker, 2014; Pucher, Buehler, Bassett, & Dannenberg, 2010; Pucher, Buehler, Merom, & Bauman, 2011; Suminski, Wasserman, Mayfield, Freeman, & Brandl, 2014). Positive associations between active commuting and psychological wellbeing have also been reported

(Humphreys, Goodman, & Ogilvie, 2013; Martin, Goryakin, & Suhrcke, 2014). As was the case with school-children, the available evidence suggests the greatest health benefits are associated with cycling for transport.

1.4.3. Economic benefits of active travel policies

Creating a modal shift from car to active travel is likely to have a greater impact on lowering CO_2 emissions than increasing the use of lower emission cars (Woodcock et al., 2009). There are several other potentially unintended economic benefits from increasing active travel in a car dependent country. Increasing the accessibility of urban centres for pedestrians and cyclists generates increased retail trade for businesses (Lawlor, 2013; New York City Department of Transportation, 2014). This is contested by many traders however and is expanded upon in chapter seven. The greatest economic benefits are in the health sector and are attributed to population increases in physical activity and reductions in air pollution, with the former being the more important factor (de Nazelle et al., 2011; Lindsay, Macmillan, & Woodward, 2011; Rabl & de Nazelle, 2012; Rojas-Rueda, de Nazelle, Teixidó, & Nieuwenhuijsen, 2013; Woodcock, Givoni, & Morgan, 2013).

The United Nations has not included active travel as a priority approach to address non-communicable diseases because of a lack of evidence on its cost-effectiveness (Beaglehole et al., 2011). However recent studies have addressed this and provide support for the cost-effectiveness of active travel to improve health (Cavill, Kahlmeier, Rutter, Racioppi, & Oja, 2008; Deenihan & Caulfield, 2014; Götschi, 2011; Kuster & Blondel, 2013; Lindsay et al., 2011; Macmillan et al., 2014; Sloman, Cavill, Cope, Muller, & Kennedy, 2009). Kuster and Blondel (2013) estimated that the total economic benefit of cycling to the EU was more than €205 billion. Cavill et al. (2008) reviewed 16 studies that included a cost-benefit analysis on the health outcomes of transport policies and reported a median cost-benefit ratio of 5:1. Macmillan and colleagues' (2014) study suggests that the greatest return on investment would be from segregated cycle lanes. The estimated cost-benefit ratio of a proposed segregated cycle lane in Dublin, Ireland was 12:1 based on the modal share for cycling increasing from 5% to 10% over a 10 year period (Deenihan & Caulfield, 2014). Jarrett et al. (2012) calculated that an increase in active travel in the UK to levels comparable with Copenhagen would result in savings in the region of £17 billion for the NHS over 20 years. The overall figure was adjusted for an increased risk of road traffic injuries. This expected increase in accidents involving pedestrians and cyclists would appear to be an inevitable outcome of increased active travel but the actual outcome may well be counterintuitive.

Accidents as an economic cost of active travel

Walking and cycling for transport have higher casualty rates than automobile travel per kilometre travelled (Litman, 2015). However accident rates are low in countries where walking and cycling for transport is commonplace such as Denmark, Germany and the Netherlands. Fatality rates for adults under 50 years of age in the Netherlands are lower for cycling than for driving (Mindell, Leslie, & Wardlaw, 2012). In these countries cycling fatalities declined by 60-80% from 1970 to 2008 while the rates of cycling increased (Pucher & Buehler, 2010). This phenomenon is known as 'safety in numbers' and is best highlighted by Jacobsen's (2003) study of pedestrian and cyclist collisions with motorists in Californian cities, Danish towns and several other European countries. They concluded that the least collisions were in locations where the most people walked and cycled for transport. In effect, active travel becomes safer as it becomes more prevalent. A person switching from a car to a bike might increase their own injury risk but will coincidentally reduce the risk of injury for the rest of the population (Aldred, 2014). In countries such as England where active travel is not commonplace, the fatality rates by time spent travelling are lower for driving but rates for walking and cycling are similar (Mindell et al., 2012). Mindell and colleagues (2012) also reported that the relative risk of both walking and cycling is still very small. However fatality rates from cycling are higher for males of all ages.

In Ireland, children under 14 years of age are at greatest risk of an accident when walking or cycling and predominantly during the summer months. As found in England, boys are at greater risk than girls but fatalities amongst both sexes have been declining steadily in recent years (Road Safety Authority, 2012). The introduction of legislation to make helmet use compulsory has been a contentious issue. The population health benefits of such legislative decisions are still equivocal (Bauman, Titze, Rissel, & Oja, 2011). In countries like Ireland where cycling is still comparatively unsafe, it is unlikely that helmets would make cycling safer or greatly improve population health. A significant reduction in participation in cycling would be a more likely outcome (de Jong, 2012). Overall, the general consensus is that the health benefits of active travel (particularly cycling) in terms of both life expectancy and morbidity outweigh the risks

(Cavill & Davis, 2008; de Hartog, Boogaard, Nijland, & Hoek, 2010; Edwards & Mason, 2014; Holm, Glümer, & Diderichsen, 2012).

1.5. Knowledge gaps in existing evidence

The previous sections have established that Ireland is a very car dependent country with low levels of active travel and physical activity. The national 'Smarter Travel' policy (Department of Transport, 2009b) was intended to reduce Ireland's CO_2 emissions but may have wider economic benefits for the areas where measures are introduced. These economic benefits may be predominantly derived from the population health benefits associated with creating a modal shift from car to active modes of travel. In other countries, the evaluation of travel behaviour change programmes have typically focused on transport (vehicle km's travelled) and environmental (CO_2 emissions) benefits and less on health benefits (Rissel, Greaves, et al., 2013). This is also the case in the evaluation framework for the Irish 'Smarter Travel Area' programme (JMP Consultants Ltd, 2010).

This thesis will address several of the limitations inherent in the national evaluation framework. It will place a greater emphasis on both active travel (predominantly measured as a continuous variable) and physical activity. JMP Consultants Limited conducted baseline measures of travel behaviour one year after the opening of a flagship infrastructural project in a town designated as a 'Smarter Travel Area'. This research conducted baseline measures six months beforehand and therefore represents the only true baseline. This thesis also attempted to provide explanatory evidence in a local context to help understand the mechanisms and processes which shaped 'Smarter Travel' policy in the South-East of Ireland. This was done by conducting a media monitoring exercise over three years (presented in appendix 7D) and a comprehensive series of interviews with key stakeholders. In contrast to this, the national evaluation has prioritised the measurement of quantitative impacts and outcomes.

Moreover most community-wide active travel interventions have not been evaluated (Pucher, Dill, & Handy, 2010) and the majority of the existing knowledge base has been acquired from cross-sectional studies (Krizek, Handy, & Forsyth, 2009; Ogilvie, Foster, Rothnie, & Cavill, 2007; Yang, Sahlqvist, McMinn, Griffin, & Ogilvie, 2010). The limited intervention studies have rarely included comparison sites (Chapman et al., 2014; Ogilvie et al., 2012) or long durations of follow-up (Rissel, Greaves, et al., 2013). These issues are partly explained by the complexities of evaluating natural experiments where experimental control is low (Craig et al., 2012). These gaps in the evidence for community-wide active travel interventions also apply to schools. There is a paucity of intervention studies assessing active travel to school as a mechanism to increase physical activity (Chillón, Evenson, Vaughn, & Ward, 2011; Larouche, Saunders, et al., 2014). Equally, knowledge of effective physical activity strategies for adolescent girls is poor (Camacho-Miñano, LaVoi, & Barr-Anderson, 2011). This quasi-experimental research will contribute new knowledge to the evidence base on the effectiveness and design of active travel initiatives and their impact on physical activity.

1.6. Aim and objectives of the research

Context for thesis aims and objectives

In 2012, an open competition was held for the establishment of three 'Smarter Travel Areas' in Ireland. Two towns in the South-East of Ireland submitted comprehensive applications as part of this process. Dungarvan (intervention town 2), the smaller of the two towns, was successful and designated as a 'Smarter Travel Area' receiving €7.2 million for the creation of a comprehensive five year demonstration project. The other town, Kilkenny, (intervention town 1) was designated as an 'Active Travel Town' and received €415,000 for a pedestrian bridge and other related infrastructural improvements in the city centre. A control community (Clonmel) that had no immediate plans for promoting active travel was selected for comparison purposes. The research evaluated the intervention period of May 2011 (baseline) until May 2013 (follow-up).

Aim

The aim of the research is to determine the potential of the 'Smarter Travel Area' and 'Active Travel Town' initiatives to increase walking and cycling for transport.

Objectives

The research objectives to accomplish this aim are;

1. To determine the current knowledge base on the factors that influence active travel and on the most effective interventions for creating a modal shift from passive travel

2. To assess the extent to which 'Smarter Travel' initiatives can increase active travel in school-children and adults
3. To assess the impact of a school-based active travel intervention on adolescent girls' travel behaviour and attitudes
4. To evaluate the mechanisms and processes that shape the implementation of 'Smarter Travel' programmes
5. To provide recommendations for the implementation and evaluation of 'Smarter Travel' initiatives in other Irish towns and cities.

1.7. The local context of the research

More detailed descriptions of the socio-demographic characteristics of each town and the specific intervention components implemented between 2011 and 2013 are contained in appendices 1 and 2, respectively. Summary information is provided below.

Intervention town 1 (Kilkenny)

Intervention town 1 is a medieval city with considerable traffic congestion (The Councils of the City and County Kilkenny, 2009) compared with intervention town 2. It is predominantly flat and has a population of approximately 25,000 people (population density of 1,825 per km^2). It is a reasonably compact city and frequently referred to as the '10 minute city' with many destinations easily accessible by foot or by bike. A mobility management plan for the city was published in 2009 (The Councils of the City and County Kilkenny, 2009) and included the provision of improved pedestrian and cycling infrastructure in the city. Several actions outlined in this plan were delivered before the baseline survey in May 2011. The construction of an orbital pedestrian and cycling track with radial links to the city centre was 85% complete by 2011. The city centre itself was designated as a 'shared space' zone, speed limits were reduced to 30kph and one street was pedestrianised. A one-way system was trialled and abandoned in 2010 due to political and trader lobbying (discussed further in chapter seven). Also in 2010, an intersectoral working group (chaired by local authority) was established to promote 'Smarter Travel' in the city. The local authority is currently constructing a new vehicular bridge in the city centre in an effort to improve accessibility and decrease congestion in the city centre. This has been a controversial issue with many advocating for the completion of the orbital ring road around the city instead.

Intervention town 2 (Dungarvan)

Intervention town 2 is a predominantly flat and compact coastal town. It is the smallest of the three towns. The population within a three mile radius of the town is 12,300 (population density of 1,116 per km^2) with approximately 46,000 people living within the immediate 30 minute catchment area. There is very little traffic congestion in the town. An old railway track was converted into a separated walking and cycling path linking the town centre with many of the town's residential areas and schools and continuing to a nearby coastal resort. This was officially opened in November 2011, six months after the baseline survey. The 'GO Dungarvan' brand was established in 2012 and a project team of four people were appointed (project-coordinator, community development officer, communications officer and programme technician). An extensive pre-consultation exercise was conducted during 2013 to redevelop the square in the town centre to improve accessibility for cyclists and pedestrians. Local traders resisted any attempts to reduce the number of car parking spaces in the square (discussed further in chapter seven).

Control town (Clonmel)

The control town is located approximately 50km south-west of intervention town 1 and 40km north of intervention town 2. It is a largely flat town with a population of 17,900 (population density of 1088 per km^2) and has significant traffic congestion (Kieran Boyle Consulting, 2013). There were limited infrastructural facilities for pedestrians and cyclists in the town during the study intervention period. In June 2012, the control town was designated as an 'Active Travel Town' and received funding of €456,000 to provide a dedicated pedestrian corridor and cycle track alongside a busy orbital route on the perimeter of the town. The project was not completed until late 2013 after the follow-up surveys for this study were conducted. Similarly, several other improvements to the pedestrian and cycling environment were also delivered in late 2013 and throughout 2014.

1.8. Structure of the thesis

1.8.1. The theoretical context

This thesis used an ecological approach to determine the potential for the 'Smarter Travel Area' and the 'Active Travel Town' initiatives to increase active travel and physical activity. Much of the early research in this area (until the 1990's) focused on interventions that targeted the social and psychological influences of physical activity (Sallis et al., 2006). However policies that foster supportive environments for active travel are arguably more important for the design and evaluation of transport studies (Giles-Corti & Donovan, 2002). Ecological models posit that physical activity behaviour has multiple levels of influence which usually include intrapersonal, interpersonal, organisational, community, physical environmental and policy levels. These models provide comprehensive frameworks to guide the design and evaluation of interventions (Sallis, Owen, & Fisher, 2008). They have also been adopted by several other studies that have examined the determinants of walking and cycling (Giles-Corti, Timperio, Bull, & Pikora, 2005; Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2003; Saelens, Sallis, & Frank, 2003; Sallis et al., 2006).

1.8.2. Outline of chapter content

Chapter 2 critically appraises the most salient literature in the area of active travel. It is divided into four separate sections; issues associated with the measurement of physical activity and active travel, the contribution of active travel to total physical activity, the factors that influence active travel and the effectiveness of single and multi-component interventions to change travel behaviour.

Chapter 3 is the first of four chapters (chapters 3-6) that describe the impact of active travel initiatives on travel behaviour. Each of these chapters represents an individual impact study and includes the methods, results, discussion and conclusions relevant to that study. In chapter three, the impact of the community-wide active travel interventions on actual and preferred mode of travel to primary school is presented.

Chapter 4 describes the impact of the community-wide active travel interventions on secondary school-children. Unlike the study described in chapter three, this study assessed the impact of the interventions on total daily minutes of active travel.

Chapter 5 presents the design and impact of a nested active travel intervention in one all-girls school in intervention town 1. This study assessed the impact of the intervention on mode of travel to school, on total daily minutes of active travel and on student attitudes to active travel.

Chapter 6 presents the final impact study and is the only study that assessed the impact of the community-wide interventions on adults and the only one that used a panel design. The studies of school-children used repeat cross-sectional designs. The adult study assessed the impact of the intervention on total daily minutes of active travel and awareness of the campaign. It also assessed whether there was an association between the change in active travel and any changes in recreational and total physical activity.

Chapter 7 is an in-depth qualitative study with key stakeholders that examined the mechanisms that shaped the implementation of the active travel measures in both intervention towns. Similar to the impact studies, the related methods, results, discussion and conclusions are all contained in this chapter. This chapter also describes the methods used to conduct an analysis of the local print media which was done to provide further context for the results of this thesis. The results of the media analysis are available in appendix 7D.

Chapter 8 is the final chapter of the thesis. It presents the main conclusions of the overall research and considers the effectiveness and generalisability of the 'Smarter Travel Area' and 'Active Travel Town' initiatives. It also highlights the study's strengths and weaknesses and makes recommendations for further 'Smarter Travel' related research and practice.

CHAPTER 2. REVIEW OF LITERATURE

2.1. Introduction

This chapter first examines the complexities of measuring both physical activity and active travel. The methods used to quantify the impact of active travel interventions are evaluated and discussed (with consideration to the methods adopted in the studies described in this thesis). The active travel literature that has contributed to our knowledge on physical activity displacement is reviewed; that is, whether an increase in active travel results in a concurrent increase in total physical activity. Finally, the chapter presents a critical assessment of the correlates and determinants of active travel and of the available active travel intervention literature. The chapter is subdivided by gender, age and travel mode type where the depth of the available literature is adequate.

2.2. Measuring the impact of natural experiments on active travel

2.2.1. Measurement of physical activity

The accurate and reliable measurement of physical activity is necessary for several reasons; to monitor the proportion of a population meeting physical activity guidelines for health, to understand the factors that influence physical activity and to measure the impact of interventions on physical activity (Bauman, Phongsavan, Schoeppe, & Owen, 2006; Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012). Physical activity is a complex behaviour to measure (Bauman et al., 2006) and the array of methods typically include self-report surveys and objective measures such as doubly labelled water, cardiorespiratory fitness, pedometers and accelerometers. Traditionally, self-report surveys have been used more frequently because they are low cost, unobtrusive and more practical for large scale studies (Adamo, Prince, Tricco, Connor-Gorber, & Tremblay, 2009; Helmerhorst et al., 2012; Panter, Costa, Dalton, Jones, & Ogilvie, 2014; Prince et al., 2008). However they have some limitations due to measurement error and have only shown moderate agreement with objective criterion measures in both adults (Helmerhorst et al., 2012; Prince et al., 2008) and children (Adamo et al., 2009). Self-report surveys tend to overestimate moderate and vigorous physical activity (Prince et al., 2008) and are susceptible to recall and response bias, particularly amongst children (Biddle, Gorely, Pearson, & Bull, 2011; Sirard & Pate, 2001). Recently the use of objective measures (especially accelerometers) have become more widespread in an effort to provide more robust and precise measures of physical activity (Adamo et al., 2009; Hallal, Andersen, et al., 2012; Prince et al., 2008). Nonetheless, there are also many limitations associated with objective measures. They are time consuming, expensive, obtrusive and are poor at classifying activity type (e.g. cycling and swimming) and location (Adamo et al., 2009; Bauman et al., 2006; Haskell, 2012; Prince et al., 2008; Sirard & Pate, 2001). Currently there is no single gold standard measure of physical activity (Bauman et al., 2006; Prince et al., 2008) and combining several measures promises the greatest level of precision (Haskell, 2012).

2.2.2. Measurement of active travel

No survey instruments can comprehensively assess active travel and total physical activity in adults (Adams et al., 2014) or children (Herrador-colmenero et al., 2014). The majority of studies have used self-report surveys and the instruments tend to be heterogeneous making it difficult to compare study outcomes. In a systematic review of 158 studies examining mode and frequency of active travel to school, only 12.7% used a valid and reliable question (Herrador-colmenero et al., 2014). These factors may have resulted in both the under and overestimation of active travel.

Many studies of active travel tend to ask about main mode of travel only, neglecting the measurement of more complex behaviours such as multi-modal travel (Carse, Goodman, Mackett, Panter, & Ogilvie, 2013; Panter, Jones, & van Sluijs, 2008; Panter & Jones, 2010). This may result in an underestimation of active travel and physical activity. The categorisation of public transport as passive travel may have a similar effect. Several studies have shown that public transport use is an important source of physical activity (Besser & Dannenberg, 2005; Morency, Trépanier, & Demers, 2011; Rissel, Mulley, & Ding, 2013; Wasfi, Ross, & El-Geneidy, 2013; Wener & Evans, 2007). Another cause of underestimating active travel is when surveys classify a participant as an active commuter when they walk or cycle to work or school on only one or two days (Faulkner et al., 2009). Furthermore, self-report surveys tend to under-record short trips (Ogilvie et al., 2012). Stopher, Clifford, Swann, and Zhang (2009) suggest that the under-reporting of short trips may account for up to 30% of total daily trips. Ironically these are the trips most likely to be influenced by active travel interventions (Stopher et al., 2009).

More recent studies have attempted to improve the sensitivity of self-report surveys by measuring walking and cycling as a continuous as opposed to a categorical variable

(Adams et al., 2014; Goodman, Sahlqvist, & Ogilvie, 2014; Larouche, Faulkner, & Tremblay, 2013). A continuous measure of active travel would facilitate the calculation of dose-response effects and the inclusion of active travel studies in meta-analyses. The 'Transport and Physical Activity Questionnaire' is an example of a self-report survey which aims to assess the frequency and participation in specific physical activity domains, total physical activity, and time spent and distance travelled using different travel modes for different trip purposes (Adams et al., 2014). Most of the current evidence is based on active travel to work or school. Trip purpose is rarely examined, yet previous studies have found that the correlates of walking and cycling for transport are different when trip purpose is considered (Carse, Goodman, Mackett, Panter, & Ogilvie, 2013a; de Vries, Hopman-Rock, Bakker, Hirasing, & van Mechelen, 2010; Panter & Jones, 2010; Steinbach, Green, & Edwards, 2012). Using continuous data does not solve the problems inherent in self-report data. Studies have shown that the self-reporting of active travel data results in over-reporting when compared to objective monitoring (Kelly, Krenn, Titze, Stopher, & Foster, 2013; Panter, Costa, et al., 2014). Panter, Costa, et al. (2014) estimated this over-estimation to be 1.1 minutes per trip suggesting that aggregate weekly self-report data would be considerably inaccurate.

In order to address these concerns, researchers have advocated for the use of mixed methods to accurately measure active travel behaviours (Adams et al., 2014; Bates & Stone, 2014; Larouche, Oyeyemi, et al., 2014; Ogilvie et al., 2012; Oliver, Badland, Mavoa, Duncan, & Duncan, 2010; Stopher et al., 2009). These methods should include; GPS, GIS, accelerometry and standardised, validated self-report surveys.

2.2.3. Research designs

The majority of active travel studies have used cross-sectional designs. Cross-sectional research is useful in the design of interventions but they do not provide any evidence of causality. The limited intervention studies have tended to be quasi-experimental trials. Randomised control trials are typically not feasible to measure the impact of complex community-wide active travel interventions (Krizek, Forsyth, & Baum, 2009). These natural experiments require complex mixed method evaluations. Qualitative research is needed to corroborate mechanisms and to validate quantitative data. While natural experiments have problems associated with lack of experimental controls, they often have high external validity (Craig et al., 2012; Petticrew et al., 2005). Repeat cross-sectional and panel designs are the two primary options for measuring the quantitative impact of these natural experiments. Repeat cross-sectional designs measure independent samples before and after an intervention. Despite their widespread use in studies reporting the impact of active travel interventions (Ogilvie et al., 2012), cross-sectional studies have many limitations. Principally they can only make aggregate comparisons of physical activity at a population level. Panel designs, which measure the same people before and after an intervention, can directly measure the magnitude of change and attribute the change to certain individual-level characteristics such as SES. Another advantage is that they require smaller sample sizes, although they are subject to attrition (Stopher et al., 2009). Panel designs are the preferred option for measuring the impact of active travel interventions (Kramer et al., 2014; Stopher et al., 2009). Recent quasi-experimental studies of new active travel infrastructure in England (Ogilvie et al., 2012), Australia (Rissel, Greaves, et al., 2013) and New Zealand (Chapman et al., 2014) have all opted for this research design. Furthermore, Stopher et al. (2009) recommend using a 3rd party to conduct the evaluation, undertaking the surveys at annual intervals to avoid seasonal fluctuations and including a control community.

2.3. The contribution of active travel to physical activity recommendations

This section examines the contribution of active travel to total physical activity and the possibility that active travel could displace other physical activity in the lives of children, adolescents and adults.

2.3.1. School-children

Tudor-Locke, Ainsworth, and Popkin (2001) stated that active travel to school could be an overlooked and important source of physical activity for children and that studies should be conducted to either support or refute this assertion. Only a small number of cross-sectional studies have done the latter, all in very young children (Cooper et al., 2006; Metcalf, Voss, Jeffery, Perkins, & Wilkin, 2004; Wilkin, Mallam, Metcalf, Jeffery, & Voss, 2006). These studies provide some support for the 'activitystat hypothesis' in very young children (five year olds) whereby habitual physical activity is controlled centrally rather than environmentally. It is worth noting however that Wilkin and colleagues'

(2006) study failed to measure travel mode 'from' school, something which may have underestimated the extent of active travel (Schoeppe et al., 2013).

In contrast to these studies, there is a plethora of cross-sectional evidence to support the potential contribution of active travel to total physical activity and particularly MVPA in both primary (Cooper, Andersen, Wedderkopp, Page, & Froberg, 2005; Goodman, Mackett, & Paskins, 2011; Owen et al., 2012; Roth, Millett, & Mindell, 2012; Saksvig et al., 2007; Southward, Page, Wheeler, & Cooper, 2012; van Sluijs et al., 2009) and secondary school-children (Carver et al., 2011; Chillón et al., 2010; Duncan, Scott Duncan, & Schofield, 2008; Larouche, Faulkner, Fortier, & Tremblay, 2014; Roth et al., 2012). A considerable number of studies have found that this association is stronger for boys than for girls (Carver et al., 2011; Chillón et al., 2010; Cooper et al., 2005; Cooper, Page, Foster, & Qahwaji, 2003; Faulkner, Stone, Buliung, Wong, & Mitra, 2013; Rosenberg, Sallis, Conway, Cain, & McKenzie, 2006; Roth et al., 2012; Smith, Sahlqvist, Ogilvie, Jones, Corder, et al., 2012). This is not to say that active travel is less important for girls. Indeed, Southward et al. (2012) stated that the active commute to school can account for a greater proportion of daily MVPA in girls due to their lower physical activity than boys. Many of these studies did not report walking and cycling separately because accelerometry often underestimates the energy expenditure associated with cycling (Chillón, Ortega, et al., 2011). This is supported by Roth et al. (2012) who found that only self-reported cycling to school (when compared with walking) contributed to meeting the physical activity guidelines in children aged 5-15 years.

Taken together these studies found that children who actively travel to school accumulated between 4.7 and 40 minutes greater total daily MVPA than those who commute passively. The actual journey to or from school contributes little to this increase. In one study, the active journey to school accounted for only 3.5 minutes of the 37.4 extra minutes of MVPA in active travel compared with passive commuters (Cooper et al., 2005). The association between active travel to school and total MVPA is stronger when the children live further from the school (Faulkner et al., 2013; van Sluijs et al., 2009). The association also exists for non-school related active travel (Goodman et al., 2011; Smith, Sahlqvist, Ogilvie, Jones, Griffin, et al., 2012). Goodman (2011) estimated that each 1% increase in weekday non-school related active travel predicted 0.38% more time in MVPA at other times. Despite the apparent weight of evidence these studies provide, their cross-sectional design precludes them from proving cause and effect i.e. it may be that active children are more inclined to walk or cycle to school. Although limited, the available evidence from randomised controlled trials (RCTs) (Mendoza et al., 2011a; Sirard, Alhassan, Spencer, & Robinson, 2008) and longitudinal studies (Cooper, Jago, Southward, & Page, 2012; Smith, Sahlqvist, Ogilvie, Jones, Corder, et al., 2012) support the hypothesis that active travel does not displace physical activity at other times of the day. Based on the available evidence, all of the systematic reviews conclude that promoting active travel is a promising method to increase physical activity in children irrespective of the culture of active travel in a country (Faulkner et al., 2009; Larouche, Saunders, et al., 2014; Lee et al., 2008; Schoeppe et al., 2013).

2.3.2. Adults

Similar associations between active travel and total physical activity are reported for adults irrespective of the travel culture in a country. As was the case with school-children, the majority of studies of adults are cross-sectional and have used self-report measures of physical activity and non-standardised self-report measures of active travel behaviour. Several cross-sectional studies have shown that both men and women who drive to work, college or to leisure activities are less likely to meet the physical activity recommendations compared to those who walk or cycle (Dombois, Braun-Fahrländer, & Martin-Diener, 2007; Gordon-Larsen, Nelson, & Beam, 2005; Sahlqvist, Song, & Ogilvie, 2012; Sisson & Tudor-Locke, 2008; Wen, Orr, Millett, & Rissel, 2006; Yang, Panter, Griffin, & Ogilvie, 2012). These findings have been confirmed by the recent iConnect longitudinal study (one year follow-up) of active travel in the UK (Sahlqvist, Goodman, Cooper, & Ogilvie, 2013). This study divided the participants into three groups; those that increased their minutes of active travel (32%), those that remained unchanged (33%) and those that decreased their minutes of active travel (35%). Those who increased their active travel engaged in an extra 112 weekly minutes of physical activity compared with those who remained unchanged. Importantly, there was no difference in minutes of recreational physical activity between groups. This longitudinal study suggests that adults that engage in active travel are more inclined to be physically active and not vice versa.

2.4. The factors that influence active travel

2.4.1. Characteristics of existing research

A recent systematic review concluded that we have only a limited understanding of the determinants of active travel (Bauman, Reis, et al., 2012). Another systematic review concluded that the quality of studies examining the environmental correlates of cycling is very poor (Fraser & Lock, 2011). The reasons for these conclusions are multi-faceted. The majority of the research is cross-sectional and walking and cycling are infrequently examined separately especially in school-children. This is despite review level evidence indicating that the correlates of walking and cycling differ considerably for both adults (Forsyth & Krizek, 2010; Krizek, Forsyth, & Baum, 2009; Panter & Jones, 2010) and for children (Davison et al., 2008; Panter et al., 2008; Pont, Ziviani, Wadley, Bennett, & Abbott, 2009; Wong, Faulkner, & Buliung, 2011). These reviews also report that studies tend to rely predominantly on a participants main mode of travel, neglecting to examine more complex and perhaps more common travel behaviours such as trip chaining (multiple destination points) and multi-modal travel. The majority of the research is from Australia, the USA and Europe and amongst urban populations (Lu et al., 2014). This is problematic because the environmental provision for active travel (and car travel) is geographically heterogeneous suggesting that research may well be country or region specific. In Europe for example, cities tend to be more compact and hence trips are shorter (Bassett et al., 2008). Finally, previous studies have found that the correlates of walking and cycling for transport are different when trip purpose is considered (Carse, Goodman, Mackett, Panter, & Ogilvie, 2013a; de Vries, Hopman-Rock, Bakker, Hirasing, & van Mechelen, 2010; Panter & Jones, 2010; Steinbach, Green, & Edwards, 2012) yet most of the evidence is based on active travel to work or school.

2.4.2. Health behaviour theories and models

Social cognitive theories and models

Health behaviour theories and models are useful to understand the determinants of physical activity and to shape the design of physical activity interventions (Baranowski, Anderson, & Carmack, 1998). Three of the most prominent models and theories used in studies of physical activity are the Transtheoretical Model (TTM, Prochaska & DiClemente, 1983), the Theory of Planned Behaviour (TPB, Ajzen & Processes, 1991) and

Social Cognitive Theory (SCT, Bandura, 1998). The first of these, the TTM is a stage based model that encompasses six stages of change that an individual progresses through, often in a cyclical manner. The other components of the model are processes of change, decisional balance and self-efficacy. In the TPB, behavioural intention is the proximal determinant of actual behaviour change, while intention is predicted by three constructs; attitudes, subjective norms and perceived behavioural control. The SCT emphasises reciprocal determinism whereby behaviour is the product of the complex interplay between personal, environmental and behavioural factors (McAlister, Perry, & Parcel, 2008). However the majority of physical activity studies have focused on self-efficacy alone and failed to apply the full SCT model in their research (Rhodes & Nigg, 2011).

Social cognitive theories (SCTs) have had modest success in terms of physical activity behaviour change in adults (Hillsdon, Foster, & Thorogood, 2005; Spencer, Adams, Malone, Roy, & Yost, 2006) and school-children (Plotnikoff, Costigan, Karunamuni, & Lubans, 2013). However SCTs are less successful when applied to moderate intensity physical activity such as walking and cycling for transport (de Bruijn, Kremers, Singh, van den Putte, & van Mechelen, 2009). The TPB for example may be effective in predicting broader physical activity but is a poor predictor of future walking or intention to walk (Eves, Hoppéa, & McLaren, 2007). Furthermore, social cognitive models do not fully incorporate factors associated with the physical environment which, if used in isolation, greatly limits their usefulness in active travel research (Ogilvie et al., 2011; Owen et al., 2004).

Ecological models

As outlined in section 1.8.1, ecological models direct attention away from the study of psychosocial correlates and towards wider environmental and policy factors. The latter are more likely to be the root cause of physical inactivity (Sallis et al., 2006). Understanding the factors that influence physical activity across all levels (individual, social, environment and policy) can inform the development of multi-level interventions which have a greater chance of success than single-level interventions (Bauman, Reis, et al., 2012; Sallis et al., 2006).

Panter et al., (2008) developed a conceptual framework to explain the most important factors that determine youth active travel (figure 2.1). This framework outlines the physical, individual and external factors associated with travel mode decision making and the most important moderating factors. It also allows for the inclusion of both parental and child perceptions. One important omission from this framework is whether the outcome involves the child travelling independently or being escorted. This has been incorporated into other frameworks (Mitra, 2013). Saelens, Sallis, and Frank (2003) developed an ecological model to explain the multiple factors that influence walking and cycling for both recreation and transport in adults. Ogilvie et al. (2011) refined this model by examining walking and cycling separately, disaggregating the psychosocial factors into subcategories and including behavioural intention (theory of planned behaviour) and habit strength (figure 2.2). The inclusion of these individual social cognitive models in wider ecological frameworks is seldom done (Panter & Jones, 2010). The section which follows will use an ecological framework to examine the correlates and determinants of active travel in children, and in adults, according to physical, social and individual level influences.

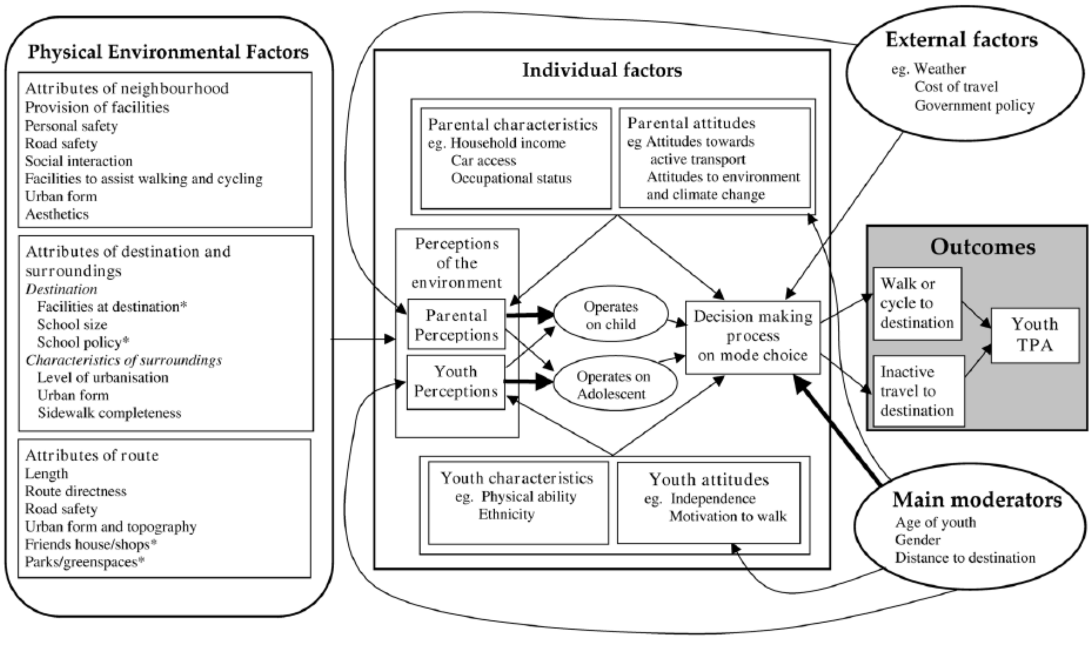

Figure 2.1 *An ecological framework for the environmental determinants of active travel in children (Panter, Jones, & Sluijs, 2008)*

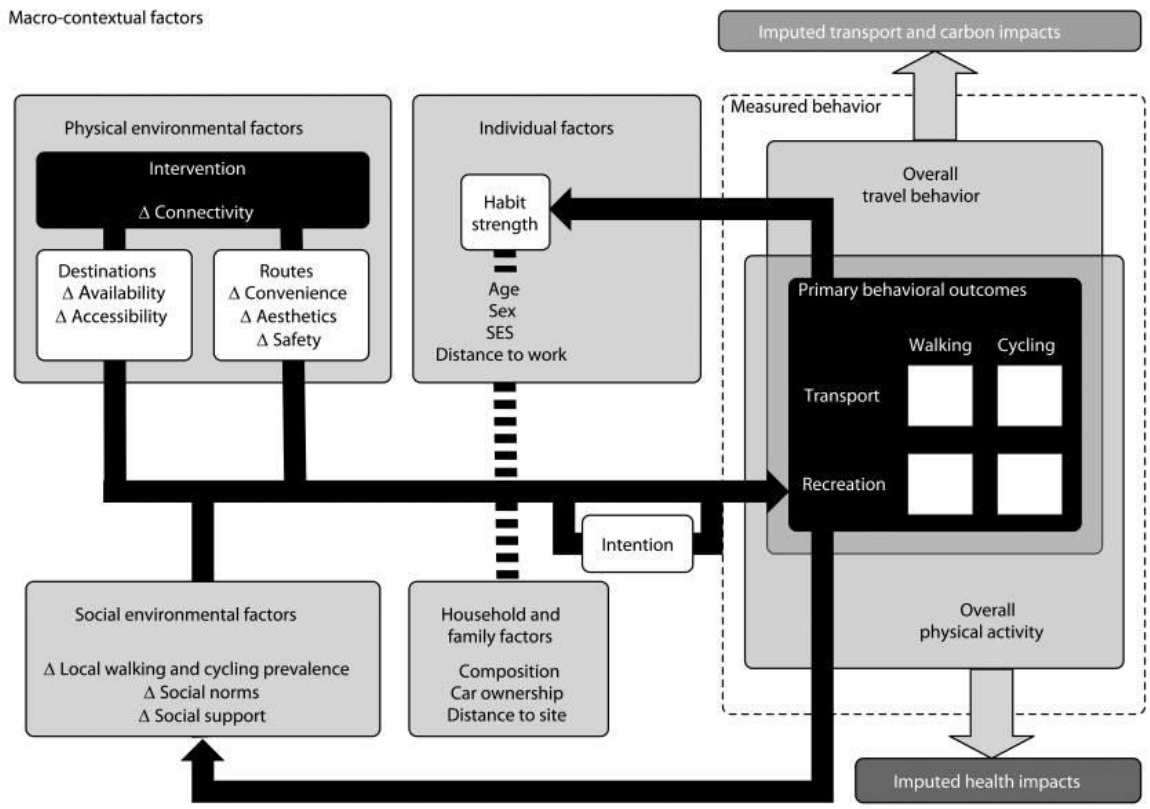

Figure 2.2 The ecological intervention model for the iConnect study of adults (Ogilvie et al., 2011)

2.4.3. Factors that influence active travel in school-children

Physical environment level

Recent systematic reviews of active travel in young people have identified distance, road safety, the presence of walk and bike paths and the presence of recreational venues and facilities as the strongest environmental determinants of active travel in youth aged 5-18 years (Davison et al., 2008; Panter et al., 2008; Pont et al., 2009; Wong et al., 2011).

The importance of journey distance and safety

The distance to a destination (school or non-school) shows the most consistent evidence of an inverse association with active travel for all ages. Proximity to school was identified as the most influential factor on travel mode choice for Irish primary school-children (Daniels et al., 2014). Another Irish study but with older adolescents (15-17 year olds) reported the criterion distances for walking and cycling to school as 2.4km and 4.0km, respectively (Nelson et al., 2008). This is similar to a criterion distance of 3046m reported for any active travel to school in 14 year olds in the UK (Chillón, Panter, Corder, Jones, & van Sluijs, 2014). D'Haese, De Meester, De Bourdeaudhuij, Deforche and Cardon (2011) estimated the criterion distances for Belgian children (11-12 year olds) to walk or cycle to school as 1.5km and 3km, respectively. Criterion distances for older Belgian adolescents (17-18 years) have been reported as 2km for walking and 8km for cycling (Van Dyck, De Bourdeaudhuij, Cardon, & Deforche, 2010). This suggests that while criterion distances for walking are relatively stable with increasing age, there is a willingness to cycle further distances as children get older. However data from the Speedy study in the UK (Chillón et al., 2014) suggest that children walk greater distances to school as they get older. The distances that best discriminated those that walked to school from those that were driven were 1421m in nine year olds, 1627m in 11 year olds and 3046m in 14 year olds.

It is possible that the relationship between distance and journey time is a major issue for adolescents. Journey time and distance were the two most frequently cited barriers to active travel in Irish adolescents (Woods et al., 2010). This is echoed in qualitative studies in the UK (Transport for London, 2008) and Belgium (Simons et al., 2013). These qualitative studies stated that journey time is an important consideration for older adolescents when making decisions about travel mode. Although distance to school shows the most consistent relationship with active travel, there are other factors that must be considered. In a Dutch study where all the students of a primary school lived within 1km of their school, active travel still declined with increasing distance from the school (Dessing, de Vries, Graham, & Pierik, 2014).

The presence of bike and foot paths consistently show a positive association with active travel to school (Panter et al., 2008; Pont et al., 2009). It is unclear to what extent this relates to the safety or walkability[1] of the route to school. Here the evidence is more equivocal. Studies from countries such as Belgium have found that while good street connectivity is important for active travel to school, the physical environmental correlates are not the most important predictors of active travel to school (Ducheyne, De Bourdeaudhuij, Spittaels, & Cardon, 2012; Van Dyck et al., 2010). In contrast, road safety is far more prominent in the literature from countries with lower levels of active travel to school such as the USA, Canada, Australia, England and Ireland. In these countries,

[1] Walkability is a combined measure of residential density, land use mixture, and connectedness of streets (Owen et al., 2010)

child and parental safety concerns (traffic related), busy road barriers and high traffic volume were all negatively associated with active travel to school (Giles-Corti et al., 2011; Larouche, Chaput, et al., 2014; Leslie, Kremer, Toumbourou, & Williams, 2010; Panter, Jones, van Sluijs, Simon, & Griffin, 2013; Su et al., 2013; Timperio et al., 2006; Trapp et al., 2011). An Irish study of independent mobility concluded that infrastructural considerations such as footpaths and lighting, largely dictate where and how children travel (O'Keefe & O'Beirne, 2015). Parents were more concerned about road safety than children were. While many studies have shown that road safety is important for both children and adolescents, Larouche, Faulkner, and Tremblay (2013) found that neighbourhood walkability was also an important determinant of walking to school for Canadian adolescents but not primary school-children. The authors' postulate that road safety could be even more important for adolescents considering they are more likely to engage in independent mobility. Furthermore, Timperio et al. (2006) found that good street connectivity (a measure of walkability) was negatively associated with walking to school in Australian adolescents but not for school-children. This was contradictory to what was found in Belgian adolescents (Van Dyck et al., 2010) and suggests that improving walkability of school routes in more car dependent countries should not coincidently improve street connectivity for car travel and consequently increase road traffic volumes.

Evidence from longitudinal studies

Many of the environmental correlates from the cross-sectional studies cited above have been confirmed by the limited longitudinal studies in this area (Hume et al., 2009; Panter, Corder, Griffin, Jones, & van Sluijs, 2013). Panter, Corder, et al. (2013) examined the predictors of uptake and maintenance of active travel to school among English school-children (n = 912, average age = 10.2 years). The physical environmental predictors of uptake of active travel were; living in an urban area, living less than 1km from school and having a parent that reported higher levels of safety on the route to school. Consistent with previous Australian research (Salmon, Salmon, Crawford, Hume, & Timperio, 2007; Timperio et al., 2006) those children whose routes to school were more direct were, counterintuitively, less likely to switch to active commuting. Of these, distance was the most important predictor. Those living within 1km of the school were almost five times more likely to start and three times more likely to maintain walking or cycling to school compared with those living further away. Importantly, only

15% of students took up active travel over the year, suggesting that the travel behaviours of school-children are relatively stable. Hume and colleagues' (2009) longitudinal study of Australian school-children (n = 121, average age = 9.1 years) found contradictory results in terms of road safety, albeit with a smaller sample size and in a different country. They found that factors associated with the social environment were more important than the physical environment for predicting uptake of active travel in younger school-children. However they also followed a cohort of adolescents (n = 188, average age = 14.5 years) over the two year study period. They reported that adolescents whose parents were satisfied with the number of pedestrian crossings in their neighbourhood were 2.4 times more likely to increase their active commuting to school.

Evidence for differences by gender

The task of identifying the most consistently reported correlates and determinants of active travel is made more complex when they are considered in a gender-specific context. It is possible that features of the physical environment that improve safety are more important determinants of active travel for girls than boys. Carver, Timperio, and Crawford (2008) reported that the physical (road) environmental predictors of active travel to 15 neighbourhood destinations differed in adolescent boys and girls in Australia. This was one of the few studies that examined the factors that influenced non-school active travel and in both sexes separately. There was no association between features of the road environment (speed limits, intersection density, walking paths, traffic calming and traffic / pedestrian lights) and active travel in 188 8-9 year olds. In the adolescent cohort (n = 346, 13-15 year olds) having at least 2-3 sets of traffic / pedestrian lights in their neighbourhood was associated with regular active travel. Interestingly, this was reported for adolescent girls only. Also in Australia, adolescent girls (n = 175, age 13 years) that perceived local roads to be safe were more likely to walk for transport. There was no relationship found for boys. Parental perception of heavy traffic was negatively associated with walking and cycling, with stronger associations reported for girls (Carver et al., 2005). Nelson and Wood's (2010) study of Irish adolescents (n = 2159, age 16 years) found that land use mix and the presence of public parks were associated with active travel to school in males only. The variables associated with active travel to school in females were excess traffic speed, shops within walking distance and paths separated from the road.

Unlike the cross-sectional baseline data from the SPEEDY study in the UK (Panter, Jones, van Sluijs, & Griffin, 2010), the 1-year follow-up results (Carver, Panter, Jones, & van Sluijs, 2014) found gender differences in the environmental predictors of active travel to school in younger children (n = 1121, 9-10 year olds). Carver et al. (2014) specifically examined 'independent mobility' as the primary independent variable. This refers to children's freedom to travel around their neighbourhood without adult supervision (Hillman, Adams, & Whitelegg, 1990). In boys, there was no association found between features of the physical environment and independent mobility to school. Land use mix (OR 1.38) and the proportion of main roads in the neighbourhood (OR 0.67) were both longitudinally associated with independent mobility to school in girls.

Social environment level

The aspects of the social environment considered for this section included; friends or family that model or encourage active travel, opportunities for social interaction, the presence of people in the neighbourhood, and the level of social cohesion or control present. Several studies have shown positive associations between active travel to school and peer social interactions (Carver et al., 2005; Ducheyne et al., 2012; Panter, Jones, et al., 2013; Salmon et al., 2007; Timperio et al., 2006). One systematic review determined social interactions to be one of the strongest correlates of active travel for adolescents (Panter et al., 2008). The potential to spend time with friends was the most important reason for adolescent girls (aged 11-14 years) to choose to walk to school in Scotland (Kirby & Inchley, 2013). On the contrary, adolescent girls have expressed greater resistance to cycling for transport in England because it was not deemed to be an acceptable social norm for this population group (Cavill & Watkins, 2007). The influence of parents appears to be another important social factor (Davison et al., 2008). Parents have been described as gatekeepers of children's independent mobility (Hillman et al., 1990). In Ireland, only 10% of primary school-children and 13% of secondary school-children travel to school unaccompanied by an adult (O'Keefe & O'Beirne, 2015). Children are typically granted independent mobility between the ages of 8-13 years and girls are generally older (Carver et al., 2014; O'Keefe & O'Beirne, 2015; Schoeppe, Duncan, Badland, Oliver, & Browne, 2014). This may be due to parents being more protective of girls or due to gender differences in socialisation patterns. Boys have been shown to socialise more on streets close to home while girls are more likely to travel further distances to socialise in a friend's house or at the cinema etc. (Brown, Mackett, Gong, Kitazawa, & Paskins, 2008).

The evidence for parental support for active travel is somewhat equivocal. Several cross-sectional studies have shown positive associations between parental encouragement and active travel (Ducheyne et al., 2012; Panter et al., 2010). Conversely, once the longitudinal follow-up data of the latter study was considered, only individual and environmental factors predicted active travel to school (Panter, Corder, et al., 2013). Furthermore, when this data was filtered based on independent active travel, parental encouragement was a predictor of not actively commuting to school (Carver et al., 2014). The evidence for parental modelling of the behaviour is more robust. Children are more likely to actively commute to school when their parents walk or cycle to work themselves (Henne, Tandon, Frank, & Saelens, 2014; Merom, Tudor-Locke, Bauman, & Rissel, 2006; Panter, Jones, et al., 2013). This is consistent with Mitra (2013) who stated that beyond road safety and distance, parents' mobility access (access and convenience of a car) and daily schedules are important mediators of children's travel behaviours.

Parental modelling of active travel behaviour may be an attempt to allay their fears of strangers in the community. McDonald, Deakin, and Aalborg (2010) found that parental perceptions of high social control (belief that their neighbours would watch out for their children) in their neighbourhood was positively associated with active travel to school in 432 American children (aged 10-14 years). The relationship between informal social control and independent mobility to any destination was examined in an Australian study of 1231 10-12 year old children and their parents (Foster, Villanueva, Wood, Christian, & Giles-Corti, 2013). Parental fear of strangers reduced the likelihood of children being granted independent mobility and perceptions of high social control had little attenuating influence. In both studies, the association was stronger for girls than for boys. In Ireland the greatest source of worry for school-children while engaging in independent mobility was the fear of dogs and kidnappers (girls only) although these fears diminished when travelling in groups (O'Keefe & O'Beirne, 2015).

Individual level

One of the first systematic reviews that included several socio-demographic variables found that car ownership and increasing household income were consistently negatively associated with active travel to school. Non-white ethnicity was found to be positively related to active travel to school (Pont et al., 2009). These trends have been extended and in most cases confirmed by the newer and more robust studies published since then. Longitudinal studies from Canada (Pabayo, Gauvin, & Barnett, 2011) and the UK (Panter, Corder, Griffin, Jones, & van Sluijs, 2013b) have confirmed that lower household income is associated with more frequent active travel to school in children of all ages. Boys (Emond & Handy, 2011; Larouche, Faulkner, & Tremblay, 2013) and older school-children up to 10 years of age (Pabayo et al., 2011) are also more likely to walk or cycle to school. Pabayo et al. (2011) found that active travel to school decreases throughout the adolescent years starting from age 10. Access to, and the associated convenience of the car, has emerged as possibly the strongest individual predictor of passive travel to school.

A large English study of over 8000 5-17 year olds reported that having no access to a vehicle was the only consistent predictor of walking to school or to other destinations (Steinbach et al., 2012). The longitudinal SPEEDY study, also conducted in England, found that household car access was inversely associated with independent active travel to school in 9-10 year old boys but not girls (Carver et al., 2014). Similarly, parents who reported it was inconvenient to use the car for school travel were more than twice as likely to take up active travel to school, and almost 5.5 times more likely to maintain active travel to school (Panter, Corder, et al., 2013). The ability to carry heavy school bags is one aspect that adds to the convenience of car travel. A longitudinal Canadian study reported that perceptions of having too much stuff to carry was a correlate of car travel for children before and after the transition to secondary school (Larouche et al., 2013). Qualitative studies have greatly added to our understanding of what convenience means in relation to travel modes. Faulkner, Richichi, Buliung, Fusco, and Moola (2010) suggest that parents of 10-11 year olds first make a decision about whether to escort their child or not and only then consider the actual mode of travel. This decision was influenced by what was easiest and most convenient particularly for parents with multi-activity trip chains. This is supported by one of the few systematic reviews of qualitative studies in this area (Lorenc, Brunton, Oliver, Oliver, & Oakley, 2008). Lorenc et al. (2008) identified the 'culture of car use' as one of the most dominant explanations of transport choices. This culture of car use;

…subsumes the perception of cars as more convenient than walking or cycling, the status of car ownership and the perception of cars as cool, and the view of car ownership as integral to a normal adult lifestyle, which mitigate against the use of active transport. (p. 854)

2.4.4. Factors that influence active travel in adults

There is a considerable volume of research published on the relationship between active travel and aspects of the environment, particularly the physical environment, for adults. This makes it possible to examine the influences of the physical environment on walking and cycling for transport separately.

Physical environment level

Walking for transport

Several reviews in this area (mostly walking to work) have all confirmed that; distance (and travel time), walkability, land use mix and population density are consistently associated with walking for transport (Panter, Jones, van Sluijs, & Griffin, 2010b; Saelens & Handy, 2008; Saelens, Sallis, & Frank, 2003; Sugiyama, Neuhaus, Cole, Giles-Corti, & Owen, 2012; Van Holle et al., 2012). Sugiyama et al., (2012) and Van Holle et al., (2012) in particular included an increasing number of studies that used objective measures of the physical environment. These reviews also suggest that the evidence for associations between walking and pedestrian infrastructure (e.g. footpaths), traffic and safety is equivocal at best. They also indicate that there are discrete differences between the correlates of recreational and utilitarian walking. Sugiyama et al. (2012) was the only review to conclude that the existence of destinations within walking distance was a more important correlate of walking for transport than walkability. In their review of 46 studies, it was found that the proximity of retail and service destinations was reported as a positive correlate in 80% of the studies compared to 50% of studies that reported footpaths and street connectivity to be positive correlates of walking. A recent cross-sectional study in the UK found no relationship between street connectivity and walking for transport (Adams, Goodman, Sahlqvist, Bull, & Ogilvie, 2013). Adams et al. (2013) found that those who perceived there to be more supportive infrastructure for walking (convenient, variety, pleasant), greater availability of local amenities (places to walk to, pavements, open spaces) and higher general quality of the physical environment were twice as likely to walk for transport. They also found no relationship for traffic safety. The lack of association found between walking for transport and road safety may be due to the limited number of studies reporting gender specific results. One longitudinal study of transport behaviour in 357 Australian females reported that road safety was both a predictor of uptake and maintenance of walking (Cleland, Timperio, & Crawford, 2008).

Cycling for transport

Heinen, van Wee, and Maat (2010) presented an overview of the cycling for transport literature and reported a wide list of influential factors that include; distance (and travel time), residential density, land use mix, bicycle infrastructure, bike parking and storage facilities and safety infrastructure such as traffic lights. Two systematic reviews of higher quality studies have cited walkability and cycling infrastructure as also being positively correlated to cycling for transport (Panter et al., 2010b; Van Holle et al., 2012). Van Holle et al. (2012) further stratified variables according to the consistency of reporting of associations. The most convincing evidence was reported for walkability, access to destinations and degree of urbanisation. Possible evidence was reported for cycling infrastructure and flat terrain. There was no evidence to suggest the existence of relationships between cycling for transport and access to public transport or recreational facilities, traffic or crime-related safety and aesthetics. Weather is a factor commonly thought to influence cycling for transport. Although the studies in relation to weather are limited, typically, inclement weather influences cycling frequency more than modal share (Heinen et al., 2010).

Despite the availability of these systematic reviews, considering the geographical variation in rates of cycling for transport, it is difficult to be certain of its precise determinants in a given context. Walkability may be the one exception to this. A UK study with a large sample size (n=2937) found that street connectivity was the only environmental correlate of cycling for transport (Adams et al., 2013). Similarly, in Ireland (Dublin), the most important consideration in choosing a cycle route was the number of junctions (fewer preferred) and travel time (Caulfield, Brick, & McCarthy, 2012). The significance of connectivity appears to be consistent irrespective of the popularity of cycling for transport in a given city (Owen et al., 2010). Two Belgian studies have shown somewhat conflicting results in relation to the influence of urbanisation. Vandenbulcke et al. (2011) reported that cycling rates were higher in larger Belgian towns. Conversely, de Geus et al. (2014) established that rates of cycling were higher in large urban towns than in a city. Both studies suggest that the presence of cycling infrastructure may be more important than the level of urbanisation. The importance of street connectivity may also be related to traffic safety. Vandenbulcke et al. (2011) found that flat terrain, high-quality cycle ways and low risk of accidents predicted commuter cycling in two different regions in Belgium. However, the presence of heavy traffic strongly discouraged cycling in one region only. The authors speculate that the quality of infrastructure and higher volume of cyclists may attenuate the safety concerns associated with traffic volume.

Despite the association between traffic safety and cycling shown by Vandenbulcke et al. (2011) the review level evidence (cited above) is not convincing, albeit acknowledging that traffic safety influences cycling more than walking. The influence of safety may be associated with the culture of cycling in a region. In Ireland, cyclists in Dublin perceive driving to be safer than cycling (Lawson, Pakrashi, Ghosh, & Szeto, 2013). This is mainly attributed to the carelessness of car drivers. However the physical infrastructure for cycling is valued. A survey of bicycle infrastructure preferences of commuters in the greater Dublin area concluded that routes with no facilities (illustrated akin to a shared space zone) and shared bus/cycle lanes were the least favoured cycle route types (Caulfield et al., 2012). In this study, 74% of respondents stated they preferred separated off-road cycle tracks and 56% stated a preference for better connected on-road cycle lanes. These preferences were mirrored by a similar survey of tourists in Dublin with a greater emphasis placed on separated cycle tracks (Deenihan & Caulfield, 2015).

A potential confounding factor in the measurement of safety is the presumption that the variables 'traffic volume' and 'traffic speeds' can be used interchangeably. A UK study found that while traffic volumes were a considerable deterrent for leisure cyclists, it had no effect on commuter cyclists for any distance (Foster, Panter, & Wareham, 2011). This is supported by Irish research (Caulfield et al., 2012). It is likely that increased traffic volume may actually increase perceived safety for cyclists by dramatically reducing traffic speed. In support of this, Titze et al. (2010) found that the presence of traffic slowing devices was positively associated with cycling for transport but not recreation. Gender is another potential confounding factor. The importance of reporting gender-specific results was highlighted in the previous section on walking. It is plausible that the correlates of cycling for transport may exhibit clear gender differences. Women have been shown to be more risk averse than men and to prefer cycling facilities that are physically separated from cars (Garrard, Rose, & Lo, 2008). Based on this, it has been suggested that the proportion of females cycling in a given country can almost be used as a proxy measure for the safety of cycling (Pucher, Buehler, et al., 2010).

The Commuting and Health in Cambridge Studies

The 'Commuting and Health in Cambridge' project is discussed separately because its findings are salient to this study considering its (Cambridge, England) geographical proximity to Ireland and comparability in terms of climate, urban transport infrastructure and modal share. While rates of cycling in the University city of Cambridge are high by English standards, they are still below European averages (Goodman, Guell, Panter, Jones, & Ogilvie, 2012). The project was a panel study of more than 1100 adults that examined the influences on modal choice for commuting to work using mixed methods. More than 25 peer-reviewed scientific papers have been published and the project outcomes have greatly advanced our understanding of the physical environmental factors that influence active commuting. Consistent with the studies cited in the previous section, distance was the strongest physical environmental predictor of active commuting to work in the baseline data (Carse et al., 2013; Dalton, Jones, Panter, & Ogilvie, 2013; Goodman et al., 2012; Panter, Griffin, Jones, Mackett, & Ogilvie, 2011). While short distance to work was a correlate of both walking and cycling, there was a stronger association for walking. Those living less than 3km from work were three times more likely to walk (Panter et al., 2011). For every extra kilometre a worker's house was located from their work, they were 3.9 and 1.3 times less likely to walk and cycle to work, respectively (Dalton et al., 2013).

Unusually, distance from work was not a significant predictor of either uptake or maintenance of active travel in the follow-up data (Panter, Griffin, Dalton, & Ogilvie, 2013). Convenient public transport, pleasant walking routes and having no free parking at work predicted the uptake of walking to work. Only convenient public transport and convenient cycle routes predicted the uptake of cycling. Having a pleasant walking route predicted the maintenance of walking to work, while there were no variables identified to predict maintenance of cycling. The authors of the study acknowledge that the study has low power considering that only 6% actually switched from car to other alternatives. Nonetheless, the findings largely mirror those cited in the cross-sectional baseline data (Dalton et al., 2013) with the exception of street connectivity (significant in baseline data). However, it is possible that variables such as the perceived convenience or pleasantness of a route could be somewhat related to street connectivity.

Workers' longitudinal perceptions of the route to work have also been shown to be important predictors of travel behaviours which differ by travel mode (Panter, Griffin, & Ogilvie, 2014). Those who reported that it became less pleasant to walk to work increased their number of car trips and spent less minutes walking every week. Those who reported an increase in the danger of cycling or crossing the road were also more likely to increase their number of car trips. Similarly, when the safety of cycling was perceived to have increased or when the convenience of public transport increased, commuters were more likely to take up alternatives to the car. As highlighted by Panter et al. (2014) the positive associations observed for car use were not simply mirrored by inverse associations for walking and cycling. A possible explanation for this is that multi-modal commute trips are very common suggesting that active and passive commuting are not mutually exclusive on any given day. In Cambridge, 31% of car commuters regularly included active travel modes into their typical journeys. Consistent with the studies discussed above, the predictors of multi-modal active commuting were having no or only paid car parking at work and a supportive environment for walking or cycling en-route (Panter, Desousa, & Ogilvie, 2013). Importantly, the concept of multi-modal commuting warrants further examination as a potential solution for those living outside typical active commuting distances.

Social environment level

Social support from family and friends has been shown to be positively associated with active travel and cycling for transport, particularly in European studies (Panter & Jones, 2010). In Australia, Cleland and colleagues' (2008) longitudinal study found that while the social environment was not predictive of increasing walking for transport, it was associated with its maintenance. Other studies suggest that the social context of people's lives is an important determinant of modal choice. Qualitative data from the Commuting in Cambridge Studies has indicated that commuting by car is necessary to negotiate certain life challenges such as childcare (Goodman et al., 2012). Correspondingly, studies from countries with both high and low levels of active travel have shown that having young children is negatively associated with active travel (Bopp, Ananian, & Campbell, 2014; Panter et al., 2013; Vandenbulcke et al., 2011). This has also been reported in an Irish context but for cycling only (Commins & Nolan, 2011). It is likely that the gendered nature of social norms is an important influence on travel mode choice, particularly for women. The routine trips that women make tend to be more complex because of family commitments (Gatersleben & Appleton, 2007). US women make approximately 1.5 times more trips to transport children to various places and to buy groceries than men, irrespective of employment status and income (Smart, Ralph, Taylor, Turley, & Brown, 2014). It is plausible that women are also more likely to combine multiple destinations into the same journey. This is significant because modal choice is thought to be determined by all the trips in a given chain unless the first trip is to work (Nurul Habib, Day, & Miller, 2009). According to De Witte, Hollevoet, Dobruszkes, Hubert, and Macharis (2013) trip chaining (and habits) is one of the least frequently studied determinants of modal choice yet is deemed to be significant more frequently than almost all others (figure 2.3).

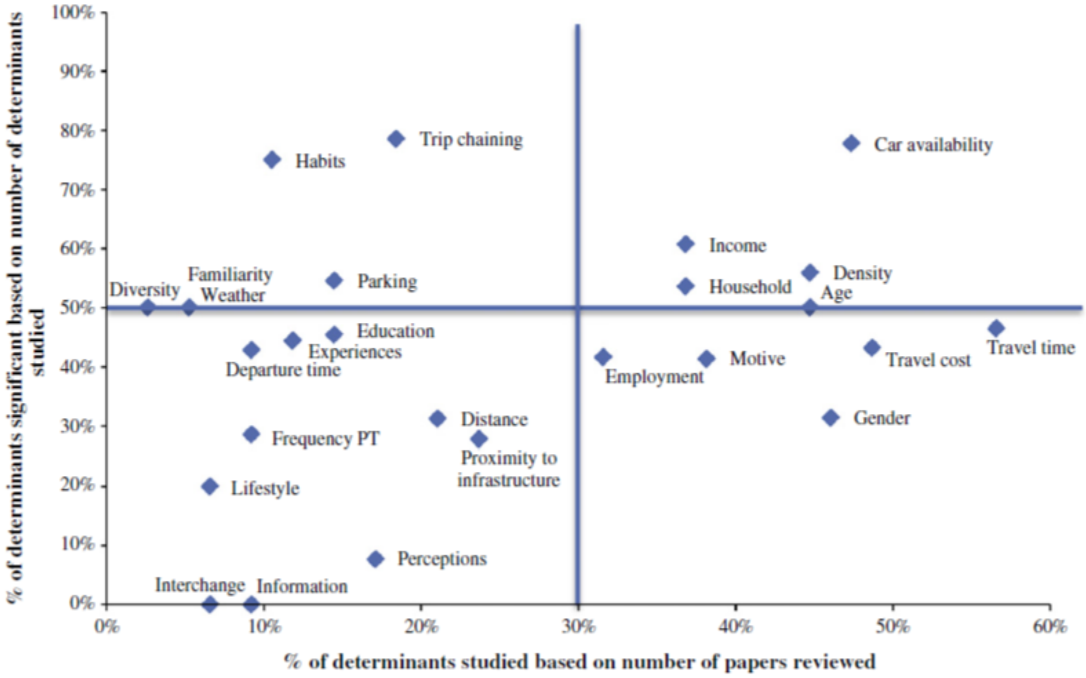

Figure 2.3 *Classification of modal choice determinants based on how frequently they were studied and how frequently they were significant (from De Witte et al., 2013)*

Individual level

The evidence for a relationship between socio-demographic factors and active travel is unclear. Socio-demographic factors appear to influence cycling more so than walking. There is reasonably consistent evidence that women cycle for transport less than men, particularly in countries where overall levels of utilitarian cycling are low (Garrard et al., 2008; Geus et al., 2014; Goodman et al., 2012; Heinen et al., 2010; Hutchinson, White, & Graham, 2014; Panter et al., 2011; Vandenbulcke et al., 2011). Gender differences are less apparent in countries with high levels of utilitarian cycling such as the Netherlands, Denmark and Germany (Pucher & Buehler, 2008). The evidence for indicators of socio-economic status (SES) is even more equivocal.

The majority of studies have shown that having a third level education is positively associated with cycling to work (Hutchinson et al., 2014; Panter, Grif, et al., 2013; Panter et al., 2011). However inverse associations between cycling for transport and level of education have been reported for commuting to work in Belgium (Vandenbulcke et al., 2011) and for leisure trips in the UK (Carse et al., 2013). Conversely, the longitudinal data from the Commuting and Health in Cambridge studies showed that lower SES predicted continued use of active travel (Panter, Grif, et al., 2013). Interestingly, Goodman et al. (2012) stated that higher SES may facilitate car travel by means of living in the outer suburbs of a city and having more flexible work conditions. The availability of a car (Carse et al., 2013; De Witte et al., 2013; Heinen et al., 2010; Panter et al., 2011) and the costs of workplace car parking (Carse et al., 2013; Dalton et al., 2013; De Witte et al., 2013; Jones & Ogilvie, 2012; Panter, Grif, et al., 2013) are also consistently reported as predictors of active travel. This is supported by international evidence that shows physical activity is positively associated with petrol prices (Hou et al., 2011; Rashad, 2009). In an Irish context, Commins and Nolan (2011) examined the determinants of mode of transport to work in the Greater Dublin Area using the 2006 census data. They reported that females were more likely to walk while males were more likely to cycle. Those of lower SES were more likely to walk and those with third level education were more likely to cycle. Car availability was a strong predictor of not walking or cycling.

According to Panter and Jones' (2010) review study, the Theory of Planned Behaviour (TPB; Ajzen, 1991) is the most common theoretical framework used to explain travel behaviours. They argue that not all of the TPB components help us to understand travel behaviours. Self-efficacy for physical activity is frequently positively associated with both walking and cycling for transport but attitudes to cycling appear to be less important. However it may be that having less favourable attitudes to cars is a more important determinant of active travel (Panter, Grif, et al., 2013). Panter and Jones (2010) also stated that habit is not addressed within the TPB but is an important and understudied determinant. This sentiment is echoed by De Witte et al., (2013) who suggested that habit (and trip chaining) was one of the determinants which was rarely studied but frequently found to be significant (figure 2.3). Habit is described as a "behaviour that has been routinely performed and is, as a result of repetition, automatically rather than intentionally, set in motion" (de Bruijn et al., 2009, p. 189). Guell, Panter, Jones, and Ogilvie (2012) explain habit in the context of active commuting.

> *It assumes that instead of consciously planning journeys, the commuter has developed a routine, for example habitually choosing to use the car parked outside the house every day without reflection. Some studies have shown that these automated and thus unconscious habits override any decision-making or choice and influence travel behaviour over and above attitudes or intentions.* (p. 234)

For example, de Bruijn et al. (2009) found that after controlling for other TPB variables, habit strength was the strongest predictor of cycling for transport in a sample of Dutch adults. It is difficult to affect long-term behaviour change in strong habit individuals (Verplanken, Aarts, VanKnippenberg, & Knippenberg, 1997) but infrequent major life events that disrupt habitual travel behaviours may be important opportunities for change (Guell et al., 2012).

2.5. The effectiveness of active travel interventions

2.5.1. Active travel to school

It is clear that school based strategies and policies for promoting physical activity can be effective (Biddle, Braithwaite, & Pearson, 2014; Camacho-Miñano et al., 2011; Chillón, Evenson, et al., 2011; Heath et al., 2012; Murillo Pardo et al., 2013; van Sluijs, McMinn, & Griffin, 2007). Several systematic reviews have highlighted the need to design school-based interventions specifically targeting girls in both primary and secondary schools (Biddle et al., 2014; Camacho-Miñano et al., 2011; Murillo Pardo et al., 2013). All of these studies emphasise the importance of implementing multi-component interventions that empower parents, teachers and students. Only one systematic review of active travel to school interventions has been published (Chillón, Evenson, et al., 2011). The authors support the belief that multi-component interventions and empowerment are important characteristics of successful interventions. However they also state that active travel interventions are more successful when they focus on active travel alone and are not integrated into a broader physical activity promotion programme. Furthermore, the authors noted that intervention effects are generally small, the quality of studies is weak (mostly quasi-experimental) and there are almost no studies in adolescents.

Single-component interventions targeting active travel to school

As expected, studies that focus predominantly on a single intervention component show little evidence of effectiveness. Regular walk to school days in New South Wales, Australia showed only a moderate effect with questionable long-term behaviour change (Merom et al., 2006). A cycling training programme in Belgian primary schools improved cycling skills five months post-intervention but had no effect on levels of cycling to school (Ducheyne, De Bourdeaudhuij, Lenoir, & Cardon, 2014). Similarly, the evidence for curricular based interventions is weak. A two year cluster randomised trial of 2258 primary school-children in Australia reported a 10% relative increase in walking to school, but only based on the surveys completed by parents. There was no intervention effect in the student reported data. The intervention was multi-strategic in design but classroom activities were the most common intervention component (Wen et al., 2008).

The 'Travelling Green' project was a curricular based active travel intervention developed for Scottish Primary Schools. Two quasi-experimental trials that have evaluated the effectiveness of the project have produced contradictory findings (McKee, Mutrie, Crawford, & Green, 2007; McMinn et al., 2012). The first evaluation of a 10-week intervention reported an increase in time spent walking to school and a decrease in time spent in passive travel to school (McKee et al., 2007). The second evaluation of a shorter six week intervention reported no intervention effect (McMinn et al., 2012). Intervention fidelity was not documented in either trial and the authors speculated that, coupled with the shorter project duration, this may have influenced the outcome. The follow-up surveys were conducted immediately after the intervention ceased so it is unsurprising that at least one of the studies reported a significant effect. Even the development of comprehensive school travel plans (sometimes with the assistance of specialist active travel advisors) does not assure their implementation, leading many studies to conclude they are ineffective (Carver et al., 2014; Macmillan, Hosking, Connor, Bullen, & Ameratunga, 2013; Mammen et al., 2014; Rowland, DiGuiseppi, Gross, Afolabi, & Roberts, 2003).

Several studies (mostly from the US) have shown that walking school buses can increase walking to school in the short-term even in low-income areas (Heelan, Abbey, Donnelly, Mayo, & Welk, 2009; Kong et al., 2009; Mendoza et al., 2011). Two studies have suggested that although the intervention effect is small, it may be sustainable (Collins &

Kearns, 2010; Mendoza, Levinger, & Johnston, 2009). In the US, Mendoza et al. (2009) stated that a 12-month walking school bus intervention increased the proportion of children walking to school in a low-income area from 20% to 25% compared with those walking to the control school which decreased from 15% to 7%. No changes were noted for car or bus use. A longitudinal analysis (over five years) of walking school buses in the Auckland region of New Zealand found that student participation was steadily increasing over the years but that adult volunteers were reducing in numbers (Collins & Kearns, 2010). Although very few routes ceased to operate as a result, the authors noted that the majority of routes tended to be located in the wealthiest areas. 'Single-component interventions' may not be the most accurate description of walking school bus projects. In many cases several additional components were included such as classroom education, promotional activities, incentives and route safety improvements. They also tended to be very well resourced and guided by external co-ordination expertise from the local authority or the research team. The inclusion of parents as integral project stakeholders distinguishes walking school buses from the projects previously discussed.

Multi-component interventions targeting active travel to school

More comprehensive school-based active travel projects are promising. The US Safe Routes to School (SRTS) programme was allocated $1.1 billion from 2005-2012 to increase the proportion of students walking and cycling to school. Early uncontrolled studies suggested the SRTS programme was effective (Boarnet, Anderson, Day, McMillan, & Alfonzo, 2005; Boarnet, 2005). Since then a more robust quasi-experimental study of 14 schools confirmed the programme's effectiveness (McDonald, Yang, Abbott, & Bullock, 2013). Programmes focusing mostly on education and promotion increased cycling by approximately 5%. The addition of infrastructural elements (particularly pedestrian crossings, sidewalk gap closures, traffic lights and covered bike parking) augmented this effect to increase both walking and cycling by 5-20 percentage points. A similar programme in New Zealand involving educational activities, traffic enforcement and infrastructural change found a more modest increase in active commuting from 40.5% - 42.2% (Hinckson, Garrett, & Duncan, 2011). Baseline levels of active travel were high in this study which may have attenuated the intervention effect. In the UK, the proportion of primary school-children who usually reported cycling to school in six cycling demonstration towns[2] increased from 0.3% to 2.2% over a 12-month period (Sloman et al., 2010). Overall the proportion of any cycling trips to school increased from 4.2% to 11.5%. The intervention components in these six towns mostly consisted of Bikeability training (cycle skills training), cycle parking and a Bike IT Officer (cycling policy advisor). Importantly, approximately half of the increase in cycling came from a reduction in walking potentially explaining the results of Mendoza et al. (2009) described above.

The effectiveness of these multi-component programmes in primary school-children may not necessarily transfer to adolescents. A two year quasi-experimental study of 1014 Danish adolescents (aged 11.0-14.4 years) in 14 schools found no intervention effect for males or females (Christiansen, Toftager, Ersbøll, & Troelsen, 2014). This was a multi-component intervention which included; policy development, parental education, traffic education, cycle skills training, school traffic patrols and physical infrastructural measures. The lack of effect was attributed to several factors. Firstly, baseline levels of active travel were already high (86%). Second, only two of the seven intervention schools had the resources to introduce infrastructural measures. Third, active travel was being targeted alongside recess physical activity and after-school physical activity and finally, there was little evidence of parents becoming actively involved in the project. Overall, while there is some clarity about how to increase active travel to school in children, it is unclear whether this translates to adolescents. There is a paucity of research on active travel interventions to non-school destinations in both cohorts.

2.5.2. Community-wide interventions targeting adults

Systematic reviews of interventions to increase population levels of active travel have been unable to definitively identify specific strategy components to increase walking (Heath et al., 2012; Ogilvie et al., 2007) and cycling for transport (Heath et al., 2012; NICE et al., 2012; Yang et al., 2010). These studies are in agreement that the quality of the available studies in the area is poor, intervention effects are small (particularly for studies of individual components) and little is known about longer-term effectiveness. They have tentatively suggested that individualised marketing (for walking and cycling)

[2] The 6 cycling demonstration towns in the UK received an annual investment of approximately £1 million (£10 per head) between 2005 and 2009 to create a modal shift from passive transport to cycling (see section 2.5.2).

and mass media (for walking) are promising strategies that should be examined further using more robust study designs. Reviews that included uncontrolled and non-peer reviewed studies found it equally difficult to isolate the impact of specific active travel measures (de Nazelle et al., 2011; Dill, Handy, & Pucher, 2013; Forsyth & Krizek, 2010; Pucher, Dill, et al., 2010). Forsyth and Krizek (2010) recommend caution when interpreting the results of studies in this area due to the fact that recreational and transportation activity overlap in many cases. They also propose that infrastructural measures are more important for increasing cycling whereas neighbourhood design is more important for increasing walking. Although there is a paucity of evidence on specific measures, the reviews of cycling specific studies all agree on one point; cities and towns that have comprehensive and co-ordinated packages of cycling-related infrastructure, programmes and policies have seen the most pronounced increases in levels of cycling. The effectiveness of single and multiple measures are discussed in the following sections.

Single-component interventions targeting adults

Infrastructure

Infrastructural measures for active travel have been, for the most part, examined in relation to cycling while the walking literature has focused more on indices of walkability (Forsyth & Krizek, 2010). Cycle lanes/paths are the most commonly studied infrastructural measures and are consistently associated with high levels of cycling (Pucher, Dill, et al., 2010). One US study reported an increase in cycling after the construction of approximately 50km of both on-road and separated cycle lanes between 1990 and 2000 (Krizek, Barnes, & Thompson, 2009). However, despite the presumption that infrastructural measures are a prerequisite for increasing cycling for recreation or travel, there are few empirical studies to support this (Yang et al., 2010). It also is unclear whether the increases in cycling reported in some studies reflect new cycling trips or whether new facilities displace trips taken by other cyclists (Yang et al., 2010). The creation of new cycling and pedestrian infrastructure represent 'natural experiments' whereby their potential to increase population physical activity levels can be tested (Craig et al., 2012).

One such 'natural experiment' was the creation of new bicycle boulevards (traffic calmed residential streets) in Portland, USA (Dill, McNeil, Broach, & Ma, 2014). There was no change in active travel or physical activity amongst adults living near the bicycle boulevards at follow-up one year later. It should be noted that the sample only included adults with children. Having children has previously been identified (section 2.4.2) as being inversely correlated with active travel. The outcome of this study may also reflect the need to promote the existence and use of newly constructed infrastructure (Douma & Cleaveland, 2008). Social marketing to promote the use of newly constructed cycling trails in Sydney, Australia only served to attract adults that were already cyclists (Merom, Bauman, Vita, & Close, 2003; Rissel, New, et al., 2010). This study did not differentiate between active travel and recreational physical activity so it unclear whether active travel actually increased even in this subgroup. The iConnect study in the UK (Ogilvie et al., 2012) is the most relevant natural experiment of active travel infrastructure in an Irish context. One objective of this study was to examine the longitudinal changes in physical activity amongst adults living nearby flagship engineering projects (one river boardwalk and two traffic free bridges) designed to increase active travel. Use of the new infrastructure was high in the two years after it opened (32% used new infrastructure one year later, 38% used new infrastructure two years later). Nonetheless, the results were less promising in the context of active travel. Users tended to be mostly previous walkers and cyclists and from higher socio-demographic groups. Furthermore, the routes were least commonly used for cycling for transport and most commonly used for recreational walking. The one positive outcome in relation to active travel was noted in the two year data only. Those living within 1500m of the infrastructure engaged in an extra 12.5 minutes of total weekly physical activity compared with those living further away with greater effects seen in those without access to a car (Goodman et al., 2014; Goodman, Sahlqvist, & Ogilvie, 2013).

Taken together, these natural experiments do not strengthen the case for implementing new infrastructural measures in isolation although research on their effectiveness is still ongoing (Chapman et al., 2014; Tully et al., 2013). Indeed, Yang et al. (2010) suggest that infrastructural measures are more important in regions with low levels of cycling to encourage new and novice cyclists to travel by bike. Aldred and Jungnickel (2014), somewhat in contradiction to these sentiments, believe that infrastructural measures (particularly separated cycle lanes) do little to normalise the image of cycling and are almost counter posed to other activities such as cycle training.

Policies and programmes

Although disentangling the relative impact of different intervention components is problematic, many active travel policies and programmes have been implemented largely in isolation. This section considers the evidence for some of these measures in household, workplace and community settings. Systematic reviews of walking (Ogilvie et al., 2007) and cycling (Yang et al., 2010) interventions have both concluded that individualised marketing of active travel opportunities to households can be effective in increasing physical activity. Individualised marketing involves targeting households that are motivated to change their travel behaviour and facilitating the process with tailored information and related incentives.

Similarly, the provision of tailored informational materials has been shown to increase the proportion of (already motivated) employees walking to work over one year (Mutrie et al., 2002). Despite the widespread development of organisational travel plans in workplaces, there is limited evidence of their effectiveness (Macmillan et al., 2013). Studies that have focused on restricting car travel to work have demonstrated considerable increases in active commuting. The restriction of car parking in the University of Bristol between 1998 and 2007 increased the proportion of employees walking to work from 19% to 30%, contrary to national trends (Brockman & Fox, 2011). There was no effect on cycling. A recent review of the use of financial incentives (both positive and negative) for active travel concluded that these measures are underused but potentially effective (Martin, Suhrcke, & Ogilvie, 2012). The 'cash-out' legislation in California which offers employees a financial subsidy in lieu of workplace car parking is an example of how successful these measures can be. In a study of eight workplaces, this policy increased the proportion of employees walking and cycling to work by 39% (Shoup, 1997). In Ireland, 3605 adults bought new bicycles after the introduction of a tax relief scheme for purchasing bicycles in 2009. Almost 50% of respondents to a survey indicated they had not owned a bicycle in the previous seven years (Caulfield & Leahy, 2011).

Individual programmes and policies targeted at the community-level vary considerably in terms of their effectiveness. Public bike sharing schemes have proven to be very popular, particularly amongst males. This is driven by the convenience and value offered by these schemes (Fishman, Washington, & Haworth, 2013). The most successful schemes are typically in areas that are compact with high population density, low vehicular traffic speeds, some cycling infrastructure and mixed land-use (Bauman et al., 2011). In the London scheme for example, there were 7.4 million trips made between April 2011 and March 2012 (Woodcock, Tainio, Cheshire, O'Brien, & Goodman, 2014). There is concern however that the apparent success of bike sharing schemes is mitigated by the substitution of other sustainable transports modes with cycling (Fishman et al., 2013; Fishman, Washington, & Haworth, 2014). For example, most of the 7.4 million cycle trips made in London would have been made on foot (31%) or by public transport (47%). This equated to the displacement of only 2% of car trips. Nonetheless, Woodcock et al. (2014) reported a small but significant increase in population physical activity attributed to the bike sharing scheme. Increases in physical activity may be even more pronounced in schemes such as the Brisbane programme which has been shown to displace 21% of car trips (Fishman et al., 2014). In an Irish context, the growth of cycling in Dublin may in part be due to the parallel success of its public bike sharing scheme (see section 1.1). Although users of the schemes are predominantly male and of higher SES, there is some evidence that indicates the scheme is displacing a sizeable volume of car trips (Murphy & Usher, 2014; O'Neill & Caulfield, 2012).

There is less evidence to support the effectiveness of other community-level interventions such as mass-participation events like the Ciclovías and community cycle training programmes. The Ciclovías are free mass participation walking and cycling events where busy city streets are temporarily closed to vehicular traffic. They originated in South America and have proven incredibly successful in terms of participation numbers and engagement of key stakeholders. Evidence to support their impact on population physical activity levels has yet to be established (Engelberg, Carlson, Black, Ryan, & Sallis, 2014; Sarmiento et al., 2010; Torres, Sarmiento, Stauber, & Zarama, 2013).

Multi-component interventions targeting adults

Multi-component interventions most closely match the description of the 'Smarter Travel'[3] programme examined in this thesis. Multi-component interventions involve the implementation of several active travel measures in a co-ordinated way to create a synergistic intervention effect. This approach provides the strongest evidence for increasing active travel in adults. The 'Smarter Choices, Smarter Places' programme in Scotland (see footnote for intervention description[4]) aimed to increase both walking and cycling for transport in seven local areas (compared with three control areas) in Scotland (Norwood, Eberth, Farrar, Anable, & Ludbrook, 2014). There was a decrease in both physical activity and the percentage of adults meeting the physical activity guidelines in all 10 areas between 2009 and 2012. However, the decrease was significantly less in the intervention areas, supporting the relative efficacy of the programme.

Similarly, the 'Cycling City and Towns' programme aimed to increase levels of cycling in 18 English towns and cities using a 'whole town' approach. Six 'Cycling Demonstration Towns' were established in 2005 in the first phase of the programme with a further 12 added in 2008. Approximately £1 million was allocated to each of the first six towns annually between 2005 and 2009. A further £80 million was allocated to the 12 towns in the second phase of the programme between 2008 and 2011. More recently £114 million was allocated for promoting cycling in eight other UK cities (Department of Transport, 2015). The interventions in the original six towns varied by town but typically included media campaigns, personalised travel planning, cycle maintenance and training, cycling infrastructure and cycling facilities. The three year interim evaluation of the first phase reported significant increases in cycling between 2005 and 2008 (Cavill et al., 2009; Sloman et al., 2009). There was a 14% (3.3 percentage points) increase in adults reporting they did 'any cycling' in the previous week and a

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[3] The Irish Smarter Travel programme consisted of the establishment of a national cycle network, provided tax free loans for purchasing new bicycles, created a Smarter Travel Workplaces programme and a Smarter Travel Campus programme and created 12 'Active Travel Towns' and 3 'Smarter Travel Area's outside of the greater Dublin area.

[4] The 'Smarter Choices, Smarter Places' programme consisted of; improved public transport infrastructure and services, footpaths, cycle lanes, pedestrian crossings, bus lanes, pedestrianisation, cycle facilities, bike sharing, social marketing campaigns, a dedicated website, media campaign, educational and informational resources and other changes to the built environment.

27% increase in the number of cycle trips as measured by automatic counters. There was no evidence of change in levels of cycling in the control towns. Encouragingly, these increases were predominantly attributed to new and returning cyclists. The increase in cycling was noted for both males and females, across all social classes (Cavill et al., 2009; Sloman et al., 2009) and was accompanied by a concomitant increase in physical activity (Cavill, Muller, Mulhall, & Rutter, 2011).

The final report on the overall programme is not currently available but a recent study used census data (1.3 million adults) on travel mode to work as a proxy measure of the programme's effectiveness in all 18 towns and cities (Goodman, Panter, Sharp, & Ogilvie, 2013). There was an increase in the proportion of adults both cycling and walking to work in the intervention towns compared with matched control towns from 2001 to 2011. There was also a significant decrease in car use. In partial agreement with Sloman et al. (2009), these effects were evident across all social classes but were more pronounced in deprived areas. There was considerable variation across towns in both studies questioning the reproducibility of the results. Furthermore, the 18 local authorities were designated 'cycling towns and cities' based on their perceived likelihood of success. Goodman, Panter, et al. (2013) proposed conducting rigorous process evaluations of these programmes to better understand the conditions that facilitate the success of multi-component programmes.

The nature of multi-component programmes in the UK differs somewhat to those in countries with the highest levels of cycling for transport such as the Netherlands, Denmark and Germany. In these countries they invest heavily in promoting cycling and many of their pro-cycling policies are comparable with those in the UK. However, they also counterbalance their pro-cycling polices with polices that make driving more expensive and less convenient. According to Pucher and Buehler (2008):

> *The key to the success of cycling policies in the Netherlands, Denmark and Germany is the coordinated implementation of the multi-faceted, mutually reinforcing set of policies. Not only do these countries implement far more of the pro-bike measures, but they greatly reinforce their overall impact with highly restrictive policies that make car use less convenient as well as more expensive. It is precisely that double-barrelled combination of 'carrot' and 'stick' policies that make cycling so irresistible.* (p. 525)

Multi-component programmes in an Irish context

In Ireland, the absolute modal share for cycling in Dublin increased by 1% from 2006 to 2011 (walking decreased by 1%) with no parallel increases in other Irish cities (Caulfield, 2014). Furthermore, the relative proportion of females cycling to work increased by 5% in the same time period. In some areas of the city centre there was a 10% increase in cycling, albeit from a very low base. Secular trends in cycling and the Irish economy may have played a role in this modal shift. Participation in recreational cycling increased from 2.5% in 2007 to 5.9% in 2013 (Irish Sports Council, 2014). The modal shift to cycling also coincided with an economic recession in Ireland (2008-2013) where unemployment increased (Kelly, McGuinness, O'Connell, Haugh, & González Pandiella, 2015) and the number of registered private cars decreased 47% between 2007 and 2013 (SEAI, 2014).

In Dublin, several integrated measures were introduced to create a modal shift to cycling during the same time period and these measures may better explain the increase in cycling in the city. These measures include the bike sharing scheme discussed in the previous section, 30kph speed limits, reconfiguration of public space away from private car use, removal of 280 city centre car parking spaces, new on-road cycle lanes, separated cycle tracks and promotional events (Caulfield, 2014). These measures were complimented by the existence of a cyclist lobby group that worked closely with the local authority and the national cycle to work scheme (tax incentives for purchasing bikes). The success of the bike sharing scheme may have acted as a catalyst for the implementation of additional hard and soft measures[5]. It has helped to reshape statutory plans for traffic management in the city and equally strengthened public advocacy for cycling in the city (Ó Tuama, 2015);

[5] Community and infrastructural design are often referred to as hard measures while pricing, programming and education are referred to as soft measures (Krizek, Forsyth, et al., 2009).

> *From the perspective of the user, the public bikes are generating new experiences of the city, especially for those without their own (recent) personal city centre cycling histories. One striking aspect of those new experiences is a collective realisation that the city centre traffic management system (which includes one way streets and particular traffic signalling configurations) is not particularly cyclist-friendly. Given the very large take-up of the Dublin scheme, the findings from this study give rise to the suggestion that new proposals for traffic management schemes which previously would have been publicly unpalatable, might now be acceptable to a much larger public (and voting public in particular). (*p. 11)

2.6. Summary

Active travel is an overlooked source of physical activity but outside of Dublin, levels have declined steadily in Irish society in recent decades. There is a plethora of mostly cross-sectional evidence to suggest that increasing active travel will not displace other physical activity, thereby conveying considerable population health benefits in addition to wider economic benefits.

Our understanding of the factors that influence active travel is largely derived from studies on active travel to work and school. The principal factors that influence active travel in school-children are; distance, car convenience and road safety. Car convenience typically relates to the cost and time associated with a specific car journey and the existence of multi-activity trip chains. Road safety is potentially more important for older children and parental modelling (past or present) of active travel is more important than parental encouragement. The potential for social interaction is especially important for adolescent females. The most promising school-based active travel interventions have been well resourced, multi-component strategies focusing on empowering key stakeholders. Little is known about the correlates and determinants of walking and cycling separately, and intervention studies are limited and predominantly focus on primary school-children. For adults, the factors that influence active travel include; distance, walkability, land-use mix, population density, convenience of public transport, car availability and the cost of workplace parking. In urban areas, pedestrian infrastructure (e.g. footpaths) is less important for walking but cycle lanes and related cycling facilities are consistently associated with higher levels of utilitarian cycling and appear particularly important for females. Although understudied, trip chaining and habit strength are two of the most frequently reported correlates of active travel. There are several examples of effective community-wide interventions to increase cycling particularly but it is difficult to isolate the separate impact effects of specific active travel measures.

In conclusion, our understanding of the determinants of active travel is greatly limited by the lack of robust evaluations of comprehensive active travel interventions. Additionally, there is a paucity of process evaluations to identify the unique conditions that contributed to their success. The following chapters will address these gaps in the literature by describing the impact of community-wide interventions on school-children and adults, and the mechanisms and processes that shaped the intervention design.

CHAPTER 3. THE IMPACT OF THE INTERVENTION ON PRIMARY SCHOOL-CHILDREN

3.1. Introduction

This chapter describes the relative impact of the community-wide active travel intervention (appendix 2) on primary school-children in both intervention towns compared with the control town. Primarily, it examines the impact of the intervention on the percentage of children that walk or cycle to school. Intervention town 2 received considerably greater resources (€153 per capita) to implement active travel measures than intervention town 1.

3.2. Methodology

3.2.1. Research design

This was a repeat cross-sectional study of a natural experiment conducted in two intervention towns and one control town. The impact of the community-wide interventions in both intervention towns (appendix 2) was measured using self-report surveys in May 2011 (baseline) and May 2013 (follow-up). Ethical approval was granted by Waterford Institute of Technology's Research Ethics Committee (appendix 1B).

3.2.2. Research questions

Primary research questions

1. What impact did the intervention have on the percentage of students that walk or cycle to school?
2. What impact did the intervention have on the percentage of students that would prefer to walk or cycle to school?
3. Was there a difference in active travel campaign awareness between the intervention and control towns at follow-up?

Secondary research question

1. Was there a difference in the change in the proportion of students participating in vigorous exercise four or more times per week between the intervention and control towns?

3.2.3. Study population and sampling

Baseline data were collected from 5th and 6th class students in all 21 primary schools in the three towns (nine schools in intervention town 1, five in intervention town 2 and seven in the control town). Letters were sent to all school principals in February 2011 requesting permission to conduct the surveys in May of the same year. Permission was duly granted and an information letter (appendix 3A) was sent home to the parents of all 5th and 6th class students (aged 10-13 years) in the first week of May 2011. This letter sought the passive consent of parents for their child to complete the survey the following week. This sampling procedure was replicated in May 2013 for the cross-sectional post-intervention survey. The parents of only one student in intervention town 1 chose not to consent to their child participating in the baseline survey.

3.2.4. Description of the community-wide intervention

As outlined in section 1.7, the project in intervention town 2 was better resourced (despite being a much smaller town), facilitating the establishment of a dedicated project team. Consequently, the most intensive intervention was implemented in intervention town 2 and consisted predominantly of infrastructural measures (figure 3.1). A detailed inventory of the community-wide intervention is contained in appendix 2. An abridged version of the intervention components relevant to primary school-children follows.

During the intervention period the local authority in intervention town 1 completed a 12km orbital pedestrian/cycleway around the town, improved existing cycleways on the town's radial routes, improved the public realm and pedestrian infrastructure in the town centre, created a 1.6km river boardwalk and organised a comprehensive 'Smarter Travel' themed campaign on two occasions. Primary school-children were specifically targeted as part of this campaign and were awarded branded t-shirts for cycling or walking to school during bike week in June 2011 and June 2012. Approximately 230 children also received cycle skills training. In intervention town 2 an old railway track was converted into a separated walking and cycling path linking the town centre with many of the town's residential areas and schools and continuing to a nearby coastal resort. This was officially opened in 2011 after the baseline survey. The 'GO Dungarvan' brand was established in 2012 and a project team of four people were appointed (project-coordinator, community development officer, communications officer and programme technician). This project team introduced a comprehensive package of predominantly hard measures[6] between 2011 and 2013. New on-road cycle lanes, traffic calming and pedestrian crossings were introduced adjacent to the newly converted railway track, all of which combined to create safe routes to two of the town's five primary schools. They also attempted to introduce a range of soft measures specifically targeting primary schools. The soft measures included an extensive programme of cycle skills training in all schools, promotional events during bike week each June (e.g. cycle to school buses) and active travel to school challenges. There was some limited evidence of cycle skills training and promotion of active travel to school in the control town but not to the same extent as in either intervention town.

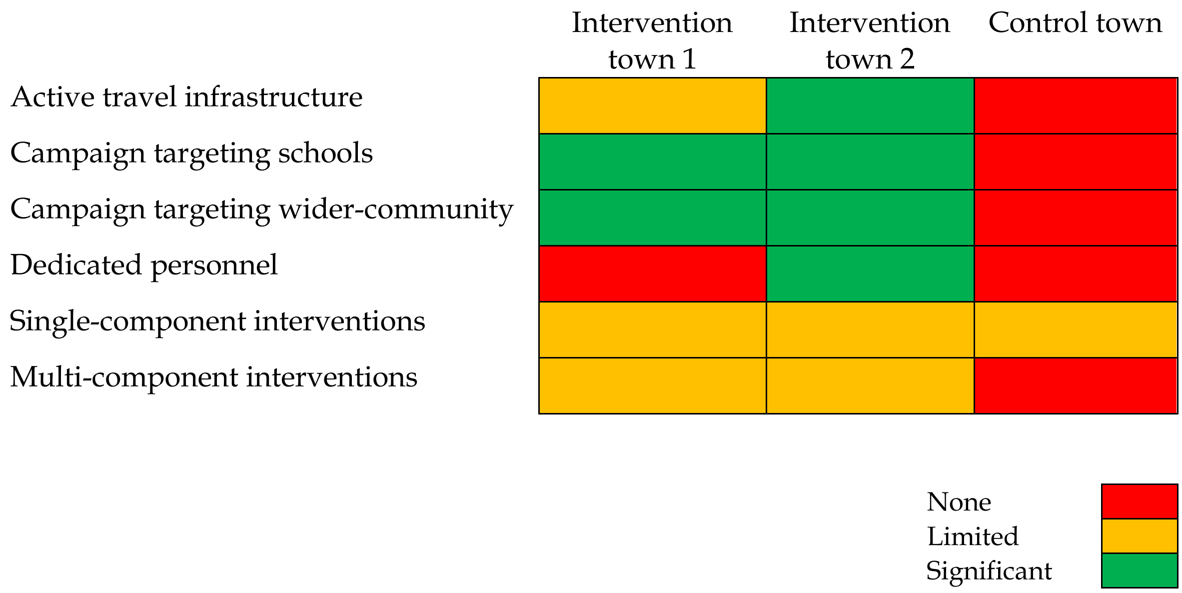

Figure 3.1 *The extent of the intervention components targeting primary school-children in each town*

3.2.5. Data collection tools

The instrument was a two section self-report questionnaire which included several items from existing Irish studies for comparative purposes. The first section measured travel mode to school and physical activity. The travel mode to school item was taken from the CSPPA study (Woods et al., 2010). It asked students "How do you usually travel to school?" with response categories of walk, cycle, car and bus. This is the question most

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[6] Community and infrastructural design are often referred to as hard measures while pricing, programming and education are referred to as soft measures (Krizek, Forsyth, et al., 2009).

commonly used to assess active travel to school (Herrador-colmenero et al., 2014). Students were asked to think of the longest part of their journey. Illustrations of each travel mode were provided adjacent to the text. Actual mode of travel both to and from school was assessed separately as was preferred mode of travel. Vigorous physical activity was measured using the two item measure from the HBSC survey (Prochaska, Sallis, & Long, 2001; Woods et al., 2010). This asked students the frequency and duration of their vigorous physical activity undertaken outside of school hours. This was included as a checking variable for social desirability bias. The second section (included at follow-up only) measured the students' awareness of the active travel campaign in their school or town. These were developed specifically for the survey. The survey was piloted with two 5th classes and two 6th classes (approximately 100 students) in a town that was not included in this research. The survey took between 9 and 12 minutes to complete and there were no changes made after the pilot study.

3.2.6. Data collection method

Ten employees from local health promotion services, sports partnerships and local authorities assisted with the data collection in their respective towns. They each contacted the principals of their allocated schools and arranged to administer the survey within a two week period (May 10th – 20th 2011 & May 14th – 24th 2013). The questionnaires were completed during class time and the process was facilitated by the research assistant using standardised instructions. Each question was explained by the research assistant before being answered simultaneously by the class i.e. all students completed the questionnaire at the same time.

3.2.7. Data analysis

The data analysis was conducted using IBM SPSS Statistical Package 21. Descriptive statistics were calculated via means, standard deviations and percentages where appropriate. Chi square and one-way Anova tests were used to examine baseline differences between categorical and continuous variables, respectively. Standardised residuals greater than +/- 1.96 were used to identify where the differences existed in 3 x 3 contingency tables. The absolute change in proportions (difference in differences) was calculated using 95% confidence intervals consistent with previous research (Goodman, Panter, et al., 2013).

3.3. Results

What were the characteristics of the sample at baseline?

The characteristics of the sample at baseline are shown in table 3.1. The average response rate was 90.5% and did not vary significantly between towns or years (range 87.2% - 94.5%). A 100% response rate was not achieved because of student absences due to school events and illness. Students living in intervention town 2 estimate their trip time to school to be significantly shorter than those living in intervention town 1 or the control town. Specifically, at baseline, students in intervention town 1 were more likely to walk or cycle to school when compared to those in the other towns (intervention town 1, 33.9%; intervention town 2, 28.8%; control 21.3%; $p<0.05$; tables 3.2-3.4). Active travel to school was significantly lower in the control town than in both intervention towns. Car was the most common mode of transport used to travel to school (60.8%). Car use was least prevalent in intervention town 1 and most prevalent in the control town (intervention town 1, 54.5%; intervention town 2, 62.0%; control 71.4%; $p<0.001$; see appendix 3B). Only 3.7% of the total sample cycled to school. In the total sample, boys were more likely than girls to cycle ($p<0.05$). Nevertheless, when examining each town separately, there was only a gender difference in cycling to school in intervention town 1 (1.8% vs 7.5%, $p<0.001$). Overall, greater proportions of students walk or cycle <u>from</u> school than to school (39.3% vs 29.3%). The only difference between towns for travel from school is that students in the control town were least likely to cycle (1.2%, $p<0.001$). Lastly, bicycle ownership was high (>85%) in each town.

Table 3.1 Sample characteristics at baseline

	Intervention town 1 (n = 743)	Intervention town 2 (n = 295)	Control town (n = 419)	P value†
Age (years ± SD)	11.5 (0.7)	11.6 (0.6)	11.6 (0.7)	**0.011***
Sex				
Male (%)	54.5	53.2	43.9	**0.002****
Female (%)	45.5	46.8	56.1	
Class				
5^{th}	51.1	47.8	52.7	0.424
6^{th}	48.9	52.2	47.3	
Journey time to school (mins ± SD)	12.8 (8.7)	8.2 (5.7)	11.9 (7.8)	**0.000*****
Walk	10.4 (7.2)	7.6 (5.5)	9.9 (8.7)	**0.02***
Cycle	10.8 (5.8)	8.3 (5.5)	11.9 (2.4)	
Car	12.1 (7.4)	7.3 (5.2)	11.8 (6.2)	**0.000*****
Bus	22.5 (12.1)	15.1 (5.6)	19.1 (13.7)	**0.01***
Own a bicycle (%)	89.2	89.8	86.6	0.315

*p<0.05 **p<0.01 ***p<0.001; † the difference between towns

What impact did the intervention have on the percentage of students that walk or cycle to school?

Overall, the intervention had no effect on active travel to or from school but there was some evidence of an effect for males in intervention town 2. In the control town there was a decrease in the percentage of all students and particularly female students walking or cycling home from school (table 3.2). For females the percentage decreased from 37.7% to 28.9% (CI -17.3, -0.1). In the intervention towns (both pooled and individually) there was no change in active travel to or from school (tables 3.2-3.4). This is despite an 8.3% and 9.7% increase in males from intervention town 2 walking or cycling to and from school respectively. The absolute change (increase of 14 percentage points) in active travel home from school for males in intervention town 2 was close to being significant (-0.05, 28.6).

There was considerable inter-school variation in terms of the proportion of students walking or cycling (walking = 0% - 66.3%; cycling = 0% - 11.9%). There was also some evidence of increases in cycling being attributed to fewer trips by foot. For example, in intervention town 2, the two schools that received the most intensive intervention and were best placed to benefit from the newly converted railway line (see photos in appendix 2) both reported a 3.9 percentage point increase in students cycling home from school. However, the overall proportion of active travel home from school decreased in both schools. There was no effect for girls in either of these schools.

Table 3.2 *The effect of the intervention on the proportion of students that walked or cycled to and from school in intervention towns 1 + 2 (pooled) vs control*

	Intervention towns (pooled)				Control town				Absolute change
	Pre % (n)	Post % (n)	% Diff	95 % CI	Pre % (n)	Post % (n)	% Diff	95 % CI	Difference in differences % (95 % CI)
TO school									
Male	32.7 (183)	33.7 (163)	1.0	-4.7, 6.8	22.1 (40)	24.8 (57)	2.7	-5.7, 10.8	-1.66 (-11.7, 8.4)
Female	32.1 (153)	29.9 (146)	-2.2	-7.9, 3.7	20.7 (48)	16.9 (38)	-3.8	-10.9, 3.4	1.59 (-7.7, 10.8)
Total	32.5 (336)	31.8 (309)	-0.7	-4.8, 3.4	21.3 (88)	20.9 (95)	-0.4	-5.9, 5.0	-0.32 (-7.1, 6.5)
FROM school									
Male	40.1 (225)	41.6 (202)	1.5	-4.4, 7.5	37.6 (67)	33.2 (76)	-4.4	-13.6, 5.0	5.85 (-5.3, 17.0)
Female	39.8 (189)	36.6 (179)	-3.2	-9.4, 2.9	37.7 (87)	28.9 (65)	**-8.8**	**-17.3, -0.1**	5.54 (-5.1, 16.1)
Total	40.0 (414)	39.1 (381)	-0.9	-5.2, 3.4	37.7 (154)	31.1 (141)	**-6.6**	**-12.9, -0.3**	5.74 (-1.9, 13.4)

(n) denotes the number of participants that equates to the given percentage; All % differences in this table are absolute differences

Table 3.3 The effect of the intervention on the proportion of students that walked or cycled to and from school in intervention town 1 vs control

	Intervention town 1				Control town				Absolute change
	Pre % (n)	Post % (n)	% Diff	95 % CI	Pre % (n)	Post % (n)	% Diff	95 % CI	Difference in differences % (95 % CI)
TO school									
Male	34.1 (137)	32.2 (110)	-1.9	-8.6, 4.9	22.1 (40)	24.8 (57)	2.7	-5.7, 10.8	-4.58 (-15.3, 6.1)
Female	33.7 (114)	30.2 (98)	-3.5	-10.5, 3.6	20.7 (48)	16.9 (38)	-3.8	-10.9, 3.4	0.33 (-9.8, 10.4)
Total	33.9 (251)	31.2 (208)	-2.7	-7.6, 2.2	21.3 (88)	20.9 (95)	-0.4	-5.9, 5.0	-2.31 (-9.6, 5.0)
FROM school									
Male	41.8 (169)	40.1 (138)	-1.7	-8.7, 5.4	37.6 (67)	33.2 (76)	-4.4	-13.6, 5.0	2.59 (-9.2, 14.3)
Female	39.9 (135)	38.8 (126)	-1.1	-8.6, 6.2	37.7 (87)	28.9 (65)	**-8.8**	**-17.3, -0.1**	7.64 (-3.8, 19.0)
Total	41.0 (304)	39.5 (264)	-1.5	-6.6, 3.6	37.7 (154)	31.1 (141)	**-6.6**	**-12.9, -0.3**	5.11 (-3.1, 13.3)

(n) denotes the number of participants that equates to the given percentage; [2] All % differences in this table are absolute differences

Table 3.4 *The effect of the intervention on the proportion of students that walked or cycled to and from school in intervention town 2 vs control*

	Intervention town 2				Control town				Absolute change
	Pre % (n)	Post % (n)	% Diff	95 % CI	Pre % (n)	Post % (n)	% Diff	95 % CI	Difference in differences % (95 % CI)
TO school									
Male	29.3 (46)	37.6 (53)	8.3	-2.4, 18.8	22.1 (40)	24.8 (57)	2.7	-5.7, 10.8	5.62 (-7.9, 19.1)
Female	28.3 (39)	29.1 (48)	0.8	-9.4, 10.9	20.7 (48)	16.9 (38)	-3.8	-10.9, 3.4	4.64 (-7.9, 17.1)
Total	28.8 (85)	33.0 (101)	4.2	-3.2, 11.5	21.3 (88)	20.9 (95)	-0.4	-5.9, 5.0	4.58 (-4.6, 13.7)
FROM school									
Male	35.7 (56)	45.4 (64)	9.7	-1.4, 20.6	37.6 (67)	33.2 (76)	-4.4	-13.6, 5.0	14.03 (-0.5, 28.6)
Female	39.4 (37)	32.3 (53)	-7.1	-17.8, 3.7	37.7 (87)	28.9 (65)	**-8.8**	**-17.3, -0.1**	1.71 (-12.2, 15.6)
Total	37.4 (94)	38.4 (117)	1.0	-6.8, 8.7	37.7 (154)	31.1 (141)	**-6.6**	**-12.9, -0.3**	7.56 (-2.5, 17.6)

(n) denotes the number of participants that equates to the given percentage; All % differences in this table are absolute differences

What impact did the intervention have on the percentage of students that would prefer to walk or cycle to school?

The intervention was somewhat effective in increasing preference for active travel home from school, but only in male students from intervention town 2 (table 3. 5). Student preferences for active travel decreased in both intervention town 1 (appendix 3B) and the control town (table 3.5). Among male students living in intervention town 2, the proportion that would prefer to walk or cycle home from school increased from 71.2% to 76.4%. Compared with the control town, this represented an absolute intervention effect of +14.7 percentage points (CI; 1.6, 27.9). Given a choice, 51.4% of the total sample would prefer to cycle to school compared to 21.3% who would prefer to travel by car (figure 3.2). Only boys in the control town reported a greater preference for cycling compared with girls ($p<0.05$).

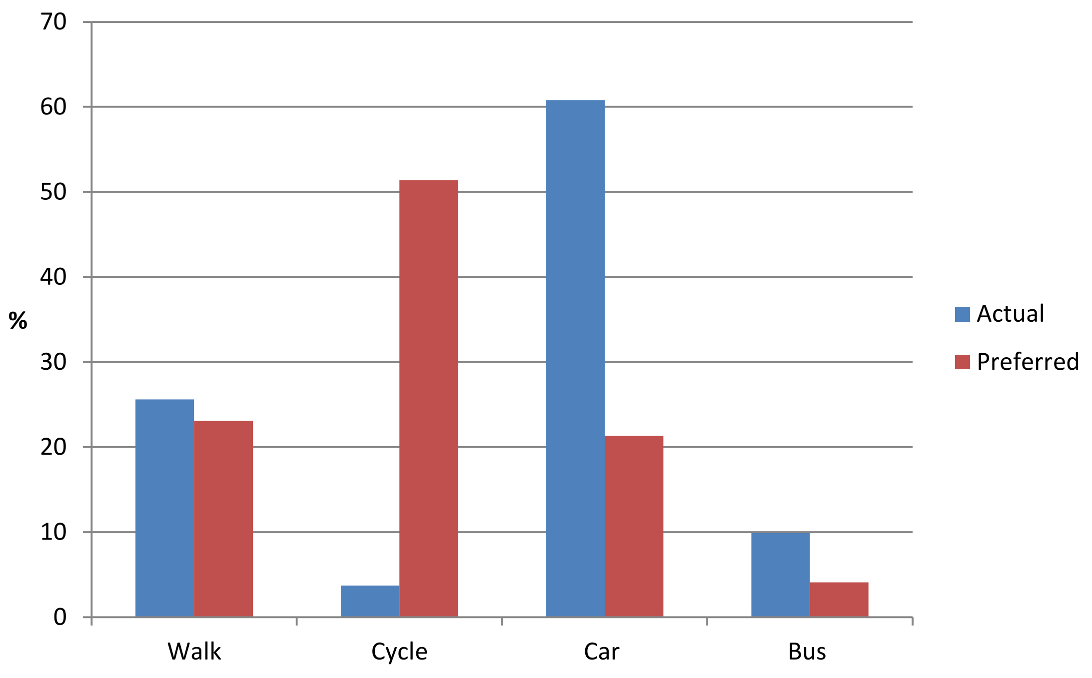

Figure 3.2 Actual and preferred mode of travel to school in the total sample (n=1452)

Table 3.5 *The effect of the intervention on the proportion of students that would prefer to walk or cycle to and from school in intervention town 2 vs control*

	Intervention town 2				Control town				Absolute change
	Pre % (n)	Post % (n)	% Diff	95 % CI	Pre % (n)	Post % (n)	% Diff	95 % CI	Difference in differences (95 % CI)
TO school									
Male	67.5 (106)	72.1 (101)	4.6	-5.9, 14.9	77.0 (183)	74.8 (172)	-2.3	-10.4, 6.1	6.89 (-6.4, 20.2)
Female	80.4 (111)	70.7 (118)	-9.8	-19.1, 0.00	68.9 (162)	62.7 (141)	-6.3	-14.8, 2.4	-3.51 (-16.4, 9.4)
Total	73.6 (217)	71.3 (219)	-2.2	-9.3, 4.9	72.5 (303)	68.8 (313)	-3.7	-9.7, 2.4	1.47 (-7.9, 10.8)
FROM school									
Male	71.2 (111)	76.4 (107)	5.3	-4.8, 15.1	77.7 (143)	68.3 (157)	-9.5	-17.7, 0.8	**14.73 (1.6, 27.9)**
Female	75.4 (104)	70.7 (118)	-4.7	-14.4, 5.4	66.4 (156)	61.3 (138)	-5.1	-13.7, 3.7	0.35 (-12.9, 13.6)
Total	73.1 (215)	73.3 (225)	0.2	-6.7, 7.2	71.4 (299)	64.8 (295)	**-6.5**	**-12.6, -0.3**	6.69 (-2.7, 16.1)

(n) denotes the number of participants that equates to the given percentage; All % differences in this table are absolute differences

Was there a difference in active travel campaign awareness between the intervention and control towns at follow-up?

The awareness of the active travel campaign was greatest in intervention town 2. Fewer children (both male and female) in the control town (24.7%) could recall anything their school had done to promote active travel when compared to children in both of the other towns (p<0.001; table 3.6). This is compared with approximately two thirds of students in both intervention towns recalling active travel measures in their schools. Boys in intervention town 2 and the control town were less likely than girls to recall measures (p<0.05). A greater proportion of children in intervention town 2 (85.0%) reported being aware of changes in their town that made it easier to walk and cycle (p<0.001; table 3.7).

Table 3.6 *Percentage of students that were aware of active travel activities in their school at follow-up*

	Control town	Intervention town 1	Intervention town 2
Total % (n)	**24.7 (112)*****	64.8 (435)	70.8 (216)
Male % (n)	**13.1 (30)*****	66.4 (227)	54.3 (76)
Female %	**36.6 (82)*****	63.2 (208)	84.8 (140)

(n) denotes the number of participants that equates to the given percentage

***p<0.001, *p<0.05

Table 3.7 *Percentage of students that were aware of changes in their town to make it easier to walk or cycle at follow-up*

	Control town	Intervention town 1	Intervention town 2
Total % (n)	64.7 (293)	66.8 (445)	**85.0 (260)** ***
Male % (n)	57.8 (133)	63.3 (216)	81.4 (114)
Female %	71.7 (160)	70.5 (229)	88.0 (146)

(n) denotes the number of participants that equates to the given percentage

***p<0.001

Secondary research question

Was there a difference in the change in the proportion of students participating in vigorous exercise four or more times per week between the intervention and control towns?

There was no difference in the change in the proportion of students participating in vigorous exercise four or more times per week between towns. Overall, the participation in vigorous exercise remained relatively stable in both intervention towns (80.8% in 2011 to 78.6% in 2013, appendix 3B). In the control town, there was an eight percentage point decrease (73.7% to 65.7%) in students meeting this threshold but there was no absolute difference between the intervention and control towns. Equally there was no absolute difference in the proportion that reported participating in vigorous exercise less than weekly between the intervention and control towns (appendix 3B).

3.4. Discussion

3.4.1. Summary of results

In this repeat cross-sectional study, we principally examined the impact of a natural experiment on active travel to and from primary schools. At baseline, 29.3% of the total sample walked or cycled to school (25.6% walked; 3.7% cycled) with boys being more likely to cycle than girls ($p<0.05$). Greater proportions of students walked or cycled home from school than to school (39.3% vs 29.3%). However car was the most common mode of travel to or from school in each town (60.8% and 49.1% respectively). Overall, the intervention had no effect on active travel behaviour to or from school but there was some evidence of an effect for males in intervention town 2 (where campaign awareness was highest). The absolute change (increase of 14 percentage points) in active travel home from school for this cohort was close to being significant (-0.05, 28.6). Similarly the proportion of students in this cohort that indicated they would prefer to cycle to school increased by 15 percentage points relative to control. Indeed, given a choice, 51.4% of the total sample would prefer to cycle to school compared to 21.3% who would prefer to travel by car.

3.4.2. The prevalence of active travel to primary schools

The overall proportion of students actively commuting to school at baseline (29%) was low by UK (Department of Education, 2011) and mainland European standards (Chillón et al., 2010; Grize et al., 2010; Stock et al., 2012). However it was considerably higher than those reported in Australia (Merom et al., 2006) and in the US (McDonald, 2007). These regional variations were even evident at a local level whereby active commuting was more prevalent in the intervention towns (pooled) than in the control town (32.5% vs 21.3%). These differences are significant for two reasons. Firstly, the relatively high prevalence of active commuting may indicate that the potential to create a modal shift was somewhat saturated in the intervention towns. Concentrating efforts on the journey home from school in regions with low levels of active travel may offer more success to physical activity practitioners. Consistent with previous research (Schoeppe et al., 2013) a greater proportion of students walked or cycled home from school than to school. Previous research highlighted that the daily schedules of parents (Mitra, 2013) and parental modelling of active commuting to work (Henne et al., 2014; Panter, Corder, et al., 2013) are important determinants of active travel to school. Accordingly, it is likely to be more convenient for a parent to accompany their child (and travel by car) on the journey <u>to</u> school than for the return journey. Indeed one of the very few longitudinal studies in this area found that parents' perceived inconvenience of using the car for school travel predicted both uptake and maintenance of active commuting to school (Panter, Corder, et al., 2013).

Secondly, the baseline difference in active travel between the intervention and control towns suggests that the wider environmental conditions for active travel may have been more favourable in the intervention towns. One explanation for these differences might be the existence of a large national primary road that traverses the control town, separating the town from large employment centres. This is also supported by the socio-economic differences between the towns highlighted in appendix 1A. Compared with the intervention towns, the control town had the highest proportion of households with two or more cars (34.2%) and paradoxically, it also had the highest proportion of adults without 3rd level education. This is counter-intuitive because active travel to school is inversely associated with household income (Pabayo et al., 2011; Panter, Corder, et al., 2013). This may have been one of many socio-environmental factors which influenced the greater degree of car ownership and use in this town. An even more plausible explanation is that the local authorities may have been more progressive in promoting active travel even before they received 'Smarter Travel' funding. There is potential that these regional differences introduced selection bias into the study.

3.4.3. Distance as a moderator of active travel to primary schools

This study used 'journey time to school' as a proxy measure for journey distance, similar to the methods adopted by the national census in Ireland (Central Statistics Office, 2012). Students in intervention town 2 are likely to have travelled the shortest distances to school. Journey distance to school is known to be one of the strongest determinants of active commuting (Davison et al., 2008; Panter et al., 2008; Pont et al., 2009). In the SPEEDY study, only living within 1km of the school and the inconvenience of driving predicted both uptake and maintenance of active travel in English 9-10 years olds (Panter, Corder, et al., 2013). Distance is so influential that some studies restrict their analysis to include only those living within certain threshold distances for active travel (Chillón et al., 2014; Henne et al., 2014). A criterion distance of approximately 1.5km best discriminates walkers from passive commuters. This distance increases both for cycling (approximately 3km) and increasing age (Chillón et al., 2014; D'Haese et al., 2011). In this study the average journey time of students travelling by car in intervention town 2 was 7.3 minutes. It would not be unreasonable to suggest that the majority of these journeys were less than the criterion distance of 3km for cycling to school. The shorter journeys in this town should have created very favourable conditions for active travel interventions in primary schools. This, however, did not transpire into a large intervention effect. There are several possible explanations for this.

One such explanation is that traffic volumes in the area may have been lower than the other more congested towns but traffic speeds may have been higher. The latter has been shown to be a greater deterrent for adults that actively commute than the volume of traffic itself (C. Foster, Panter, et al., 2011). Another explanation is that children living in smaller towns may have more direct routes to school. Paradoxically, having a direct route to school has been shown to be inversely related to active travel in primary school-children (Panter, Corder, et al., 2013). This is potentially due to the increased traffic volumes and speeds associated with direct routes to schools. However in contradiction to this, there was an extensive programme of traffic calming and pedestrian infrastructure improvements introduced on the primary routes to schools in the area (appendix 2). This is supported by the media analysis data (appendix 7D) which highlighted the significant drop in negative stories related to inadequate pedestrian infrastructure in 2012-13 and the rise in stories related to the noise created by speed ramps in residential areas. The lack of a more substantial intervention effect in this town points to a wider array of conditions, beyond distance, that are necessary to create a modal shift to active commuting. Indeed, Dessing, de Vries, Graham, and Pierik (2014) found that active travel declined with increasing distance from school even in a sample of students that live within 1km of their school.

3.4.4. Gender as a moderator of active travel to primary schools

In agreement with previous research, girls in this study were less likely to cycle to or from school (Panter & Jones, 2010). Despite this, the majority of students (51.4%), irrespective of sex, preferred to travel to school by bike. Cycling to school has been shown to have greater health benefits than walking with stronger effects evident for boys (Larouche, Saunders, et al., 2014). While cycling, boys spend a greater portion of their journey in MVPA (Smith, Sahlqvist, Ogilvie, Jones, Corder, et al., 2012; Southward et al., 2012). Considering the lower physical activity levels of girls (Kelly et al., 2012), this represents a greater proportion of their daily MVPA suggesting that creating a modal shift towards active travel by bike may be even more important for girls.

This disparity between girls' actual and preferred modes of travel to school highlights the role parents' play as gatekeepers to children's active travel. It was highlighted in the previous section that parental modelling of active travel is more important than parental support. However encouraging parents and guardians to escort their older children to primary school on foot or by bike is unsustainable in the long-term. Intervention efforts that address the determinants of independent mobility to school warrant further attention especially for pre-adolescent girls who are granted such privileges later than boys (Carver et al., 2014; Schoeppe et al., 2014). Carver and colleagues' (2014) longitudinal study of independent mobility to school reported that household car access was associated with active travel to school for boys (OR 0.27). For girls however, land-use mix (OR 1.38) and the proportion of main roads in the neighbourhood (OR 0.67) were longitudinally associated with active travel to school. This could be interpreted as parents being more protective of girls in terms of road safety and social control. Taking a gender-specific approach to addressing these determinants of independent mobility to school (as opposed to escorted active travel) would most likely be paralleled by an increase in active travel to non-school destinations. Such an outcome may be even more favourable for girls who tend to travel further distances than boys to socialise (Brown et al., 2008).

3.4.5. The effectiveness of active travel interventions in primary schools

This study suggests that it is relatively easy to achieve high levels of campaign awareness amongst children, particularly when it relates to the creation and continued promotion of new infrastructural measures for active travel. Attenuating the secular trend for declining active travel to school appears relatively harder to achieve. There was no evidence from this study that the community-wide interventions were effective in increasing active travel in the overall sample of students. The lack of effect is easier to explain for intervention town 1. Active travel to school is a very stable behaviour (Panter, Corder, et al., 2013) and some of the most well-resourced programmes have only demonstrated modest effects (Hinckson et al., 2011; Sloman et al., 2009). That is not to say that increasing active travel to primary schools is unattainable. The large variation in levels of walking and cycling reported between schools in the same town suggest that levels of active commuting are context specific i.e. individual, social and environmental factors may differ greatly between schools. Nonetheless there were considerably fewer resources available for active travel initiatives in intervention town 1. There was also little evidence of sustained multi-component programmes aimed at primary schools in the town (appendix 2). Even sustained multi-component programmes have only produced modest effects in the absence of significant infrastructural measures (McDonald et al., 2013).

The data from intervention town 2 is more complex to interpret. There are two possible conclusions to be drawn here. One is that there was no measureable intervention effect for either boys or girls. Alternatively, the intervention may have been effective for boys only. There are several arguments to support either conclusion. The intervention effect which approached significance for boys in town 2 may have been just random variation. If this was a true effect, we might have expected the data for active commuting to school to also have approached significance. It is also possible that there was insufficient traffic calming measures introduced in the town to compliment the creation of the new railway track. When infrastructural measures for active travel are phased in over time, the full effect and synergy of the integrated measures are often not seen for several years (Hinckson et al., 2011). The specific programmes delivered in the schools (appendix 2) were not entirely consistent with the characteristics of effective schools interventions (Chillón, Evenson, et al., 2011). The interventions were not gender specific as advocated by systematic reviews of physical activity interventions (Biddle et al., 2014; Camacho-Miñano et al., 2011; Murillo Pardo et al., 2013). There was no evidence that the programmes were targeted at students living within criterion distances or that they focused on reducing car travel in conjunction with increasing active travel. There was a predominant focus on cycle training (in both towns) which has been shown to have little impact on levels of active travel, especially if the training takes place away from traffic (Ducheyne et al., 2014). There was some indication of empowerment at the school level with the appointment of schools co-ordinators but little evidence of parental involvement. Walking school buses are proven to be relatively successful intervention components (Collins & Kearns, 2010; Mendoza et al., 2011, 2009) but these were only adopted on a short-term and ad-hoc basis. Finally, there was no obvious intervention effect, or a trend towards one, in the two intervention schools that received the most intensive intervention (best served by new hard measures). The main focus of the intervention in these schools was cycling. As anticipated there was an increase in cycling but only at the expense of reduced walking trips and reduced overall active travel. This displacement of walking is consistent with that reported by Sloman et al. (2009) in the UK Cycling Demonstration Towns (CDTs).

On the contrary, there is more evidence to support the existence of an intervention effect for boys in intervention town 2. Social desirability bias can influence physical activity intervention studies (Taber et al., 2009). However, there was no change in the frequency of participation in vigorous exercise in intervention town 2. This is as expected because there was no intervention to increase vigorous exercise, signifying the influence of social desirability bias was minimal. Equally, the result may not have been due to random variation. As discussed in section 3.4.2, it is not entirely unexpected that an intervention might influence travel home from school and not to school. Furthermore, although the 95% CIs did not approach significance, the magnitude of the within town increases were very similar (+8.3% to school; +9.7% from school). The outcome measure of 'usual' mode of travel to school may not have been sensitive enough to detect a greater intervention effect. In relation to the phasing in of infrastructure, the converted railway track was a flagship project and was completely operational six months after the baseline surveys. The acute effects of this unique separated pathway which linked residential areas to schools should have been evident 18 months later. Indeed, this separated pathway may have prompted parents to grant independent mobility to their sons at an earlier age helping to explain the lack of effect for girls. The combination of the pathway, the pedestrian crossings and the traffic calming measures in intervention town 2 is comparable to the scale of measures adopted in the well-resourced US SRTS programme. The SRTS programme reported increases in active travel in the region of 5-20% (McDonald et al., 2013). This is similar to the 14% absolute increase reported for males in this study. The magnitude of this increase is substantially higher than the 1-2% increases reported for multi-component interventions in the UK and NZ (Hinckson et al., 2011; Sloman et al., 2009). However the levels of funding were also substantially different. The UK CDTs received £10 (€13) per capita compared with €153 per capita in intervention town 2. This is a crude comparison because the CDTs also received additional community infrastructural funding and additional support from the UK Travelling to School Initiative. Nonetheless it points to the unsustainable level of funding received by intervention town 2 and questions the reproducibility of effects in other towns.

3.4.6. Study strengths and limitations

The main strengths of the research design included; the use of seasonally matched surveys, the relatively large sample sizes with good response rates and the timing of the baseline data collection. The timing was important because the opening of the converted railway track happened six months after the baseline surveys. The official baseline surveys conducted on behalf of the National Transport Authority were administered six months after the opening of the converted railway track. Therefore the data from the current study provide the only true baseline available for intervention town 2. The study also had high external validity because it was a natural experiment. Equally, natural experiments have significant limitations. They lack experimental control and there is no random selection of towns. Both intervention towns in this study were allocated funding on a competitive basis thereby differentiating themselves from towns where the intervention components may be replicated. Natural experiments are typically measured using repeat cross-sectional designs which limit our ability to attribute changes in active travel to certain individual level characteristics such as SES. However a panel design was not considered appropriate for two reasons. Firstly we aimed to target only the oldest two classes (5th and 6th classes) of primary school-children to ensure better comprehension of the self-report survey. Using a panel design would have meant that half of the cohort would be secondary school-children at follow-up. Secondly, we were cognisant of designing a survey that was as short as possible with the greatest amount of anonymity. A survey for a panel design would have required personal data for the matching process.

Journey to school was used as a proxy measure of distance in lieu of objective measures to protect anonymity. Additional items such as examining active travel to non-school destinations, trip chaining and independent mobility were not included both to simplify the survey and because travel to school has been established as a reasonable proxy measure for all destinations (Smith, Sahlqvist, Ogilvie, Jones, Griffin, et al., 2012). In the absence of a validated continuous measure of active travel to school, 'usual travel to school' was measured. This is the item most commonly used in the wider literature although its validity has not yet been tested (Herrador-colmenero et al., 2014). Finally, objective measures of the built environment would have greatly enhanced our understanding of the differential intervention effects between towns but were precluded by financial constraints.

3.4.7. Implications of the research findings

Implications for practice

- In this study, the principals of each school were sent a report outlining the travel and physical activity data for students in their school. The report compared the data from their own school to community-wide and national averages. This could be adopted as a strategy to prompt wider discussion about active travel and physical activity at the school level.
- Active travel interventions should aim to reduce the convenience of car parking outside primary schools in parallel with promoting walking and cycling. This would help to prevent displacement of other active modes of commuting and to address one of the most consistently reported determinants of active travel to school i.e. convenience of the car.
- Interventions should be tailored to accommodate students that commute varying distances to school. That is, students living within the criterion distances

(approximately 1km for walking and 3km for cycling) should be encouraged to actively commute to school preferably as part of walking or cycling school buses. Drop-off points should be established near to the walking and cycling school bus stops to accommodate those living outside these thresholds.

- Parents are gatekeepers of children's independent mobility. The creation of separated walk and cycle paths in conjunction with pedestrian crossings and traffic calming measures should be introduced to encourage parents to allow their children to travel independently to school.
- Primary school interventions should target boys and girls separately and perhaps focus on the journey home from school initially. The intervention should have a multi-component design, aim to empower schools and to involve parents as key stakeholders. These interventions should be relatively long-term and be rolled out across all schools in the area.
- Planning laws should be amended so that new schools are not located on the periphery of towns but in areas with good land use mix. This may encourage greater independent mobility to school for girls and lessen the influence of distance from home to school.

Implications for research

- The incidence of type two errors may be reduced if analysis of active travel to school data were stratified according to criterion distances for walking and cycling. Studies should also stratify results by sex and report them separately for walking and cycling.
- Preferred mode of travel to school should be included as an item in active travel surveys. There were substantial differences between preferred and actual modes of travel in this study. Knowing preferred modes of travel justifies the need for active travel interventions and creates leverage for sourcing local authority funding. It is also likely to be the type of data that elicits media attention for potential active travel projects.
- A valid measure of active travel to school needs to be developed. Currently, 'usual mode of travel' to school is the most commonly used item but this has not been validated. A continuous measure of active travel would facilitate the calculation of the dose response effects associated with active travel. The new

measure should include both active travel to and from school and whether the child travelled independently or not.

- The factors that influence active travel to school appear to be geographically heterogeneous. More intervention and longitudinal studies of active travel interventions in primary schools are needed.

3.5. Conclusion

This study failed to provide evidence for an intervention effect in the overall sample in either intervention town. This may be partly attributed to the dominance of car use for the school commute in each town. Also, the intensity of the 'soft measures' targeting schools in the intervention towns was relatively low. Nonetheless the findings from this study suggest that multi-component interventions with this cohort hold some promise. Firstly, despite the dominance of car travel, students overwhelmingly cited cycling as their preferred mode of travel to school. We have also tentatively concluded that the intervention was somewhat effective for male students in intervention town 2. This is likely to reflect the positive impact that the converted railway track had on independent mobility in boys. It is unclear what measures are needed to replicate these effects in girls and the extent to which the level of funding is transferable to other Irish towns.

CHAPTER 4. THE IMPACT OF THE INTERVENTION ON SECONDARY SCHOOL-CHILDREN

4.1. Introduction

This chapter describes the relative impact of the community-wide active travel intervention (appendix 2) on secondary school-children in both intervention towns compared with the control town. Specifically, it examines the impact of the intervention on the total volume of active travel and not just on school-related travel.

4.2. Methodology

4.2.1. Research design

This was a repeat cross-sectional study of a natural experiment conducted in two intervention towns and one control town. The impact of the community-wide interventions focusing on secondary school-children in both intervention towns (see appendix 2) was measured using self-report surveys in May 2011 (baseline) and May 2013 (follow-up). Ethical approval was granted by Waterford Institute of Technology's Research Ethics Committee (appendix 1B).

4.2.2. Research questions

1. What impact did the intervention have on average daily minutes of active travel among secondary school-children?
2. What impact did the intervention have on awareness of the 'Smarter Travel' campaign among secondary school-children?

4.2.3. Study population and sampling

Baseline data were collected from all 15 secondary schools in the three towns (six in intervention town 1, five in intervention town 2 and four in the control town). All 1st, 2nd and 5th year students were sampled in intervention town 2 and the control town. Only 2nd and 5th years were sampled in intervention town 1 because of the larger secondary school population. Letters were sent to all school principals in February 2011 requesting permission to conduct the surveys in May of the same year. Permission was granted and an information letter (appendix 4A) was sent home to the parents of all students in the sample in the first week of May 2011. This letter sought the passive consent of parents for their child to complete the survey the following week. This sampling procedure was replicated in May 2013 for the cross-sectional post-intervention survey. One all-boys secondary school in intervention town 2 did not complete the follow-up survey in 2013 due to time constraints cited by the school administration.

4.2.4. Description of the community-wide intervention

As outlined in sections 1.7 and 3.2.4, the project in Intervention town 2 was better resourced (despite being a much smaller town), facilitating the establishment of a dedicated project team. Consequently, the most intensive intervention was implemented in intervention town 2 and consisted predominantly of infrastructural measures (figure 4.1). A detailed inventory of the community-wide intervention is contained in appendix 2. An abridged version of the intervention components relevant to secondary school-children follows.

In intervention town 1, there was no comprehensive intervention that specifically targeted all secondary schools. There was one intensive multi-component active travel intervention implemented in an all-girls school in 2012. This five month intervention consisted of soft measures such as; e-books, cycle training, active travel challenges, social media promotion and an educational module. In intervention town 2, new on-road cycle lanes, traffic calming and pedestrian crossings were introduced adjacent to the newly converted railway track, all of which combined to create a safe route to one of the town's four secondary schools. There was also an intensive active travel intervention implemented in one all-boys secondary school, mostly targeting year one students (n=24). The intervention components included the provision of e-books, cycle training, new bikes, sheltered bike parking, rain gear, high-visibility clothing, cycle helmets, bicycle maintenance training and route audit training. Route audit training was also provided to a small number of classes in each of the town's four secondary schools.

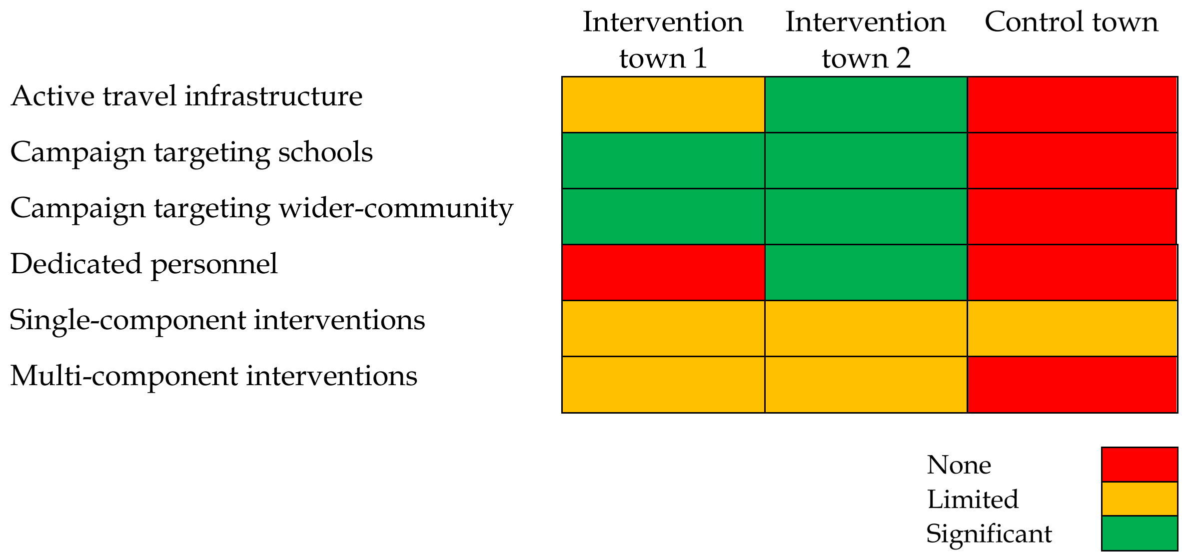

Figure 4.1 *The extent of the intervention components targeting secondary school-children in each town*

4.2.5. Data collection tools

Questionnaire

The four part questionnaire (appendix 4A) was piloted with approximately 50 female students (aged 12-17 years) from a separate town prior to its use. No changes were made except minor grammatical amendments to the IPAQ-A (part two). Questions 1-11 were included in 2011 and 2013. Questions 12-18 were added in 2013.

Part 1: Demographic information

This section measured age, school year and sex.

Part 2: International Physical Activity Questionnaire for Adolescents (IPAQ-A)

This questionnaire was developed by the 'Healthy Lifestyle in Europe by Nutrition in Adolescence' (HELENA) study (Moreno et al., 2008). It is an adapted version of the International Physical Activity Questionnaire developed for adults aged 18-65 years (Craig et al., 2003). The IPAQ-A includes four domains of physical activity; (1) school (during PE and breaks), (2) housework and gardening, (3) transport and (4) recreation, sport and leisure. The number of days per week and minutes per day spent walking, in moderate activity and in vigorous activity are recorded in domains one (during breaks) and four. The number of PE classes per week and their duration is measured in domain one also. Domain two measures the number of days per week and minutes per day doing moderate intensity housework and gardening similar to a number examples given. Similarly, domain three measures the number of days per week and minutes per day that the respondent travels for at least 10 uninterrupted minutes in a motor vehicle, by walking or by cycling (separately). Some minor grammatical amendments were made to the questionnaire before the pilot study was conducted.

Validity of the IPAQ-A

International validation studies have reported weak but significant correlations between the IPAQ-A and accelerometry for moderate, vigorous and MVPA (Hagströmer et al., 2008; Ottevaere et al., 2011). A concurrent baseline validity study of the adapted IPAQ-A was carried out with 362 Irish adolescents aged between 13 and 16 years (Spratt, 2015). In agreement with these international studies, this study reported weak to moderate correlation coefficients (0.061 – 0.327). The correlation coefficients were stronger for older adolescents (15-16 year olds vs 13-14 year olds). The validity of the transport sub-domain alone has not been established but previous studies have reported the transport data as a main outcome measure (Chillón, Ortega, et al., 2011).

Measurement error associated with leisure domain

A printing error resulted in the response option for the number of days students were physically active in the leisure domain being a maximum of five instead of seven days. The transport domain (and all other sub-domains) was correctly administered at baseline and follow-up. All 15 schools completed this version of the survey at baseline. At follow-up, all but two of the participating schools completed this same 'incorrect' questionnaire. These schools were the intervention and control schools from the nested schools intervention in intervention town 1 (chapter five). The follow-up survey conducted in these two schools included the correct seven day response option for the leisure domain. As a result, all continuous data were converted to minutes of physical activity per day instead of per week. This was done to ensure comparability across each physical activity domain. This error is likely to result in an underestimation of leisure time physical activity and MVPA because of the omission of weekend activity. However, these variables were only secondary outcome variables.

Part 3: Active travel campaign awareness

The third section included questions about whether respondents could recall any events or activities related to active travel in their town. They were asked to name and provide details of the event or activity.

Part 4: Characteristics of active travel to school (follow-up only)

This section measured how children usually travelled to school and how they would prefer to travel to school. It also asked whether they had access to a bicycle and how long (minutes) and far (km) their trip to school was. These items were only included at follow-up because the community-wide intervention did not specifically target active travel to schools.

4.2.6. Data collection method

The PE teachers in each school sent the parents information letter home with all participating students between Tuesday April 26th and Thursday April 28th 2011. The PE teachers were instructed by phone on how to inform students on completion of the questionnaire. The baseline questionnaires were completed by students during class from Tuesday May 10th to Friday May 13th 2011. The parent letters for follow-up were sent home between Tuesday May 7th and Thursday May 9th. The survey was completed between Tuesday May 14th and Friday May 17th 2013. There were no requests to withdraw a student from the study in either year.

4.2.7. Data analysis

Statistical analysis

The data analysis was conducted using IBM SPSS Statistical Package 21. The IPAQ-A data were processed based on the scoring protocols of the HELENA study (De Cocker et al., 2011) and the IPAQ for adults (www.ipaq.ki.se). Total minutes per week were calculated for total physical activity, MVPA and each physical activity domain. Daily physical activity minutes were truncated as follows: all scores lower than 10 minutes per day were recoded to 0 minutes and scores greater than 180 minutes per day were recoded to 180 minutes. The only exception to this was that activity during school breaks was truncated at 90 minutes. Total weekly minutes were truncated at 2540 for total physical activity (average of 92 cases between pre and post), 1800 for school (0 cases), 1680 for leisure (76 cases) and home (0 cases), 1290 for transport (47 cases) and 1260 for moderate (47 cases) and vigorous intensity (2 cases). Total MVPA was calculated using truncated values. Chi square and one-way Anova tests were used to examine baseline differences between categorical and continuous variables, respectively. Standardised residuals greater than +/- 1.96 were used to identify where the differences existed in 3 x 3 contingency tables. The impact of the intervention on minutes of active travel was assessed by calculating 95% confidence intervals for the within town differences (Newcombe, 1998). An independent t-test was then conducted to examine the absolute change between the intervention (individually and pooled) and control towns. This was conducted in conjunction with the examination of the extent of overlap of confidence intervals. A Bonferroni correction was applied to the secondary outcome variables to control for familywise error with multiple testing of physical activity domains. The absolute change in proportions (difference in differences) were calculated using 95% confidence intervals consistent with previous research (Goodman, Panter, et al., 2013). Finally, all statistical analyses were conducted on the continuous data both before and after being log transformed. The log transformed data were used as the primary outcome measure because of the large standard deviations in the raw data. The analysis of male specific data was not conducted in intervention town 1 because the largest all-male school did not participate in the follow-up survey.

4.3. Results

What were the characteristics of the sample?

Descriptive statistics for the sample are presented in table 4.1 below. Average response rates were 84.2% in the control town, 81.1% in intervention town 2 and 65.9% in intervention town 1. A 100% response rate was not achieved in the control town and intervention town 2 because of student absences due to school events and illness. The response rate was lower in intervention town 1 because of the non-participation of one large all-boys school at follow-up. The students in intervention town 1 were older ($p<0.001$) and had a longer perceived travel time to school when compared with those in the other towns ($p<0.01$). Students in the control town had the shortest estimated journey distance to school ($p<0.05$). Intervention town 2 had the greatest proportion of students (17.4%) living within 1.5km of their school. The majority of students had access to a bicycle but those in the control town were less likely to have access ($p<0.01$).

Table 4.1 Sample characteristics

	Intervention town 1 (n = 721)	Intervention town 2 (n =612)	Control town (n = 928)	P value
Age (years ± SD)[7]	15.3 (1.5)	14.4 (1.5)	14.3 (1.4)	**0.000*** **
Sex				
Male (%)	46.5	49.5	42.1	0.057
Female (%)	53.4	50.5	57.8	
	(n = 608)	(n = 657)	(n = 892)	
Journey time to school (mins ± SD)	18.2 (10.9)	16.4 (12.5)	16.6 (11.5)	**0.007****
Journey distance to school (km ± SD)	9.7 (9.7)	9.2 (11.5)	8.1 (8.4)	**0.015***
Home <1.5km from school (%)	11.6	17.4	9.3	
Home 1.5-3km from school (%)	19.3	21.3	26.8	
Home >3km from school (%)	69.1	61.3	63.9	
Access to bicycle (%)	79.6	80.2	73.7	**0.003****

*p<0.05, **p<0.01, ***p<0.001

Only 17% of the entire sample travelled actively to school (14.8% walked, 2.4% cycled)[8]. Sixty two per cent travelled to school by car with students in the control town being more likely to do so ($p<0.05$). Active travel to school was most prevalent in those living closest to their school (figure 4.2). Less than 7% of students living beyond 3km from their school actively commuted. A greater percentage of students from intervention town 1, living within 1.5km ($p<0.01$) and between 1.5-3km ($p<0.05$) of their school walked or cycled to school. Students in intervention town 1 engaged in more daily minutes of active travel to any destination than those in intervention town 2 ($p<0.05$; 40.4 ± 52 mins vs 32.7 ± 45.5 mins). There was a trend towards significance in the log10 transformed data also ($p<0.05$; 1.01 ± 1.03 vs 0.88 ± 1.03; 95%CI -0.003, 0.26). There was also a clear sex

[7] Age and gender are baseline variables. All other variables are follow-up data because the number of survey items was increased at follow-up.

[8] Additional data on actual and preferred travel modes by town is contained in appendix 4B

difference in active travel to school. Overall a greater percentage of boys travelled actively to school (boys 23.0%; girls 12.9%; $p<0.0001$) and in each town they were more likely than girls to cycle to school ($p<0.05$). The data in figure 4.3 illustrate that given a choice, 46.5% of the entire sample would still prefer to travel to school by car although this was significantly higher in the control town (51.4%, $p<0.05$). As was the case for actual mode of travel, boys were more likely to state that they would prefer to cycle to school ($p<0.05$).

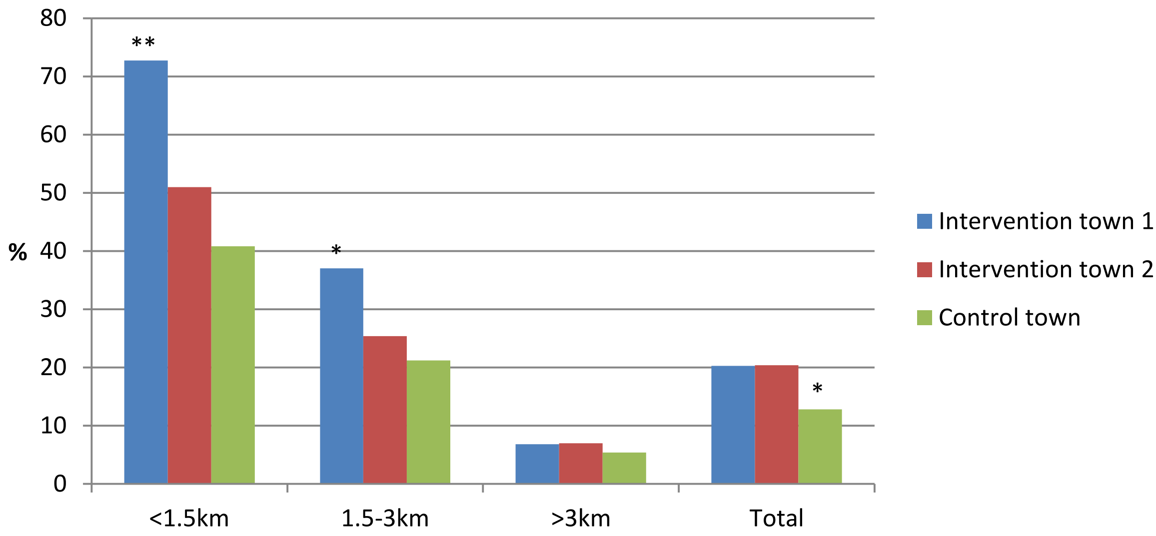

Figure 4.2 *The prevalence of active travel to school according to perceived distance between home and school at follow-up (n=2099)*

*p<0.05, **p<0.01

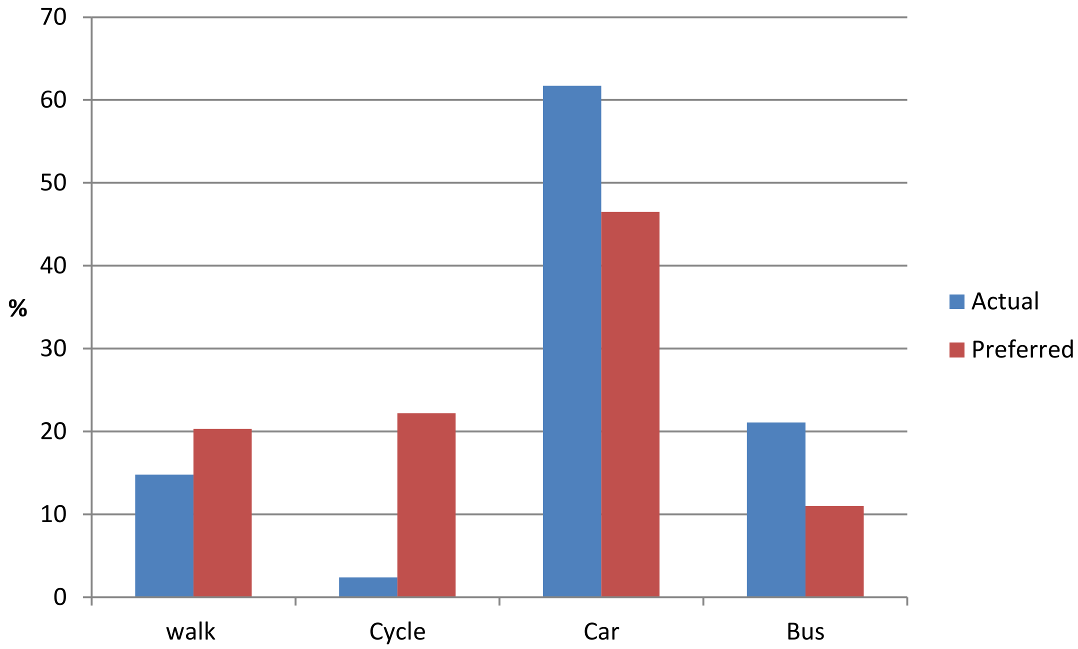

Figure 4.3 *Actual and preferred mode of travel to school in the total sample at follow-up (n=2099)*

What impact did the intervention have on average daily minutes of active travel among secondary school-children?

There was some evidence of an intervention effect but in adolescent males only. There was no significant change in the log transformed daily minutes of active travel in any town (or in the pooled data from both intervention towns) for the entire sample (table 4.2). Equally there was no difference in the change in active travel between the intervention and control towns. This was also the case in the untransformed data (table 4.3). Gender specific analysis indicated no intervention effect for females (tables 4.4 + 4.5) but some evidence of an intervention effect in males (table 4.7). The change in daily minutes of active travel in adolescent males in intervention town 2 (and pooled data) was significantly greater than the change in the control town ($p<0.05$). The significance of this change is supported by the non-overlapping confidence intervals (intervention town 2; -1.47, 15.67 & control town; -16.84, -1.96). However, the increased active travel in adolescent males was not evident in the log transformed data (table 4.6). There were also no parallel changes in MVPA or total physical activity in either town (appendix 4B). At the school level there was a significant increase in mean minutes of active travel per day (16.4 mins) in one mixed school in intervention town 2 (tables 4.8 + 4.9). The absolute increase relative to control was 25.8 minutes ($p<0.01$) and the same trend was significant in the log10 transformed data ($p<0.05$). This school had the lowest overall levels of active travel to school (15.1%) in intervention town 2 but one of the highest proportions of students cycling to school (5.9%) across the three towns. The data for this school was also analysed separately for boys and girls. The only absolute increase that remained significant in the sex-specific analysis was the increase in minutes (untransformed only) for boys.

Table 4.2 The effect of the intervention on Log10 transformed average daily minutes of active travel

	Pre (n, SD)	Post (n, SD)	Mean diff	95 % CI	P value[1]
Control	0.99 (881, 0.99)	0.91 (853, 1.02)	-0.08 (2.01)	-0.17, 0.01	
Town 1	1.01 (704, 1.03)	0.97 (573, 1.04)	-0.04 (2.03)	-0.15, 0.07	0.71
Town 2	0.88 (583, 1.03)	0.91 (607, 1.08)	0.03 (2.11)	-0.09, 0.15	0.32
Towns 1+2	0.95 (1287, 1.03)	0.94 (1180, 1.06)	-0.01 (2.08)	-0.09, 0.07	0.44

[1] Change in intervention versus change in control

Table 4.3 The effect of the intervention on average daily minutes of active travel

	Pre (n, SD)	Post (n, SD)	Mean diff	95 % CI	P value[1]
Control	37.0 (881, 49.6)	33.4 (853, 45.7)	-3.6 (95.2)	-8.1, 0.90	
Town 1	40.3 (704, 51.7)	38.3 (573, 49.5)	-2.0 (100.1)	-6.07, 2.07	0.76
Town 2	32.6 (583, 45.5)	37.7 (607, 50.5)	5.1 (95.8)	-0.37, 10.57	0.09
Towns 1+2	36.8 (1287, 49.1)	38.0 (1180, 50.0)	1.2 (98.7)	-2.71, 5.11	0.27

[1] Change in intervention versus change in control

Table 4.4 The effect of the intervention on Log10 transformed average daily minutes of active travel in adolescent females

	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value[1]
Control	0.87 (520, 0.99)	0.81 (445, 1.02)	-0.06 (1.98)	-0.19, 0.07	
Town 1	0.85 (378, 1.05)	0.86 (431, 1.08)	0.01 (2.12)	-0.14, 0.15	0.68
Town 2	0.78 (298, 0.01)	0.84 (295, 1.04)	0.06 (1.04)	-0.06, 0.18	0.28
Towns 1+2	0.82 (676, 1.03)	0.85 (726, 1.06)	0.03 (2.08)	-0.08, 0.14	0.47

[1] Change in intervention versus change in control

Table 4.5 *The effect of the intervention on average minutes of active travel per day in adolescent females*

	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value[1]
Control	29.4 (520, 42.6)	28.5 (445, 42.4)	-0.9 (84.0)	-6.29, 4.49	
Town 1	33.3 (378, 47.0)	33.3 (432, 45.3)	0 (91.2)	-6.37, 6.37	0.88
Town 2	26.9 (298, 41.9)	29.2 (295, 40.4)	2.3 (82.1)	-4.34, 8.94	0.60
Towns 1+2	30.5 (676, 44.9)	31.7 (727, 43.4)	1.2 (87.9)	-3.43, 5.83	0.69

[1] Change in intervention versus change in control

Table 4.6 *The effect of the intervention on Log10 transformed average daily minutes of active travel in adolescent males*[9]

	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value[1]
Control	1.15 (360, 0.97)	1.01 (408, 1.00)	-0.14 (1.96)	-0.28, 0.00	
Town 1	1.12 (143, 1.02)	1.31 (141, 0.84)	0.19 (1.83)	-0.03, 0.41	0.08
Town 2	0.98 (285, 1.05)	0.98 (311, 1.11)	0 (2.16)	-0.17, 0.17	0.39
Towns 1+2	1.02 (428, 1.04)	1.09 (452, 1.05)	0.06 (2.08)	-0.08, 0.19	0.15

[1] Change in intervention versus change in control

Table 4.7 *The effect of the intervention on average minutes of active travel per day in adolescent males*

	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value[1]
Control	48.1 (360, 56.6)	38.7 (408, 48.4)	-9.4 (102.0)	-16.84, -1.96	
Town 1	45.0 (143, 51.3)	53.4 (141, 58.2)	8.5 (108.3)	-4.3, 21.22	0.20
Town 2	38.7 (285, 48.2)	45.8 (311, 57.4)	**7.1 (105.1)**	**-1.47, 15.67**	**0.045***
Towns 1+2	40.8 (428, 49.3)	48.2 (452, 57.7)	**7.4 (106.5)**	**0.32, 14.47**	**0.02***

[1] Change in intervention versus change in control. *p<0.05

[9] One large all-boys school in intervention town 1 did not participate in the follow-up survey. The data for this school was not included in the analysis shown in tables 4.6 or 4.7

Table 4.8 *The effect of the intervention on Log10 transformed average daily minutes of active travel in one mixed school in intervention town 2*

	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value[1]
Control	0.99 (881, 0.99)	0.91 (853, 1.02)	-0.08 (2.01)	-0.17, 0.01	
1 school in town 2	0.60 (235, 1.09)	0.87 (287, 1.12)	**0.26 (2.18)**	**0.07, 0.45**	**0.03***

[1] Change in intervention versus change in control; *p<0.05, **p<0.01, ***p<0.001

Table 4.9 *The effect of the intervention on average minutes of active travel per day in one mixed school in intervention town 2*

	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value[1]
Control	37.0 (881, 49.6)	33.4 (853, 45.7)	-3.6 (95.2)	-8.1, 0.90	
1 school in town 2	22.61 (235, 35.3)	39.0 (287, 53.0)	**16.4 (86.9)**	**8.76, 23.99**	**0.002****

[1] Change in intervention versus change in control; *p<0.05, **p<0.01, ***p<0.001

What impact did the intervention have on awareness of the 'Smarter Travel' campaign among secondary school-children?

The intervention was effective in increasing the awareness of the 'Smarter Travel' campaign. There was a 6.2 percentage point increase in awareness in the control town. However, the absolute increases were greater in both intervention towns (table 4.10). Specifically, there was an absolute percentage point increase of 12.7 and 19.7 in intervention towns 1+2 respectively. At follow-up, students from intervention town 2 were most likely to report noticing changes in their town that made it easier to walk and cycle places (table 4.11; $p<0.05$, 88.3% noticed changes). Conversely, students from the control town reported the least awareness of changes in their town ($p<0.05$, 62.3% noticed changes).

Table 4.10 The effect of the intervention on the percentage of students that were aware of a 'Smarter Travel' campaign in their community

	Pre % (n)	Post % (n)	% Diff (95% CI)	Difference in differences % (int vs control; 95%CI)
Control town	16.7 (880)	22.9 (876)	**6.2 (2.5, 10.0)**	
Intervention town 1	17.5 (691)	36.5 (578)	**19.0 (14.1, 23.8)**	**12.7 (6.65, 18.86)**
Intervention town 2	34.4 (596)	60.3 (643)	**25.9 (20.5, 31.2)**	**19.7 (13.17, 26.24)**

All % differences in this table are absolute differences

Table 4.11 The percentage of students that were aware of changes in their town to make it easier to walk or cycle at follow-up

	Control town	Intervention town 1	Intervention town 2	P Value
Total % (n)	62.3 (859)	66.0 (570)	83.3 (633)	**0.000*****
Male % (n)	61.7 (412)	66.7 (141)	82.6 (334)	**0.000*****
Female % (n)	62.9 (447)	65.9 (428)	84.2 (298)	**0.000*****

***p<0.001

4.4. Discussion

4.4.1. Summary of results

In this repeat cross-sectional study, we principally examined the impact of a natural experiment on the total volume of active travel in adolescents. In general, levels of active travel to school were very low. Only 17% of the total sample actively commuted to school and distance was a key factor. Approximately 64% of the total sample lived more than 3km from their school and of these, only 7% actively commuted to school. Boys were more likely to engage in active travel to school but car travel was still the most common (62%) and preferred (47%) mode of travel for both boys and girls. Overall the intervention had a positive effect on students' awareness of the community-wide active travel campaign in both towns. Awareness of the campaign increased by 13 and 20 percentage points in intervention towns 1 and 2, respectively. However there was no concomitant intervention effect on active travel behaviour in either town. There was an intervention effect in one mixed school in intervention town 2 after the installation of new cycle paths and the opening of the converted railway track.

4.4.2. The prevalence of active travel in the intervention and control towns

The prevalence of active travel recorded in this study is noteworthy for two reasons. Firstly, there was a discrepancy in the data from the categorical measure of active travel to school and the continuous measure of active travel to all destinations. Secondly, the overall prevalence of active travel to secondary school was relatively low by Irish standards. Only 17% of the total sample actively commuted to school compared with national estimates of approximately 26% (Central Statistics Office, 2012; Clarke & HBSC Ireland Team, 2013). Consequently, it is a reasonable assumption to expect the average minutes of active travel per day to also be low. Counter-intuitively however, the volume of active travel to all destinations appears relatively high. Chillón, Ortega, et al. (2011) used the IPAQ-A to compare levels of active commuting in adolescents from ten European cities. They reported median values for minutes of walking and cycling per day as 30 and 0, respectively. This is comparable to the pooled mean of 37 minutes of active travel per day in the intervention towns at baseline. This discrepancy is significant because it suggests that adolescents do engage in active travel but it may not necessarily be to school. They may accumulate greater physical activity on the journey home from school or at the weekends. Alternatively, the 'usual travel mode' question may have underestimated active travel to school in circumstances where children walk or cycle a significant portion of the journey to school.

The other noteworthy point is that the baseline difference in active travel between the intervention and control towns suggests that the wider environmental conditions for active travel may have been more favourable in the intervention towns. The potential for change however may have been greatest in intervention town 2. Students in the control town were less likely to have had access to a bike and were more likely to be driven to school. This is despite students in the control town having the shortest journeys to school. As highlighted previously there is a large national primary road that traverses the control town. This may help to explain why the control town had the highest proportion of households with two cars (appendix 1A) and more of a car culture than both intervention towns. It may have been more difficult to detect an intervention effect in intervention town 1 where the 'at-risk' group for active travel was somewhat saturated. Intervention town 1 had the highest proportion of students actively commuting to school. They also engaged in more minutes of any active travel per day than those in intervention town 2. This was expected because intervention town 1 was the largest and most densely populated town of the three and a previous Irish study identified greater population density as a positive correlate of active travel to school in adolescents (Nelson et al., 2008). Furthermore, the students in intervention town 1 were also more than a year older than the rest of the sample. Active travel decreases in Irish adolescents with increasing age (Clarke & HBSC Ireland Team, 2013). Finally, the students from intervention town 2 travelled comparable distances to school (compared with intervention town 1) and the 'at-risk' group for active travel may not have been saturated to the same extent. While these regional differences inevitably introduced bias into the study it is still possible to examine the absolute intervention effects across towns without adjusting for baseline differences. The more favourable conditions for creating a modal shift in intervention town 2 supports the trend towards an intervention effect in one particular school. Additionally, this may have been a factor in their designation as a 'Smarter Travel Area'[10]. This also highlights the selection bias inherent in quasi-experimental studies.

4.4.3. The convenience of passive travel to school for adolescents

The main focus of the interventions targeting adolescents in both intervention towns was to increase active travel to school. The school setting is the most obvious location to focus these interventions but their potential to create a modal shift away from passive travel to school is questionable. In this study, consistent with the primary school data, car use was the most common mode of travel to school in the total sample (62%). There are several possible explanations for this but students' concern about road safety is unlikely to be the main one. The average age of the students was greater than 14 years in both intervention towns suggesting that they may already have been granted independent mobility (Carver et al., 2014). Parents of adolescents tend to be more concerned with road safety than adolescents themselves are (Forman et al., 2008; Hume et al., 2009). This is supported by Panter, Jones, and van Sluijs' (2008) systematic review of the environmental determinants of active travel in adolescents. Panter and colleagues (2008) noted that social interactions and facilities to assist active travel (footpaths and

[10] Intervention town 2 was one of three Irish demonstration towns that shared €22 million in funding over 5 years for active travel initiatives.

cycle lanes) were more important determinants of active travel than road safety for adolescents. It is also supported by the fact that given a choice, 47% of the sample would still prefer to travel to school by car. Although not directly measured in this study, it is plausible that this preference for car travel is supported by high parental habit strength and trip chaining (De Witte et al., 2013).

The relationship between active travel and social interactions may have evolved somewhat in recent years. It is plausible that car travel may now actually facilitate greater opportunities for social interaction via social media than offered by (accompanied) active travel. Younger children's (12-14 years) travel decisions tend to be motivated by fun seeking and less about the practicality associated with different travel modes (Transport for London, 2008). This age group may be more receptive to messages emphasising the greater social connectedness associated with active travel to school. Parental perceptions about road safety on the route to school should also be addressed. The travel decisions of older adolescents (15-18 years) tend to be more influenced by the practicality associated with different modes of travel (Transport for London, 2008). This may be even more applicable in smaller towns and cities. These attitudes may be harder to influence and particularly for active travel to school. The barriers associated with active travel to school for adolescents (getting hot and sweaty, not cool, stuff to carry, easier to be driven, no other children, too much planning) are greater than those reported for active travel to other destinations (Forman et al., 2008). Older adolescents need to be convinced that active travel is superior to passive travel in terms of practicality (Transport for London, 2008). They are greatly influenced by the journey time associated with active travel and the degree of autonomy it offers (Simons et al., 2013).

Considering 65% of students in this study lived more than 3km from their school, it is understandable why the car may have been more convenient in terms of travel time, carrying schoolbags and less trip planning. The distance of the journey to school is an important factor that is likely to significantly reduce the practicality of active travel and is consistently reported as a negative correlate of active travel to secondary schools (Babey, Hastert, Huang, & Brown, 2009; Chillón et al., 2014; Nelson et al., 2008; Silva, Vasques, Martins, Williams, & Lopes, 2011; Van Dyck et al., 2010). This is another explanation of why the proportion of students actively commuting to school and the total volume of all active travel was higher in intervention town 1. Intervention town 1 was the largest and most congested town (appendix 1A). The majority of active travel was by walking and while walking may not necessarily be quicker than car travel, parents may have been more reluctant to drive their children to school. The previous section highlighted how the at-risk group for the intervention may have been somewhat saturated in intervention town 1. This may be particularly true for active travel to school. Approximately 31% of students lived more than 3km from their school in intervention town 1 compared with 39% in intervention town 2. Furthermore, town 2 had the highest proportion (17%) of students living within 1.5km of their school. Therefore intervention town 2 was better placed to detect an intervention effect (based on increased active travel to school) but the at-risk population for change was still quite small. This helps to explain the lack of an overall intervention effect in either town. It also questions the effectiveness of promoting active travel to school for older adolescents who indicate high preferences for car travel and low preferences for cycling.

4.4.4. The effectiveness of active travel interventions for adolescents

The intervention did have a significant effect on awareness of the active travel campaign in the intervention towns. There was an absolute percentage point increase in campaign awareness of 12.7 and 19.7 in intervention towns 1 and 2 respectively. Nonetheless there was still a marked difference in campaign awareness between the towns at follow-up (Intervention town 1, 36.5%; intervention town 2, 60.3%). This pronounced difference in campaign awareness was expected for several reasons. The campaign in intervention town 2 was sustained, had a consistent brand, targeted secondary school-children specifically and used social media as a social marketing platform. The most obvious explanation however might be the volume of infrastructural measures implemented in intervention town 2 between the baseline and follow-up surveys (appendix 2). The introduction of new cycle lanes (converted railway track), footpaths, traffic calming measures and associated signage created greater visibility for the campaign and also garnered considerable media attention (appendix 7D). This is reflected in the fact that at follow-up, 83.3% of students from town 2 were aware of changes to make it easier to walk and cycle places in their town (17% higher than town 1). Consistent with the outcomes reported in chapter 3, increased campaign awareness didn't translate into a detectable community-wide change in travel behaviour. This may be due to the timing of the follow-up surveys only a year after the establishment of the GO Dungarvan brand in town 2. Evaluations of fully complete and integrated active travel interventions report the greatest intervention effects (Pucher, Dill, et al., 2010).

Despite the lack of an overall intervention effect, there were several significant changes evident when the data were analysed separately for boys and girls and for individual schools. Firstly, there was an absolute increase in mean minutes of active travel per day in adolescent males in both the pooled data and in intervention town 2. This could be due to an increase in cycling for transport in the intervention towns and particularly intervention town 2. Consistent with other Irish data (Central Statistics Office, 2012), boys in this study were more likely to cycle to school than girls. They also indicated a greater preference for cycling compared with walking (opposite trend for girls). National trends suggest that the prevalence of cycling to secondary school is increasing, albeit at the expense of walking (Central Statistics Office, 2012). This apparent increase in active travel may have been facilitated by the lack of access to bicycles in the control town (74% in control town; 80% in intervention towns) so their potential for change was limited. Alternatively, there are several reasons why this intervention effect may just be random variation. Seven minutes is only a marginal increase, the standard deviations were large and there was no concomitant absolute increase evident in the log10 transformed data. There were multiple comparisons conducted in tables 4.2-4.9. The intervention effects would not have been significant had the Bonferroni correction been applied. Taken together it is most likely that the intervention effect was either random variation or a very small intervention effect. Both of these conclusions are supported by the fact there was no concurrent changes in MVPA or total physical activity.

There are more compelling arguments to support and explain the intervention effect detected in the mixed school in intervention town 2. The absolute magnitude of the increase (20 minutes per day) was greater than that reported for males in the wider sample and the change was also significant in the log10 transformed data. This school had the lowest levels of active commuting in intervention town 2 so there was a large at-risk population for change. This is in contrast to the results of a multi-component active travel intervention targeting Danish adolescents (Christiansen et al., 2014). Christiansen and colleagues mainly attributed the lack of intervention effect to the high baseline levels of active commuting (85%) and the lack of infrastructural provision.

The school in this study was ideally located in an area called 'Duckspool' which was located within 2km of the local town and within 1km of a major residential suburb (see map in appendix 2). Most importantly this school benefitted from the introduction of significant infrastructural measures for active travel within 12 months of the baseline surveys. This was the main focus of interventions to increase active travel in adolescents in the town. These measures included the converted railway track passing in close proximity to the school, new cycle lanes, upgraded footpaths, a pedestrian crossing and separation of pedestrians and cyclists from traffic at a roundabout (description and photos in appendix 2). There were similar measures implemented in the vicinity of the towns' other schools but not on the same scale. The influence of such facilities to assist active travel is supported by systematic reviews of the determinants of active travel in school-children (Pont et al., 2009) and particularly for adolescents (Panter et al., 2008). One unexpected finding is that no intervention effect was detected for girls in intervention town 2 (all schools). Although road safety appears to be a less important determinant of active travel for adolescents it is significantly more important for adolescent girls (Carver et al., 2008; Evenson, 2006; Nelson & Woods, 2010). The predominant intervention focus (location of hard measures) and considerable investment in infrastructure for active travel should have greatly improved the safety of children's routes to school. It may be that the provision of safe routes to school allayed parental fears of their children's travel mode but did little to promote active travel as a credible alternative to passive travel for girls themselves. It would be interesting to replicate the same scale of infrastructural investment in town 1 where the most preferred mode of travel amongst boys was cycling. After distance, time was cited as the most important barrier to active travel amongst Irish adolescents (Woods et al., 2010). The greater congestion in town 1 may have presented cycling as a credible alternative to passive travel amongst adolescents and boys in particular. The combination of infrastructural provision may have a greater synergy than one infrastructural measure alone.

4.4.5. Strengths and limitations

The research design for this study was similar to that described in the previous chapter. Many of the strengths and limitations associated with the primary school study also apply here. That is, the main strengths of the research design included the use of seasonally matched surveys, relatively large sample sizes, high external validity and most importantly, the timing of the baseline surveys immediately prior to the introduction of extensive infrastructural measures in intervention town 2. Although it was a repeat cross-sectional design and we cannot comment on the individual determinants of change, it nonetheless adds to the very limited experimental literature in the area of active travel and for adolescents in particular. The results were also presented separately for boys and girls. The large sample sizes made it possible to detect changes at the school level which may otherwise have been missed. The response rates were good but one all-male school in intervention town 1 failed to return their follow-up surveys. There was a trend towards an increase in mean minutes of active travel in the remaining sample of males in this town. An intervention effect may have been detected with a greater sample size. However this would have been unexpected considering the lack of intervention components likely to influence active travel in adolescent boys in intervention town 1. Another limitation inherent in natural experiments is the lack of experimental control. In this study, there were several examples of why the students in the control town may have had less potential to change to active modes of travel (i.e. greater car ownership, lower walkability due to the national primary route traversing the town and having less access to bicycles).

Aside from the research design, there were also several strengths and limitations associated with the survey instrument itself (both design and administration). Unlike the majority of the literature (Herrador-colmenero et al., 2014) the IPAQ-A provided a continuous measure of active travel which encompassed both school and non-school related active travel. Mode preference for travel to school was measured in addition to actual mode of travel. This survey item highlighted students' preference for car travel. Although the IPAQ-A has been used elsewhere to measure active travel specifically, it has not been validated for the measurement of subdomains (Chillón, Ortega, et al., 2011; Herrador-colmenero et al., 2014). The IPAQ-A has been shown to over-report physical activity (De Cocker et al., 2011; Ottevaere et al., 2011) something which is always a concern in self-reported physical activity surveys due to social desirability bias. Recall bias is another issue particularly for adolescents who may underestimate moderate activity and overestimate vigorous activity (Armstrong & Welsman, 2006). The validity of the total physical activity and MVPA variables in the IPAQ-A is weaker in younger adolescents. This may infer that the measurement of the transport subdomain is also less precise in younger adolescents. However, this study is more concerned with the magnitude of change than the accuracy of the volume of active travel at any one point in time. In relation to the survey administration, one of the subdomains (leisure) incorrectly restricted student's answers to five days instead of seven days. Consequently all data were presented as daily minutes of physical activity. However, the data for MVPA and total physical activity is likely to be underestimated because of the omission of weekend activity. Nonetheless these variables were only secondary outcomes in this study.

The IPAQ-A doesn't differentiate between school and non-school active travel which would have facilitated clearer recommendations about strategies for promoting active travel with adolescents. Questions on student's destination specific attitudes to walking and cycling were not included but would have helped to interpret the lack of a community-wide intervention effect. Mode of travel to school was only measured at follow-up and there was no question on travel home from school. Perceived distance to school was used as an estimate of actual distance to school to protect the anonymity of children. These limitations were all considered before the final survey was designed. One overriding consideration was the importance of administering the survey before the opening of the flagship infrastructural measures in intervention town 2. Furthermore, the aim of the programme evaluation was to measure the volume of active travel as opposed to active travel to school specifically. Finally, the questionnaire was designed to be as short and as anonymous as possible to ensure high response rates. Financial constraints precluded the use of GIS and accelerometry to validate the self-reported active travel data. Objective measures of the built environment were not included for the same reason. The concurrent validity study of the emended IPAQ-A only examined the validity of the tool for measuring overall physical activity and the associated intensity (Spratt, 2015). Finally, the data were not analysed for those that lived within criterion distances for active travel because the vast majority of students lived beyond these thresholds and active travel to school was not a primary outcome measure.

4.4.6. Implications of the research findings

Implications for practice

- In this study, the principals of each school were sent a report outlining the travel and physical activity data for students in their school. The report compared the data from their own school to community-wide and national averages. This could be adopted as a strategy to prompt wider discussion about active travel and physical activity at the school level.

- Measures to reduce the convenience of travel to school by car should be implemented alongside measures to promote active travel. Such measures should include initiatives to change parental attitudes to driving their children to school and the introduction of parking restrictions outside schools. Adolescents should be targeted with initiatives to present cycling to school or other destinations as a superior mode of transport than travel by car. These messages should present cycling as a time efficient mode of travelling independently and safely. Active travel to school interventions should also target those living within the criterion distances for walking and cycling and introduce drop-off points within walkable distances (<1.5km) of the school.
- Comprehensive infrastructural measures on the primary routes to secondary schools should be introduced, particularly in areas where levels of active travel to school are known to be low and criterion distances are favourable. These measures should be designed to create a fully integrated active travel network in the wider neighbourhood. That is, the primary routes to school should be linked to all the residential, recreational and retail destinations within 2-3km of the school. The cycle lanes and footpaths should be continuous and separated from traffic where greater safety is required (e.g. at roundabouts). They should be introduced before sex and age specific softer active travel measures are introduced. Infrastructural provision alone is unlikely to be enough in locations where levels of active travel are near average.

Implications for research

- Further longitudinal and experimental studies should be conducted separately for boys and girls to identify the sex and age specific determinants of active travel. These studies should assess the contribution of features of the built and physical environment. Quasi-experimental interventions should include control towns that are better matched to intervention towns in terms of the physical environmental conditions for active travel. Studies should also identify other areas within the intervention town to act as controls when active travel infrastructure is being phased in.
- The two year follow-up data should be repeated again in 2016 to assess the longer-term impact. The baseline data from this study represents the only true baseline of active travel in intervention town 2. The official evaluation of the

national 'Smarter Travel Area' programme commenced data collection several months after the opening of the converted railway track. A second follow-up survey would facilitate the examination of the potential synergy achieved by the addition of a comprehensive suite of softer measures in intervention town 2. Furthermore several new infrastructural measures have been introduced in both towns since the collection of the follow-up data.

- An in-depth qualitative study of Irish adolescents should be conducted to better understand the factors that influence their travel choices. Data should be collected separately for boys and girls and separately for younger (12-14 years) and older adolescents (15-18 years). This study should also examine the factors that contribute to the convenience of car travel to school and whether the same factors apply to non-school travel.
- There is a paucity of studies on active travel to non-school destinations. Further studies should examine the factors that influence active travel to school, parks and other recreational facilities, friends' houses and shops separately.
- Studies of active travel to school should stratify their analysis according to the distance travelled to school and separately for walking and cycling.
- A validated self-report tool of destination specific active travel for both younger and older adolescents is required. This tool should provide a continuous measure of destination specific active travel. It should also contain items to assess the proportions of actual and preferred modes of travel to school.

4.5. Conclusion

This study failed to detect a community-wide intervention effect on active travel behaviour in either intervention town. This was understandable in intervention town 1 where the intervention intensity for adolescents was relatively low. The lack of an intervention effect in town 2 was more surprising considering the extent of the investment in infrastructural measures. The large magnitude of the effect in students attending the mixed school in town 2 was the most important finding in this study. Replicating the scale and intensity of these measures in specific areas of other Irish towns where levels of active travel are already low would appear to be an effective strategy. They may also be financially prohibitive. The mechanisms for this intervention effect are still unclear. It may be that this type of approach creates more opportunities for social connections either through independent travel to non-school destinations or via active commuting to any destination with friends. It may be that the scale of the infrastructure allayed parental fears about road safety. It is unknown whether replicating these infrastructural measures would have a similar effect in towns where levels of active travel are already high due to congestion. The results of this study suggest that infrastructure for active travel should be introduced into neighbourhoods surrounding schools before the implementation of soft measures. Given girls' greater preference for passive travel to school and the proportion of all students living beyond 3km of their school these soft measures should preferentially promote active travel to non-school destinations. Finally, they should simultaneously promote active travel and reduce the perceived or actual convenience of car travel.

CHAPTER 5. THE IMPACT OF A MULTI-COMPONENT ACTIVE TRAVEL INTERVENTION IN ONE ALL-GIRLS SECONDARY SCHOOL

5.1. Introduction

Chapters three and four described the impact of the community-wide interventions on primary and secondary school-children, respectively. The community-wide interventions did not specifically target schools in a comprehensive and multi-strategic manner. Unlike chapters three and four, chapter five describes the impact of an intensive and targeted active travel intervention with one all-girls secondary school in intervention town 1. The chosen intervention school had planned to participate in the Samsung Smart School pilot programme. All 1st year students were to receive tablets with digital pens (e-books) preloaded with the majority of the textbooks for their 13 subjects. This initiative facilitates more interactive learning but coincidentally reduces the weight of schoolbags considerably (weight of schoolbags estimated to be approximately 15kg). This offered the opportunity to conduct a natural experiment whereby the weight of schoolbags would no longer be a barrier to active travel to school. There was potential to achieve a certain synergy from introducing further measures in parallel with this e-book initiative.

The rationale for conducting an intervention with adolescent girls in a school setting was presented in chapter two. The key features of this evidence is summarised as follows. It is well documented that adolescent girls are less likely than adolescent boys to meet the guidelines for daily MVPA (Kelly et al., 2012; Woods et al., 2010). In countries with lower levels of active travel like Ireland, they are also less likely to walk or cycle to school (Central Statistics Office, 2012; Woods et al., 2010). A higher percentage of children walk or cycle to Irish primary schools compared with secondary schools. The transition from primary to secondary school has been associated with a significant decrease in active travel (Larouche et al., 2013). Finally, active travel to school has been shown to contribute to the achievement of physical activity guidelines, particularly among females (Southward et al., 2012). Despite this, there is a notable absence of active travel intervention studies in the physical activity and transport literature.

5.2. Methodology

5.2.1. Research design

This was a quasi-experimental study conducted in one all-girls school in intervention town 1 from May to December, 2012. A second all-girls school in the same town was chosen as a control. The study also coincided with the implementation of the community-wide intervention in intervention town 1 (less intensive than intervention town 2). Unlike the community-wide intervention, this study specifically targeted one school and was the only multi-component, whole-school intervention implemented in either intervention town. The impact of the study was measured by the administration of surveys in May 2012 and May 2013 (five months post-intervention). Qualitative data were also collected from December 2012 - January 2013 to inform the intervention design and to serve as a process evaluation. The qualitative data included four focus groups (before and after the intervention), reflective notes from two trainers and notes from two class workshops on active travel.

5.2.2. Research questions

Impact of intervention

1. What impact did the intervention have on the proportion of students (girls) that walk or cycle to this all-girls school, compared to one control?
2. What impact did the intervention have on weekly minutes of active travel and physical activity in this all-girls school, compared to one control?
    a. Was there a difference in the change in weekly minutes of MVPA or total physical activity between this all-girls school, compared to one control?
3. What impact did the intervention have on the students' attitudes to active travel in this all-girls school, compared to one control?
4. What impact did the intervention have on the students' awareness of active travel promotion in this all-girls school, compared to one control?
5. What were the factors that influenced travel mode to school of adolescent girls in this all-girls school?

Secondary research questions

1. Was there an association between active travel and meeting the MVPA guidelines for adolescent girls?
2. What were the correlates of walking to school for adolescent girls?

5.2.3. Study population and sampling

There are only two all-girls secondary schools in intervention town 1. One of these schools, the Loreto Secondary School (821 pupils), planned to introduce e-books for their 1st year cohort enrolling in September 2012. The Loreto is 1.3 km from the centre of intervention town 1 and in 2012 was one of only two secondary schools in the town to be awarded the 'Active Schools Flag' from the Department of Education and Skills. The other all-girls school is the Presentation Secondary School (549 pupils) which is located 1.6 km from the centre of intervention town 1. This was selected as the control school. Both schools had comparable facilities for sport and physical activity. The promotion of both curricular and extra-curricular sport was central to the ethos of both schools. Walking or cycling to school was not actively promoted in either school before 2012. Pedestrian access to both schools was adequate but neither school was completely served by safe cycle lanes before or during the intervention. The principals of both schools granted permission to conduct the study which was administered with the help of the schools Physical Education (PE) teachers. An information letter (appendix 5A) was sent home to the parents of all students (years 1-6) in both schools in the first week of May 2012. This letter sought the passive consent of parents for their child to complete the survey the following week and to participate in a focus group if selected. This sampling procedure was replicated in May 2013 for the cross-sectional post-intervention survey. Focus group participants were identified by the PE teacher in the intervention school using convenience sampling. They were chosen from 1st and 2nd year classes (aged 12-15 years) and the final sample was diverse in terms of residential location and mode of travel to school. An average of eight students attended each of the four focus groups. Approximately 25 4th year students (aged 15-16 years) participated in each of the two active travel workshops. These workshops were delivered as part of the 4th year active travel module.

5.2.4. Intervention

A female-specific active travel module was developed and piloted with one 4th year (transition year) class from January to April 2012. Transition year is the 4th year in Irish secondary schools. It focuses on personal development and offers students an opportunity to study non-traditional subjects, learn new skills and get work experience. Six 1-hour workshops (table 5.1) were delivered by the investigator (trainer one) as part of the 4th year module in the presence of the school PE teacher. Trainer one was a 3rd level lecturer with extensive experience in teaching and group facilitation. The workshops were designed to be interactive and experiential. On completion of the structured workshops, the class took ownership of several active travel related projects (planning of a school-wide active travel day, recording of weather during commute periods and both walkability and bikeability audits of the most common routes to school). Both the PE teacher and the investigator supported them with these tasks. An active travel to school day (Leg it to Loreto) was held on May 15th 2012. The entire school was encouraged to walk or cycle to school on that day. Those that did walk or cycle were given a ticket outside the school gates entitling them to a free breakfast bag. Over 230 students walked (n=208) or cycled (n=24) to school on the day. The advertising of 'Leg it to Loreto' day was the first active travel message received by the entire school population after they completed the baseline questionnaire.

Table 5.1 Structure and content of the active travel module

Workshop	Content
1	Barriers and benefits
2	Challenging barriers
3	Case study – Bike Belles project
4	Project planning 1
5	Walkability and bikeability audits
6	Project planning 2

In September 2012, a three week bike training course was delivered to all 1st, 2nd and 4th year students (approximately 340 students). This was designed based on feedback from the 4th year classes. It consisted of three 80-minute classes that were delivered during PE classes by three trainers who had the UK's Bikeability training qualification. Two of the classes were held in a closed environment on the school all-weather playing field and one class was held on the road in a real traffic situation.

Also in September, as mentioned in the introduction (section 5.1), the school participated in the Samsung Smart School pilot programme. All 174 1st year students received tablets (with digital pens) preloaded with the majority of the textbooks for their 13 subjects. A shorter version of the active travel module was delivered to two 4th year classes between September and December 2012. Each class received workshops 1-3 listed in table 5.1 above (class one from Sept-Oct; class two from Nov-Dec). Half of these were delivered by trainer one and the other half by one of the bikeability trainers (trainer two). The PE teacher was present for all workshops. Class one organised a 10-week active travel to school challenge for the entire school supported by their PE teacher. This ran from October 2nd until December 12th and required students to walk or cycle to school at least twice per week for nine of the ten challenge weeks. Students from class one monitored and recorded the names of students walking and cycling to school on the designated active travel days (Tuesdays and Thursdays). A specially designed active travel hoodie (appendix 5C) was offered as an incentive to complete the challenge. In total, 189 students successfully completed the challenge predominantly by regular walking as opposed to cycling. The challenge was promoted weekly throughout the school by the 4th year classes via intercom announcements, calling to each class and posters.

A social media group (Facebook) was also formed and maintained by trainers one and two to promote active travel in general and challenge students' barriers and stereotypes. One hundred and ninety four students joined this group with approximately 140 seeing the weekly posts. The trainer-led intervention finished in December 2012 but the PE teacher used the workshop resources in January 2013 to deliver workshops one, two, three and five to new 4th year classes. Section 5.2.7 contains a Gantt chart illustrating the timeframe associated with the implementation of all the intervention components. Photos of the intervention are available in appendix 5C.

5.2.5. Data collection tools

Questionnaire

The five part questionnaire (appendix 5A) was piloted with approximately 50 female students (aged 12-17 years) from another town, prior to its use. No changes were made except minor grammatical amendments to the IPAQ-A (part three).

Part 1: Demographic information

This section measured age, school year and socioeconomic status (SES). Socioeconomic status was estimated using one of the five items normally contained in the Family Affluence Scale used in the International HBSC surveys (Schnohr et al., 2008). The item used was 'perceived family wealth' which has been shown to be an important element of the scale (Schnohr et al., 2008) and has been used in isolation elsewhere (Szczepaniak-Kubat, Kurnatowska, Jakubowska-Pietkiewicz, & Chlebna-Sokół).

Part 2: Characteristics of active travel to school

This section measured how students usually travelled to school and how they would prefer to travel to school. It also asked whether they had access to a bicycle and to estimate how long (minutes) and far (km) their trip to school was. A parallel study was conducted to examine the relationship between estimated and actual distance to school (Spratt, 2015). This was conducted with a sub-sample of students from this study and male students from a school in a nearby town (n=254, aged 13-16 years). Students estimated that their journey to school was 1.49km (±4.5) longer than it actually was. Younger students (13-14 years compared with 15-16 years) were most likely to overestimate their journey distance.

Part 3: International Physical Activity Questionnaire for Adolescents (IPAQ-A)

See section 4.2.5

Part 4: Attitudes to walking and cycling for transport

This section contained 37 statements (21 for cycling and 16 for walking) related to the individual, social and environmental factors that influence active travel to school. Each statement was measured on a five point Likert Scale from strongly agree to strongly disagree. The statements were adapted from a similar study reported in the US (Emond

& Handy, 2011). Reliability analysis was conducted on the baseline data. Items 3, 12, 19 and 20 were reversed for the cycling scale and items 8, 10, 14 and 15 were reversed for the walking scale. The Cronbach alpha coefficient was 0.78 for the cycling scale and 0.83 for the walking scale.

Part 5: Active travel campaign awareness

The last section included questions about whether respondents could recall any events or activities related to active travel in either their school or in the wider community. They were asked to name and provide details of the event or activity.

Focus Groups

The focus group topic guides (appendix 5A) were predominantly unstructured. The pre-intervention topic guide adopted a mostly phenomenological approach by asking students about their experiences of different travel modes to school e.g. '*tell me about your typical trip to school*'. The discussion also focused on the factors that most influenced their travel behaviours e.g. '*What things would make you want to get a lift instead of walking / cycling?*' The post-intervention topic guide was similar but also gauged students opinions of the specific intervention components.

5.2.6. Data collection method

Questionnaire

The PE teachers in the intervention and control schools sent the baseline study information and passive consent letters home with all students (years 1-6) between Tuesday April 24th and Thursday April 26th 2012. There were no requests to withdraw a student from the study. The PE teachers were instructed by phone on how to complete the questionnaire. The baseline questionnaires were completed by students during class from Monday April 30th to Friday May 4th 2012. The post-intervention information and consent letters were sent home between Tuesday April 23rd and Friday April 26th 2013. The post-intervention questionnaires were completed from Monday April 29th to Friday May 3rd.

Qualitative data

Four focus groups were conducted in total. Two were held in January 2012 (pre-intervention) with 1st and 2nd years separately followed by two more in December 2012 (post-intervention). The focus groups were held in classrooms and lasted between 25-30 minutes and were recorded using an Olympus DS-2300 digital voice recorder. Active travel workshops were conducted as part of the 4th year active travel module. These were held in January and December 2012. One of these workshops examined the barriers and benefits of active travel. Specifically, students were asked to list and rank the main barriers and benefits of active travel to school. The data from the workshop was recorded on the white board during class and then transferred to a note pad. Two trainers made reflective notes during the implementation of several specific intervention components (cycle training, 'Leg it to Loreto' day and the incentivised challenge). Trainer one (investigator) reflected on the overall intervention and trainer two (bikeability trainer) reflected on the cycle skills training only. Both trainers only documented factors that influenced the delivery or outcome of the intervention components.

5.2.7. Intervention and data collection timeframe

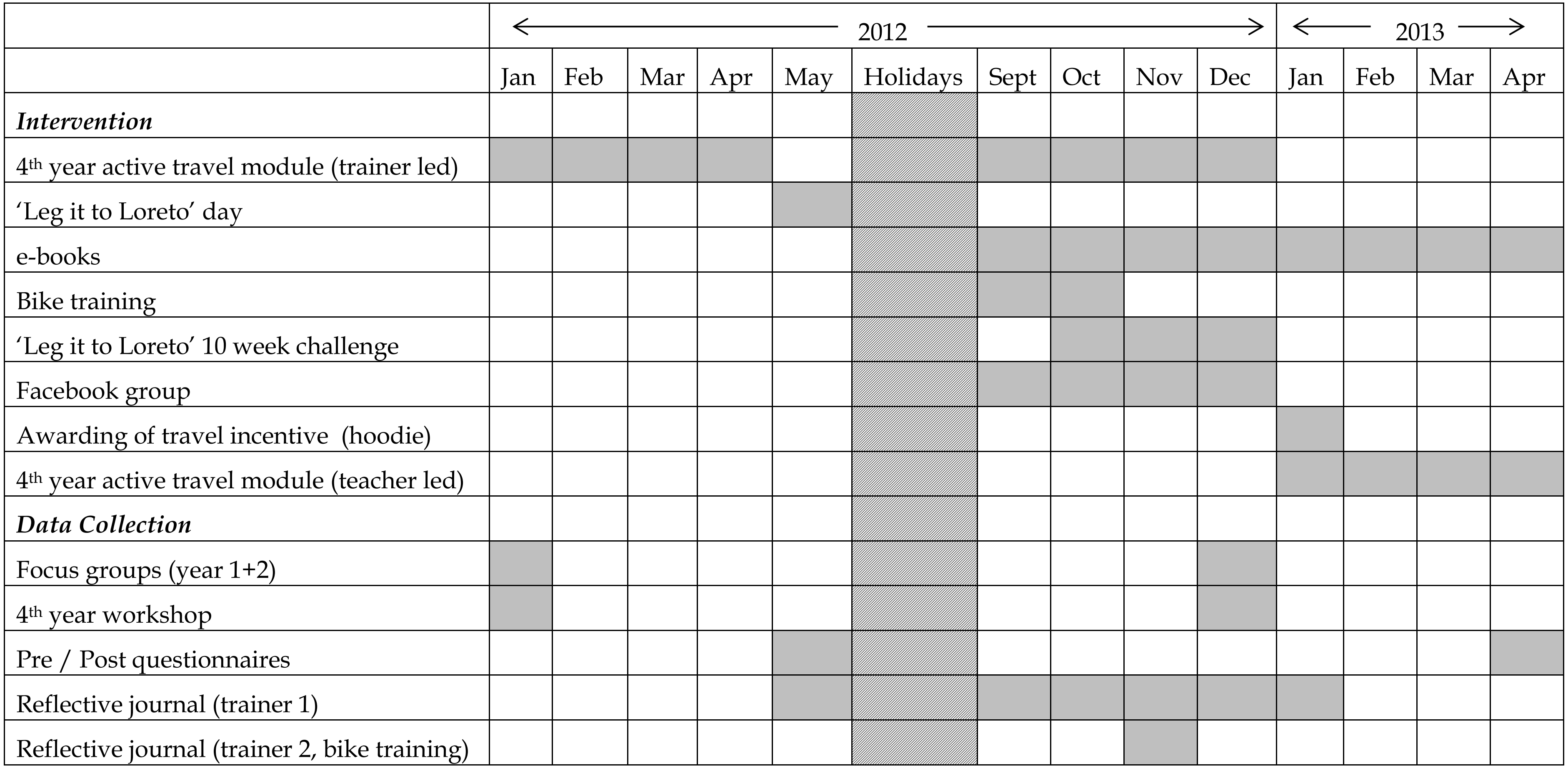

Figure 5.1 Gantt chart of intervention and associated data collection timeframe

This was a nested intervention. See appendix 2 for a description of the wider community intervention in intervention town 1 and section 4.2.4 for a figure illustrating the relative intensity of the intervention components targeting secondary schools.

5.2.8. Data analysis

Questionnaire

The cleaning, truncation and data analysis procedures for the IPAQ-A described in section 4.2.7 were replicated in this study. The absolute change in proportions (difference in differences) and within school changes in physical activity minutes were calculated using 95% confidence intervals consistent with previous research (Goodman, Panter, et al., 2013). The absolute change in physical activity between schools (minutes and log transformed minutes) was tested using an independent t-test of the difference between means and examination of the extent of overlap between confidence intervals. A Bonferroni correction was applied to all secondary outcome variables to control for familywise error with multiple testing of physical activity domains.

Binary logistic regression was used to determine whether those that engaged in active travel were more likely to meet the MVPA guidelines for adolescents. All data were tested for multicollinearity. The outcome variables were active travel to school, walking for transport (>2 days per week) and cycling for transport (>2 days per week). The predictor variables were age, family affluence, distance from home to school and bicycle access. Binary logistic regression was also used to identify the correlates of walking to school. There were insufficient numbers to model cycling to school. Two sets of models were created. The first consisted of entering all attitudinal statements (dichotomised) into a logistic regression model individually while controlling for age, family affluence, access to a bicycle and distance from home to school. Those variables that were statistically significant were then entered into a fully adjusted model. The distance variable was recoded as <1.5km, 1.5-3km and >3km. These thresholds were previously identified to represent criterion distances for walking and cycling (Ducheyne et al., 2012). Regression analysis was conducted on the baseline data only and significance was set at an alpha level of 0.05 for all analysis.

Qualitative Data

The qualitative analysis was conducted to better understand the factors that influenced students' travel mode choices to school (before and during the intervention). This served to both help design the intervention and to understand how effective it was once triangulated with the quantitative data. Although there were eight sources of qualitative data, the actual quantity of data was small. The reflective notes from trainers and the 4th year workshops were short. The students that participated in the focus groups did not contribute as much as expected so much of this data is paraphrased by the researcher. Nonetheless, the focus group recordings were transcribed verbatim using MS Word 2010. Firstly, hard copies of each data source were read twice. Subsequently, they were read a 3rd time and codes that summarised several sentences or a short paragraph were written in the margin. Six final codes were generated during this process and a code book was created to reflect the content of each code. A simple coding hierarchy was created by dividing five codes into two separate themes (barriers and motivations). The final code (empowering project leaders) was promoted to be a theme on its own.

5.3. Results

What were the characteristics of the sample at baseline?

The average response rates (2011 and 2013) were 78% and 82% for the intervention and control schools, respectively. The baseline characteristics of the sample are shown in table 5.2 below. Students in the intervention school were slightly younger ($p<0.05$, although the difference was very small) and they were more likely to have access to a bicycle ($p<0.01$). They were also more likely to perceive their family as being well off ($p<0.01$). The majority of students lived more than 3km from their school. The data in figure 5.2 indicates that active travel to school was more common in the control school (13.9% vs 19.4%, $p<0.05$) and that those who lived within 1.5km of their school were most likely to walk or cycle to school ($p<0.001$). The relative difference between schools in the proportion that actively travelled to school was similar when the data was analysed by distance category (<1.5km, 1.5-3km, >3km). Car travel was both the most common and most preferred mode of transport to school in both schools (figures 5.3 and 5.4). Students in the intervention school travelled shorter distances to school by car ($p<0.05$). For those that travel to school by car, 42% lived within 3km of the intervention school and 30% lived within 3km of the control school. Conversely, cycling was both the least common and least preferred mode of transport to school in both schools[11].

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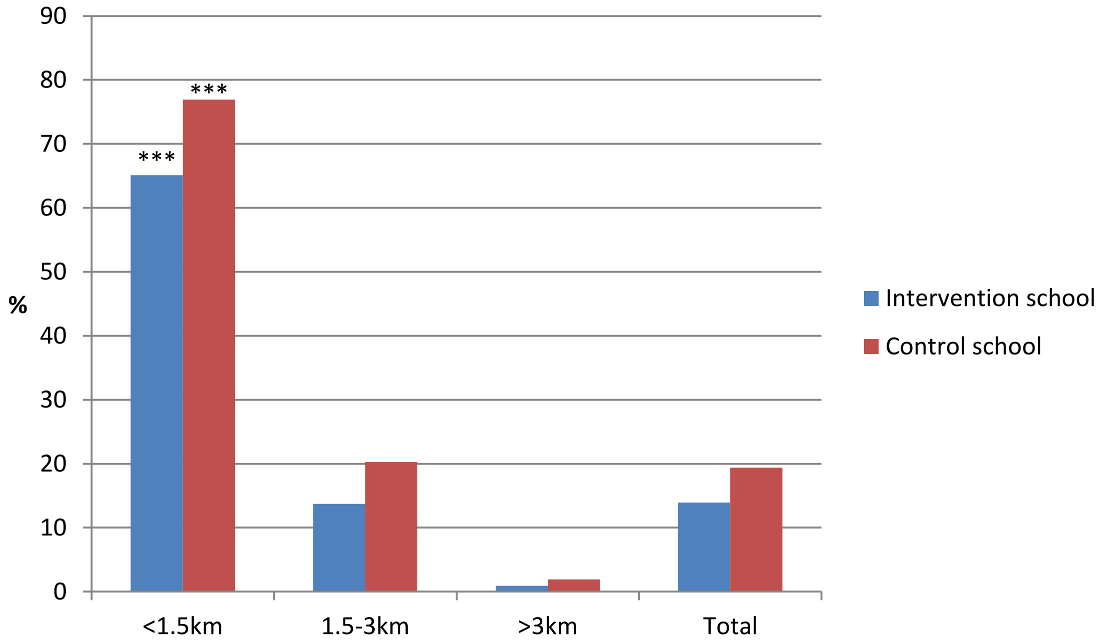
[11] See appendix 5B for full data on actual and preferred travel modes by school and year

Table 5.2 Sample characteristics at baseline

	Intervention school (n = 641)	Control school (n = 450)	P value
Age (years ± SD)	15.1 (1.6)	15.3 (1.6)	0.038*
Family not well off (%)	5.4	9.3	0.002**
Journey time to school (mins ± SD)	18.2 (10.2)	17.3 (10.8)	0.153
Journey distance to school (km ± SD)	8.1 (7.0)	8.4 (8.0)	0.596
Home <1.5km from school (%)	15.5	18.6	
Home 1.5-3km from school (%)	23.1	17.7	
Home >3km from school (%)	61.4	63.7	
Access to bicycle (%)	82.9	74.4	0.001**
Meeting MVPA guidelines (%)	53.2	46.1	0.022*

*p<0.05, **p<0.01, ***p<0.001



***p<0.001

Figure 5.2 The prevalence of (usual) active travel to intervention (n=536) and control schools (n=419) according to distance between home and school at baseline

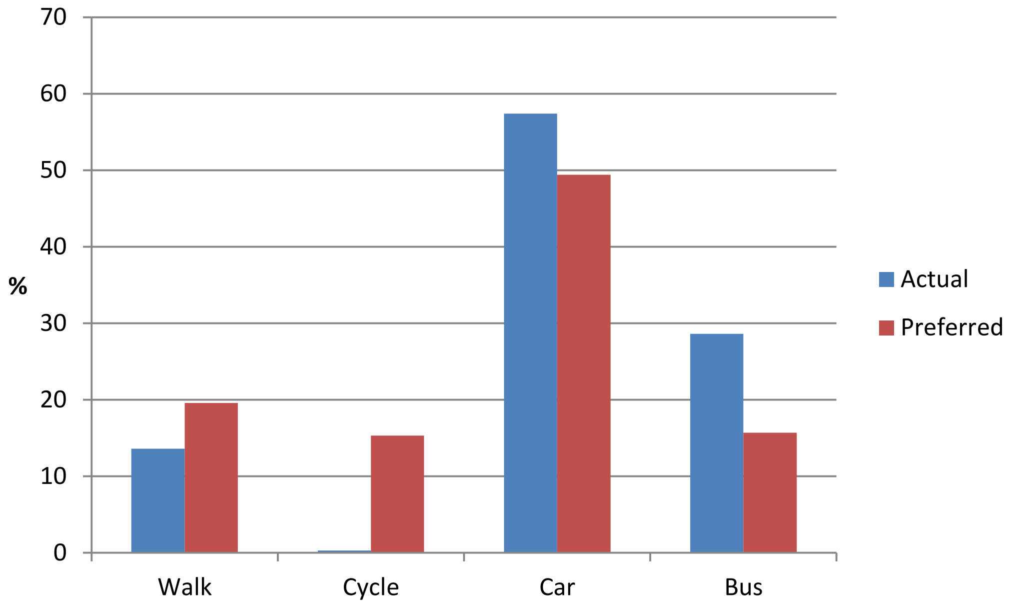


Figure 5.3 *Actual (usual) and preferred mode of travel to school in the intervention school at baseline (n=611)*

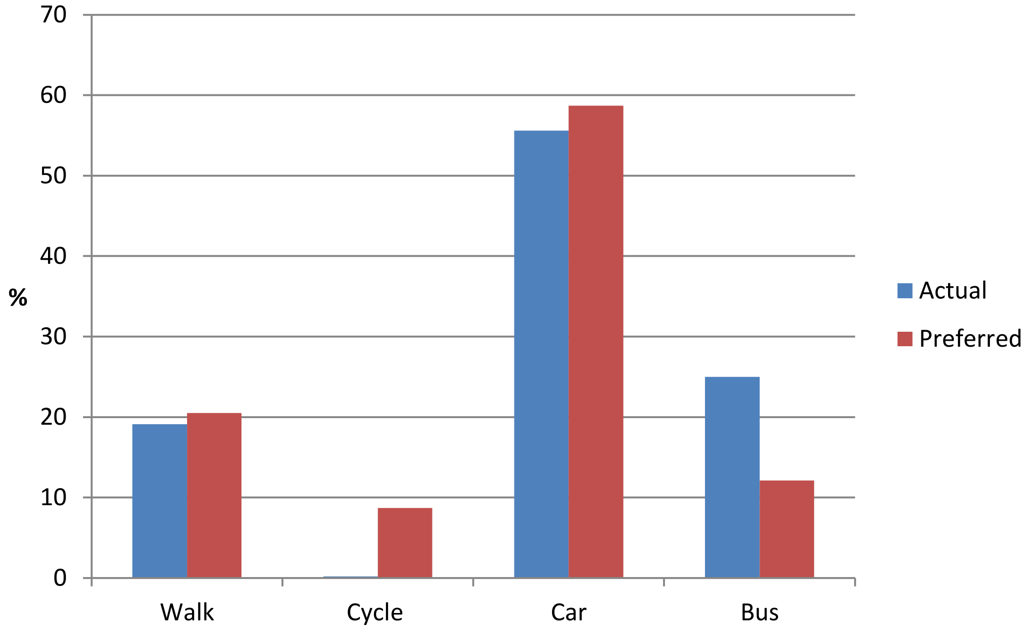


Figure 5.4 *Actual (usual) and preferred mode of travel to school in the control school at baseline (n=444)*

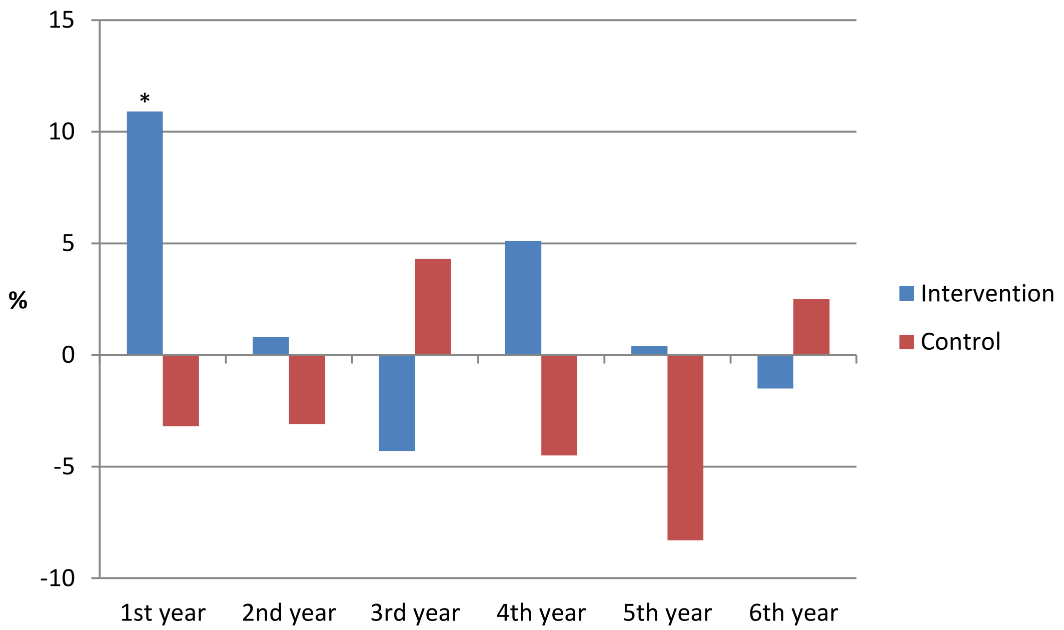
What impact did the intervention have on the proportion of students (girls) that walk or cycle to this all-girls school, compared to one control?

The intervention was effective in increasing the proportion of students that walked or cycled to school in the pooled data for the years that received the most intensive intervention (1st, 2nd and 4th years). For these years there was a significant within school increase of almost six percentage points and a significant absolute increase of almost ten percentage points. The intervention was most effective in increasing the proportion of 1st year students that walked or cycled to school (figure 5.5). There was no change in active travel to school noted for the 1st year cohort in the control school. On the contrary, in the intervention school the proportion of 1st year students walking or cycling to school increased from 11.3%in 2012 to 22.2% in 2013 (Table 5.4). Compared with the control school, this represented an intervention effect of 14.5 percentage points (0.04, 28.88). No other within school intervention effect or absolute intervention effect between schools was evident. This was true for both the total school population and for individual years. The analysis was also repeated using only the data for students living within the criterion distances of 1.5km and 3km of their school (table 5.3). Similarly, there was no intervention effect evident for this cohort either. However, it is notable that there was an absolute increase of 16.1 percentage points in active travel to the intervention school in those living within 3km of their school. This can be attributed to a reduction of 12.9 percentage points in the control school which was close to being significant (-25.5, 0.4).

Table 5.3 *The effect of the intervention on the proportion of students who walk or cycle to school among those who live within 3km of their school*

	Pre % (n)	Post % (n)	% Diff (95% CI)	Diff in differences % (int vs control; 95%CI)
≤1.5km				
Intervention	69.0 (29)	71.1 (32)	2.1 (-16.8, 20.8)	12.8 (-12.2, 37.8)
Control	81.2 (39)	70.5 (43)	-10.8 (-25.8, 5.8)	
≤3km				
Intervention	39.8 (43)	43.0 (52)	3.2 (-9.5, 15.6)	16.1 (-2.3, 34.4)
Control	56.5 (52)	43.6 (58)	-12.9 (-25.5, 0.4)	
Total				
Intervention	13.9 (625)	16.0 (656)	2.1 (-1.8, 6.0)	4.42 (-1.81, 10.62)
Control	19.4 (444)	17.0 (546)	-2.3 (-7.2, 2.5)	

All % differences in this table are absolute differences



*P<0.05

Figure 5.5 *The absolute percentage change in the proportion of students that walked or cycled to school by school and year*

Table 5.4 The effect of the intervention on the proportion of students who walked or cycled to school

	Intervention School				Control School				Absolute change
	Pre % (n=625)	Post % (n=656)	% Diff	95 % CI	Pre % (n=444)	Post % (n=546)	% Diff	95 % CI	Difference in differences %(95%CI)
Total	13.9	16.0	2.1	-1.8, 6.0	19.4	17.0	-2.3	-7.2, 2.5	4.42 (-1.81, 10.62)
1st year	11.3	22.2	**10.9**	**2.1, 19.2**	20.7	17.6	-3.2	-15.0, 8.6	**14.46 (0.04, 28.88)**
2nd year	12.1	12.9	0.8	-7.3, 8.8	18.2	15.1	-3.1	-16.6, 8.6	3.96 (-10.84, 18.75)
3rd year	19.0	14.7	-4.3	-13.9, 5.7	12.4	16.7	4.3	-5.4, 13.4	-8.64 (-22.04, 4.76)
4th year	14.9	20.0	5.1	-7.1, 18.3	25.4	20.9	-4.5	-18.2, 9.7	9.51 (-9.35, 28.38)
5th year	12.1	12.5	0.4	-9.4, 10.0	22.9	14.9	-8.3	-19.4, 3.1	8.72 (-5.88, 23.32)
6th year	13.8	12.4	-1.5	-13.1, 8.8	16.3	18.8	2.5	-12.9, 15.3	-3.95 (-21.51, 13.61)

All % differences in this table are absolute differences

What impact did the intervention have on weekly minutes of active travel and physical activity in this girls' school, compared to one control?

There was no evidence that the intervention increased the total weekly volume of active travel to any destination. There was no significant increase in minutes of active travel for the total sample in either school and there was no difference in the change in active travel between schools (table 5.5). There was also no intervention effect detected for the pooled data for the years that received the most intensive intervention (1st, 2nd and 4th). The data for average weekly minutes of active travel in the intervention school was identical in 2012 (200.3 ± 301.9) and 2013 (200.3 ± 295.4). Equally, there was no intervention effect evident for any particular year group. In the log10 transformed data (table 5.6) there was no significant within school increase in active travel and there was no difference in the change in active travel between schools. However, there was an unexpected decrease in the log10 transformed minutes of active travel in the 3rd year cohort in the intervention school (-0.36; -0.65, -0.08). In absolute terms, there was a significant increase in log10 transformed minutes of active travel in the 3rd year cohort from the control school ($p<0.05$).

Was there a difference in the change in weekly minutes of MVPA or total physical activity between the intervention and control schools?

There was no evidence that the intervention increased weekly minutes of MVPA or total physical activity (appendix 5B). There was no within school change for either variable in the intervention school. There were however within school changes evident in the control school. In this school, there was a significant increase in MVPA in both the transformed (0.17; 0.08, 0.27) and untransformed data (97.9; 32.1, 163.7). There was also an increase in total physical activity but only in the transformed data (0.13; 0.05, 0.22). In absolute terms there was no difference in the change in MVPA or total physical activity between schools.

Table 5.5 The effect of the intervention on weekly minutes (mean, SD) of active travel

	Intervention school				Control school				Change in int vs change in control
	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
1st year	166.8	224.1	57.3	-14.8, 129.4	263.9	273.1	9.2	-99.5, 117.9	0.62
	(108, 257.7)	(151, 311.7)	(563)		(75, 337.7)	(94, 369.2)	(698)		
2nd year	183.5	236.6	53.1	-21.65, 127.9	287.7	299.5	11.8	-117.6, 141.2	0.70
	(127, 285.2)	(121, 312.3)	(591)		(54, 403.9)	(93, 369.8)	(680)		
3rd year	213.2	163.6	-49.6	-131.7, 32.5	137.0	186.1	49.1	-20.8, 119.0	0.22
	(124, 296.0)	(90, 306.8)	(574)		(96, 237.7)	(127, 279.1)	(512)		
4th year	253.9	240.6	-13.3	-126.9, 100.3	215.8	141.9	-73.9	-162.1, 14.3	0.55
	(79, 345.9)	(58, 312.2)	(643)		(70, 314.2)	(67, 190.1)	(472)		
5th year	221.8	200.9	-20.9	-111.9, 68.3	260.2	220.1	-40.1	-139.0, 58.8	0.84
	(91, 326.3)	(94, 294.4)	(613)		(95, 358.9)	(89, 317.8)	(672)		
6th year	167.0	123.2	-43.8	-126.1, 38.5	178.3	173.4	-4.9	-106.7, 96.9	0.68
	(61, 319.3)	(92, 196.0)	(434)		(45, 232.8)	(78, 295.9)	(505)		
Total	200.3	200.3	0	-33.9, 33.9	221.5	218.6	2.9	-37.3, 43.1	0.94
	(590, 301.9)	(606, 295.4)	(596)		(435, 322.2)	(548, 316.1)	(623)		

Table 5.6 The effect of the intervention on Log10 transformed weekly minutes (mean, SD) of active travel

	Intervention school				Control school			Change in int vs change in control	
Year	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
1st year	1.65	1.76	0.11	-0.13, 0.34	1.86	1.80	-0.05	-0.36, 0.25	0.58
	(108, 0.92)	(151, 0.98)	(1.84)		(75, 0.97)	(94, 1.02)	(1.96)		
2nd year	1.55	1.73	0.18	-0.08, 0.45	1.69	1.98	0.29	-0.05, 0.63	0.72
	(127, 1.04)	(121, 1.05)	(2.08)		(54, 1.13)	(93, 0.91)	(1.74)		
3rd year	1.71	1.34	**-0.36**	**-0.65, -0.08**	1.37	1.59	0.22	-0.06, 0.50	**0.047***
	(124, 0.99)	(90, 1.09)	**(1.95)**		(96, 1.06)	(127, 1.04)	(2.02)		
4th year	1.70	1.90	0.20	-0.15, 0.54	1.72	1.63	-0.09	-0.42, 0.24	0.41
	(79, 1.1)	(58, 0.91)	(1.98)		(70, 1.01)	(67, 0.92)	(1.91)		
5th year	1.69	1.60	-0.08	-0.39, 0.22	1.68	1.71	0.04	-0.27, 0.35	0.70
	(91, 1.04)	(94, 1.06)	(2.09)		(95, 1.12)	(89, 1.01)	(2.12)		
6th year	1.16	1.39	0.23	-0.13, 0.59	1.49	1.37	-0.12	-0.53, 0.29	0.37
	(61, 1.19)	(92, 1.02)	(1.99)		(45, 1.13)	(78, 1.11)	(2.00)		
Total	1.60	1.63	0.02	-0.09, 0.14	1.63	1.68	0.05	-0.08, 0.19	0.82
	(590, 1.04)	(608, 1.03)	(2.07)		(435, 1.07)	(549, 1.02)	(2.03)		

*p<0.05

What impact did the intervention have on student attitudes to active travel in this all-girls school, compared to one control?

Overall there was some evidence that the intervention had a favourable impact on attitudes to active travel, most notably for cycling. Analysis of the total cycling scale revealed a significant decrease in negative attitudes towards cycling to school (mean differences; intervention school = -0.16, 95%CI -0.21, -0.11; control school = -0.08, 95%CI -0.14, -0.01) in both schools (table 5.7). There was no difference in the change in the overall scale between schools. However, several individual social-environmental attitudes to cycling changed in the intervention school when compared to the control school. These absolute changes in percentage points included 'having stuff to carry' (-6.0 percentage points), 'friends thinking they would look stupid if they cycled' (-10.8 percentage points), 'clothes making it hard to cycle' (-5.7 percentage points), 'students thinking they would look stupid if they cycled' (-18.1 percentage points) and the perception that their 'friends cycle to school' (+12.8 percentage points). In the 1st year cohort in the intervention school there was an absolute decrease in the proportion of students that agreed that they had 'stuff to carry to school' (-19.2 percentage points, appendix 5B). There was also an absolute increase in the proportion of 1st years that perceived their friends as 'cycling to school' (+30.0 percentage points).

There was a significant but less pronounced decrease in negative attitudes to walking to school as measured by the total walking scale (mean differences; intervention school = -0.06, 95%CI -0.13, -0.01; control school = -0.1, 95%CI -0.18, -0.02) in both schools (table 5.8). As was the case for cycling, there was no difference in the change in the overall scale between schools for walking. The only positive intervention effect for individual items was an absolute decrease of 10 percentage points in the proportion of students in the intervention school that agreed they 'have lots of stuff to carry'. Unexpectedly, in the control school there was an absolute decrease in the proportion of students that agreed 'friends would think they look stupid if they walked' (-4.6 percentage points) and that other 'students would think they look stupid if they walked' (-6.2 percentage points). In the 1st year cohort, there was an absolute decrease of 14.3 percentage points in the proportion of students in the intervention school that agreed they 'have lots of stuff to carry'. There was also an absolute increase in the proportion of 1st years that perceived their friends as 'walking to school' (+20.1 percentage points). This mirrored the changes in attitudes to cycling in the 1st year cohort cited above. The one exception to this was a

13.7 percentage point reduction in the proportion of 1^{st} years in the control school that agreed 'driving is the coolest way' to travel to school. This equated to an absolute reduction of 14.6 percentage points when compared to the intervention school.

Table 5.7 Percentage of students that agreed with attitudinal statements related to cycling for transport

	Intervention school			Control school			Absolute change
	Pre % (n = 643)	Post % (n = 672)	% Diff (95%CI)	Pre % (n = 451)	Post % (n = 559)	% Diff (95%CI)	Difference in differences % (95%CI)
Cycling to school too tiring	44.2	41.9	-2.3 (-7.6, 3.1)	45.0	48.6	3.6 (-2.6, 9.8)	-5.9 (-14.1, 2.3)
Cycling to school not safe	41.6	34.5	**-7.1 (-12.3, -1.8)**	42.5	40.6	-1.9 (-8.0, 4.3)	-5.2 (-13.3, 2.9)
Confident in cycling ability	85.4	81.8	-0.6 (-4.8, 3.6)	76.1	78.7	2.6 (-2.6, 7.8)	-3.2 (-9.9, 3.5)
I hate wearing a helmet	76.5	80.4	3.9 (-0.6, 8.4)	80.4	81.6	1.2 (-3.7, 6.1)	2.7 (-3.9, 9.3)
Don't cycle bad weather	87.6	86.5	-1.2 (-4.8, 2.5)	90.4	87.8	-2.7 (-6.5, 1.3)	1.5 (-3.8, 6.8)
Stuff to carry to school	89.3	86.4	-2.9 (-6.4, 0.7)	88.0	91.2	3.1 (-0.6, 7.1)	**-6.0 (-11.2, -0.8)**
I couldn't be bothered	40.9	35.8	-5.2 (-10.4, 0.1)	50.9	41.9	**-9.0 (-15.1, -2.8)**	3.9 (-4.3, 12.0)
Take too long	64.0	61.6	-2.4 (-7.6, 2.9)	60.1	61.6	1.4 (-4.6, 7.5)	-3.8 (-11.8, 4.2)
Looking stupid (friends)	24.9	11.9	**-13.0 (-17.2, -8.8)**	40.2	38.0	-2.2 (-8.3, 3.9)	**-10.8 (-18.2, -3.4)**
Clothes - hard to cycle	80.6	75.2	**-5.4 (-9.8, -0.9)**	92.0	92.3	0.3 (-3.0, 3.8)	**-5.7 (-11.3, -0.1)**
Looking stupid (students)	30.9	12.9	**-18.0 (-22.4, -13.5)**	45.9	46.0	0.2 (-6.0, 6.3)	**-18.1 (-25.7, -10.5)**
Friends cycle to school	7.9	19.0	**11.1 (7.4, 14.8)**	4.0	2.4	-1.6 (-4.1, 0.5)	**12.8 (8.5, 17.0)**
Driving is the easiest way	75.9	71.6	-4.3 (-9.0, 0.5)	82.0	77.3	-4.7 (-9.6, 0.4)	0.4 (-6.5, 7.3)
Parental support to cycle	27.6	33.6	**5.7 (0.7, 10.7)**	19.9	25.4	**5.5 (0.2, 10.6)**	0.6 (-6.6, 7.8)
Cycling ruins my hair	41.5	29.8	**-11.8 (-16.9, -6.5)**	40.8	34.4	-6.4 (-12.4, 0.4)	-5.4 (-13.3, 2.6)
Parents happy to drive	69.5	66.1	-3.5 (-8.5, 1.6)	72.0	74.4	2.4 (-3.1, 8.0)	-5.9 (-13.4, 1.6)
Cycling ruins make-up	17.4	12.5	**-4.9 (-8.8, -1.0)**	18.7	13.0	**-5.7 (-10.3, -1.1)**	0.8 (-5.2, 2.6)
Worry bicycle being stolen	36.2	34.7	-1.5 (-6.7, 3.7)	35.3	34.6	-0.7 (-6.6, 5.2)	-0.8 (-8.7, 7.1)
Safe cycling route	19.8	25.6	**5.8 (1.3, 10.4)**	26.3	27.6	1.3 (-4.3, 6.8)	4.6 (-2.6, 11.7)
Direct cycling route	17.0	19.8	2.8 (-1.4, 7.0)	18.6	19.5	0.9 (-4.0, 5.8)	1.9 (-4.6, 8.3)
Too far away	54.7	54.4	-0.3 (-5.7, 5.1)	56.0	56.5	0.5 (-5.7, 6.6)	-0.7 (-8.9, 7.5)

All % differences in this table are absolute differences

Table 5.8 *Percentage of students that agreed with attitudinal statements related to walking for transport*

	Intervention school			Control school			Absolute change
	Pre % (n = 638)	Post % (n = 665)	% Diff (95%CI)	Pre % (n = 450)	Post % (n = 559)	% Diff (95%CI)	Difference in differences % (95%CI)
Walking too tiring	48.4	49.3	0.9 (-4.6, 6.5)	52.1	46.8	-5.3 (-11.6, 1.0)	6.3 (-2.15, 14.67)
Don't walk bad weather	82.4	80.1	-2.3 (-6.6, 2.0)	81.4	80.6	-0.8 (-5.7, 4.2)	-1.5 (-8.1, 5.1)
Lots of stuff to carry	86.4	83.0	-3.4 (-7.3, 0.6)	81.6	88.2	**6.6 (2.2, 11.2)**	**-10.0 (-4.1, -16.0)**
I couldn't be bothered	31.8	30.7	-1.2 (-6.2, 3.9)	33.0	30.0	-3.1 (-8.9, 2.7)	1.9 (-5.8, 9.6)
Walking take too long	69.9	69.2	-0.7 (-5.8, 4.3)	67.9	69.6	1.7 (-4.1, 7.5)	-2.4 (-10.1, 5.2)
Looking stupid (friends)	5.0	5.5	0.5 (-2.0, 3.0)	6.2	2.2	-4.1 (-6.9, 1.6)	**4.6 (1.1, 8.1)**
Looking stupid (students)	4.7	5.6	0.9 (-1.6, 3.3)	7.1	1.8	**-5.3 (-8.2, -2.8)**	**6.2 (2.6, 9.7)**
My friends walk to school	52.9	60.3	**7.5 (2.1, 12.8)**	59.2	59.9	0.7 (-5.3, 6.8)	6.7 (-1.4, 14.9)
Driving is the coolest way	19.1	15.2	-3.8 (-7.9, 0.3)	19.0	14.8	-4.2 (-9.0, 0.4)	0.4 (-5.8, 6.6)
Parental support to walk	68.1	71.1	3.0 (-2.0, 8.0)	70.8	72.6	1.8 (-3.8, 7.4)	1.2 (-6.3, 8.7)
Walking ruins hair	20.1	16.1	-4.0 (-8.2, 0.2)	17.4	13.1	-4.4 (-8.9, 0.1)	0.4 (-5.8, 6.5)
Parents happy to drive	69.6	69.5	-0.1 (-5.1, 4.9)	71.7	73.8	2.1 (-3.4, 7.7)	-2.2 (-9.7, 5.3)
Walking ruins make-up	12.6	8.9	**-3.7 (-7.1, -0.3)**	12.3	7.1	**-5.3 (-9.1, -1.6)**	1.57 (-3.5, 6.6)
Safe walking route	36.1	36.6	0.5 (-4.7, 5.7)	42.9	42.5	-0.4 (-6.5, 5.7)	0.9 (-7.2, 9.0)
Direct walking route	33.4	32.9	-0.5 (-5.6, 4.7)	36.4	39.4	2.9 (-3.1, 8.9)	-3.4 (-11.3, 4.5)
Live too far away	59.9	59.1	-0.8 (-6.1, 4.5)	59.5	59.3	-0.2 (-6.2, 6.0)	1.0 (-7.2, 9.1)

All % differences in this table are absolute differences

What impact did the intervention have on the students' awareness of active travel promotion in this all-girls school, compared to one control?

The intervention was effective in increasing students' awareness of active travel promotion but only at the school level. There was no increase in awareness of the wider 'Smarter Travel' campaign in the community within or between schools. Nevertheless, the awareness of the school-specific campaign in the intervention school increased from 79.0% to 90.3% representing an absolute intervention effect of 23.9 percentage points (95%CIs; 17.9, 29.8) when compared with the control school (table 5.9).

Table 5.9 *The effect of the intervention on the percentage of students that were aware of a 'Smarter Travel' campaign in their school or community*

	Pre % (n)	Post % (n)	% Diff (95% CI)	Difference in differences % (int vs control; 95%CI)
School				
Intervention	79.0 (623)	90.3 (650)	**11.3 (7.4, 15.4)**	**23.9 (17.9, 29.8)**
Control	21.1 (427)	8.6 (549)	**-12.5 (-17.1, -8.1)**	
Community				
Intervention	34.1 (623)	36.3 (650)	2.3 (-3.1, 7.5)	5.4 (-2.6, 13.4)
Control	33.7 (427)	30.6 (549)	-3.1 (-9.1, 2.7)	

All % differences in this table are absolute differences

Was there an association between active travel and meeting the MVPA guidelines for adolescent girls?

There was an association between active travel and meeting the MVPA guidelines but not for active travel to school. Approximately 50% of all students were meeting the physical activity guidelines of at least 60 minutes daily MVPA. The percentage meeting the guidelines decreased in each year from 63.6% in 1st year to 33.9% in 6th year. Students in the intervention school were more likely to meet the guidelines (53.2% intervention; 46.1% control; $p<0.05$). Students that commuted actively to school were not more likely to meet the guidelines (table 5.10). Fifty one percent of the passive travel to school group met the guidelines compared with 43.9% of the active travel group. There was however, an association between frequent active travel to all destinations and meeting the guidelines. Those who walked and cycled for transport more than twice weekly were

1.86 and 4.39 times more likely to meet the guidelines compared with those that did so less often (p<0.001). Approximately 90% of those cycling for transport more than twice weekly met the guidelines compared with 50.2% that only cycled for transport twice weekly or less. That being said, doing any amount of active transport was associated with meeting the guidelines compared with doing none. Seventy six percent of those doing any cycling for transport met the guidelines compared with 45.8% that did none (p<0.001). Likewise, 55.3% of those doing any walking for transport met the guidelines compared with 40.2% that did none (p<0.001).

Table 5.10 *Likelihood of meeting the physical activity guidelines (MVPA ≥ 60 min) according to participation in active travel*

	n	OR	95% CI	P Value
Travel mode to school[a]				
Passive	681	1	Ref	
Active	120	0.76	0.48, 1.19	0.231
All active travel[b]				
Infrequent walking	321	1	Ref	
Frequent walking	480	**1.86**	**1.36, 2.54**	**0.000**
Infrequent cycling	748	1	Ref	
Frequent cycling	53	**4.39**	**1.93, 9.99**	**0.000**

[a] All models were adjusted for age, family affluence, distance from school and access to a bicycle.

[b] Frequent walking and cycling for transport was classified as more than twice weekly trips of at least 10 minutes.

What were the correlates of walking to school for adolescent girls?

The correlates of walking to school are listed in table 5.11 below. There were six factors correlated with walking to school in the final adjusted model; distance, weather, carrying bags and equipment, apathy about walking, parental support and safety. Of these, distance was the most influential determinant of walking to school. Students living within 1.5km of their school were almost 69 times more likely to walk to school compared to those living more than 3km from school. The other most influential determinants were apathy about walking and parental support for driving. Students that did not agree with the statement 'I couldn't be bothered walking to school' were nine times more likely to walk to school. Similarly, those that didn't say that their 'parents were happy to drive' them were 14 times more likely to walk to school ($p<0.05$).

Table 5.11 *Individual, social and environmental correlates associated with walking to school*[a]

Variable	OR	95% CI	P Value
Distance from home to school			
> 3.0 km (Reference)			
1.5 – 3.0 km	**4.78**	**1.35, 16.9**	**0.016***
< 1.5 km	**68.5**	**17.0, 276.8**	**0.000***
Individual[b]			
Age	0.79	0.61, 1.02	0.071
Walking to school would be too tiring	1.11	0.42, 2.90	0.838
I don't like to walk when the weather is bad	**0.37**	**0.15, 0.92**	**0.033***
I have lots of stuff to carry to school	**0.41**	**0.18, 0.97**	**0.042***
I couldn't be bothered walking to school	**0.11**	**0.03, 0.43**	**0.002***
Walking to school would take too long	0.44	0.12, 1.60	0.214
Social-environmental[b]			
My friends walk to school	1.87	0.88, 3.93	0.102
My parents encourage me to walk places	1.06	0.42, 2.69	0.903
My parents are happy to drive me to school	**0.07**	**0.03, 0.17**	**0.000***
Physical-environmental[b]			
There is a safe walking route to school	**7.24**	**1.85, 28.3**	**0.004***
There is a direct walking route to school	0.48	0.14, 1.64	0.238
I live too far away to walk to school	0.72	0.19, 2.68	0.621

[a] Fully adjusted for all variables in model

[b]Reference category is disagree

*p<0.05

What were the factors that influenced travel mode to school in this all-girls school?

Barriers

Parental gatekeeping

Parents greatly influence their children's travel mode to school albeit for different reasons depending on the child's age. Older students (15-16 years, 4th years) stated that when their parents were taking a car trip anyway, it was just convenient and less hassle for them to get a lift. For younger students (1st and 2nd years) it appears that their parents were the main decision makers in terms of travel mode. Trainer one acknowledged that a weakness of the intervention was that the parents were not directly targeted and should have been. Most parents did not permit cycling to school. Students perceived traffic danger to be the main reason for this. One student explained how her "Mam said she doesn't like the thought of us cycling because it's so dangerous because some cars like they just don't really care around ya" [2nd year, pre-intervention]. There was some disagreement in relation to whether the country or city roads were more dangerous. While some deemed the country roads to be less safe, others claimed that the presence of cycle lanes in the city did little for the safety of cyclists; "like just coming up to my old school like there is a cycle lane but cars keep going on it so you just go up on the footpath" [1st year pre-intervention]. Others stressed that irrespective of the presence of cycle lanes, many students would not be confident enough to cycle on a roundabout when cycle lanes end. This was confirmed during the cycle training programme. Students had very low confidence and very low cycling ability particularly in relation to cycling in the city centre. Almost no students had experienced cycling in the city before the training. The training was extremely well received and greatly increased their confidence to cycle in traffic although did not necessarily encourage them to cycle to school.

Commuting distance

Distance was an important barrier to active travel to school for all ages. Anything beyond 20-30 minutes was considered too long to walk or cycle. The reasons included; carrying heavy bags, time constraints and the physical effort required. Students believed that "it's too hard to walk when you've a load of stuff to be carrying" [1st year, pre-intervention]. In addition to heavy schoolbags, most students are carrying extra equipment for both curricular and non-curricular activities on an almost daily basis.

Carrying such equipment was a greater barrier for cycling than for walking. Indeed the introduction of the e-books was considered extremely successful in terms of reducing the weight of schoolbags. The 2nd year students were in agreement that this is likely to have increased the numbers walking to school. Walking was seen as less physically demanding than cycling but not an option because of the longer travel time associated with it. One student commented that "it's quicker to like go in the car rather than like walk or cycle. You have to get up earlier if you walk or cycle" [1st year, pre-intervention]. Older students were less likely to agree that driving was faster but commented that even if the difference in travel times was negligible, there would be little incentive to walk or cycle instead of driving.

Pack following

Students are fearful of deviating from travel norms and perceive cycling to school as something incompatible with "fitting in" amongst their peers. This is due to the importance placed on their appearance and image. There are several aspects of cycling which are inconsistent with the portrayal of an acceptable image for adolescent girls. Rain was considered the worst type of weather for cycling because their "hair would go all frizzy" [1st year, pre-intervention] and for older students, their make-up would be ruined. Wearing a helmet would simultaneously ruin their hair and be an affront to their appearance; "It just looks embarrassing or something" [2nd year, pre-intervention]. Similarly, skirts were seen to be impractical for cycling; "You can't really cycle with a skirt, like I used to cycle in primary school but I had to change. I'd cycle in tracksuit bottoms and then I'd have to change back when I got to school" [2nd year, pre-intervention]. Even the bicycles owned by many students may cause embarrassment because of its design or decoration. Although students of all ages perceived cycling to be unfeminine, older students also spoke about their fear of boys mocking them and the possibility of getting sweaty because of cycling.

Motivations

Socialising

The barriers cited for cycling greatly outweighed those for walking and students had great difficulty offering advantages of either mode. Advantages such as; feeling fresh for the day, getting fit and being more environmentally friendly were offered in a merely tokenistic manner. An increased opportunity to socialise with friends was the one consistently cited advantage to active travel. This applied to walking only whereby students wouldn't feel bored on their journey to school if they walked with a group of friends. One student mentioned that intervention components such as the active travel challenge will only work if there is a buddy system incorporated into it; "I think it will start like if you have an incentive to walk and then you get used to it and then you keep walking but you need to find someone to walk with. Not just you on your own" [2nd year, post-intervention]. Older students spoke of the potential opportunities that cycling to non-school destinations offered in terms of their independent travel.

Incentivising walking and cycling

There was consensus across all ages that when the incentive for walking or cycling to school is attractive enough, then all the other barriers become less significant. Students would not be enthused by the notion of creating competition between individuals or classes in terms of the volume of active travel accumulated. Examples of appropriate incentives would include; clothes or vouchers for clothes shops, free breakfasts, non-uniform days, certificates and fashionable wristbands. The popularity of such incentives was reflected in the large numbers of students that participated in both the active travel day (free breakfast and goodie bag) and the longer active travel challenge (free hoodie). The active travel day generated a sense of excitement in the school and the incentives were very well received. They suggested that the provision of the hoodie was possibly excessive in terms of what was required to incentivise walking and cycling in the longer challenge. Less expensive incentives were more acceptable for younger students. Despite the popularity of both incentivised events, one of the trainers was unsure whether they are anything more than triggers for short-term and unsustainable behaviour change.

Empowering project leaders (reflections from trainer one)

The intervention was limited by the level of empowerment achieved. The school principal was very supportive of the ethos of active travel and the PE teacher was the main (sole) driver of the active travel agenda within the school. The promotion of active travel was deemed a suitable project for the 4th year cohort in the school. This group were tasked with the implementation of many of the project activities. However the rotation of class groups restricted the continuity of this process. The project required a steering group to ensure the continuity of work and to co-ordinate the wide range of activities. There was a reluctance to merge the active travel agenda with the work of a previously established physical activity group (active flag group) in the school. This would have helped to embed active travel promotion within the school in a more sustainable manner. In addition to further school personnel, a project steering group would have benefited from representation and support from the local health authorities and the local sports and recreation partnership. This did not happen. It is likely that such quasi-experimental interventions are viewed locally as inequitable in the context of wider communities.

5.4. Discussion

5.4.1. Summary of results

This was a quasi-experimental study of a targeted, multi-component intervention in one all-girls school. There was no significant intervention effect detected for active commuting to one all-girls school compared to one other school. Equally there was no intervention effect detected for the total volume of active travel in the total sample. Despite this, there was both an increase in awareness of active travel promotion and in the normalisation of cycling in the intervention school. There was also a significant intervention effect for active commuting to school in the 1st year cohort. Only 13.9% of all students walked or cycled to the intervention school at baseline and, given a choice, only an additional 21% would prefer to walk or cycle to school. Those that frequently walked or cycled for transport were 1.86 and 4.39 times more likely to meet the guidelines for MVPA, respectively. However there was no parallel relationship for active travel to school. Travel by car was the most common and the most preferred mode of travel. The majority of students lived more than 3km from school and this was identified as the strongest correlate of walking to school. There was a trend towards an intervention effect for active commuting to school when the data were analysed including only those that lived within a 3km radius. Other factors that influenced active travel to school were parents prohibiting active travel, parents being happy to drive their child, having safe routes, social norms for cycling, not being bothered to walk and the greater social opportunities offered by accompanied active travel to school.

5.4.2. The prevalence of active travel in both all-girl schools

Baseline differences in the prevalence of active travel to school may have influenced the intervention outcomes. There was a greater at-risk group for active travel to school in the intervention school. Only 14% of students walked or cycled to the intervention school compared with 19% to the control school. These figures are slightly higher than those reported in chapter four for adolescent girls in the other towns (11.7%) but considerably lower than national (Clarke & HBSC Ireland Team, 2013; Nelson & Woods, 2010; Nelson et al., 2008; Woods et al., 2010) and international estimates (Chillón et al., 2010; Mota et al., 2007) . This difference between schools may be attributable to the higher perceived family affluence and greater access to bikes in the intervention school at baseline. This explanation would align with previous studies supporting an inverse association between SES and active travel in adolescents (Clarke & HBSC Ireland Team, 2013; Mota et al., 2007). Perceived family affluence is only a proxy measure of SES. Nonetheless there was no association between active travel and family affluence found in this study.

The importance of the greater access to bicycles is also likely to be minimal considering less than 9% of students in the control school indicated a preference for cycling to school. Additionally, the ownership of bicycles doesn't necessarily translate into an increase in cycling (Bauman, Merom, & Rissel, 2012). Students' preference for car travel was another important difference between the schools. Car travel was the most common and most preferred mode of travel to school in both schools. In chapter four it was reported that the proportion of adolescent girls that preferred to travel by car was actually greater than those that actually travelled by car. Notably, in this study preference for car travel was more than actual car travel in the control school only. Preference for active travel was greatest in the intervention school. The absolute difference in the proportion that actively commuted to school and those that would prefer to was 21% in the intervention school and only 9.8% in the control school.

There was also a significantly higher awareness of active travel promotion in the intervention school even at baseline (79% aware). The intervention school were in the process of being awarded an 'active school flag' by the Department of Education and Skills in 2012. The flag is awarded to schools that strive to increase the provision of Physical Education and physical activity for students. A separate well known programme, run by the Foundation for Environmental Education called the 'Green

Schools' programme, awards flags to schools for introducing steps to promote environmental awareness amongst students. Active travel is one these designated flags awarded to schools. It is possible that many students perceived active travel to be an inherent message associated with the separate active school flag. Taken together, these baseline differences between schools help to explain why the intervention school was better positioned to benefit from an active travel intervention.

The baseline data for active travel also helps to partly explain why the intervention effect was modest at best. Although preference for car travel was lower in the intervention school it was still the most preferred mode of travel to school (49.4%). In the intervention school, 13.9% of students actively travelled to school while only 34.9% would prefer to. This absolute difference of 21% only equates to a small at-risk group for the intervention compared with an absolute difference of 45% for girls in the town's primary schools (chapter three). Furthermore the majority of this absolute increase is attributable to students indicating a preference for cycling. Despite this, and consistent with other Irish studies (Central Statistics Office, 2012; Clarke & HBSC Ireland Team, 2013; Nelson & Woods, 2010; Nelson et al., 2008; Woods et al., 2010), only 0.3% of students actually cycled to school. The attitudinal and qualitative data from this study also suggested that there are more barriers associated with cycling to school than for walking. The barriers would appear greatest for older adolescents. Only 14% of 6th years in the intervention school walked or cycled to school and only 18% would prefer to. The barriers associated with active travel to school have been shown to be greater than for non-school destinations (Forman et al., 2008) and this may apply here. The total volume of active travel to all destinations in both schools was comparable with data for adolescent girls across ten European cities (Chillón, Ortega, et al., 2011).

5.4.3. The association between active travel and MVPA in adolescent girls

Physical activity levels were relatively high in the intervention school. The proportion of students that participated in at least 60 minutes of MVPA per day decreased from 64% in 1st year to 34% in 6th year. The proportion of students classified as insufficiently active (49.8%) is not as high as reported in other Irish studies (Kelly et al., 2012; Woods et al., 2010) and possibly reflects the prominence of both curricular and extra-curricular sports in both schools. Active commuting may present an important opportunity to reverse or at least moderate the decline in levels of physical activity in adolescent girls. Active commuting has been shown to track from adolescence into adulthood (Yang et al., 2014) and it may also help to attenuate the decline in physical activity associated with the transition from primary to secondary school (Larouche et al., 2013).

However in this study frequent active travel to all destinations was associated with meeting the MVPA guidelines but there was no association for walking to school. There are several possible explanations for this anomaly. Firstly, previous studies found the association between active travel to school and MVPA is stronger for adolescent boys than for girls (Chillón et al., 2010; Roth et al., 2012). They also reported that the association is stronger for cycling to school yet there were virtually no cyclists commuting to the intervention school. It may have been that the majority of students were only walking very short distances to school compared with the distance covered by adolescent girls actively commuting to non-school destinations. This is supported by Carver, Timperio, and Crawford (2008) who found that cul-de-sacs are negatively associated with physical activity in adolescent girls and positively associated with physical activity in boys. It may be that the categorical measure of 'usual travel mode to school' was not behaviourally specific enough to detect an association compared with the measure of frequency of all active travel.

Those who walked and cycled for transport more than twice weekly were 1.86 and 4.39 times more likely to meet the guidelines compared with those that did so less often ($p<0.001$). Despite this, even doing one day of active travel for at least ten minutes increased the likelihood of meeting the MVPA guidelines. It is plausible that, as found in younger and pre-adolescents (Goodman et al., 2011), the increase in MVPA associated with active travel is not entirely attributable to the journey itself. Adolescent girls who opt to use active modes of travel to non-school destinations may engage in greater physical activity at their destination. It is noteworthy that cycling for transport for at least ten minutes on at least three days per week is a very small amount of time but yet was very strongly associated with meeting the guidelines. This is a very important public health message for the promotion of physical activity in adolescent girls. It may be even more important for older adolescents for whom active travel to non-school destinations has been shown to have a stronger association with meeting the MVPA guidelines (Carver et al., 2011). That is not to say that promoting active travel to school is a futile pursuit. An Irish study found that active travel to school was associated with MVPA in adolescent girls and not in boys (Woods et al., 2010). However, given the extent of girls' barriers to cycling to school, the promotion of cycling to non-school destinations may offer less resistance and a greater public health benefit.

5.4.4. The influence of the physical environment on active travel

Distance

Distance is one of the most consistently reported determinants of active travel to school in adolescents (Babey et al., 2009; Chillón et al., 2014; Nelson et al., 2008; Silva et al., 2011; Van Dyck et al., 2010). In agreement with these studies (and data presented in chapter four), distance had a major influence on students travel decisions in this study, albeit that estimates of distance were possibly more than actual distance. Approximately 65% of students that lived within 1.5km of the intervention school usually walked or cycled to school. This is compared with 14% of those living 1.5km-3km from school and only 1% living more than 3km from school. The adjusted predictors of walking to school illustrate the extent of the influence of distance on travel behaviours. Those that lived within 1.5km of their school were almost 69 times more likely to walk to school compared with those living beyond 3km. Considering the majority (>60%) of students lived more than 3km from the intervention school, this further supports the assertion that the intervention was never likely to have produced large effect sizes and that the promotion of non-school active travel should not be neglected. However, the fact that 42% of those that travelled to the intervention school by car lived within a criterion distance of 3km (and that the majority of those who travel by car would prefer to cycle) suggests that there is some potential to increase cycling to school. This 42%was also more than the 30% reported in the control school, again supporting the greater potential for modal shift in the intervention school. Interestingly, when the data were stratified by criterion distances, there was a trend towards an intervention effect. It is possible that the 16.1% absolute increase in active travel amongst those living within 3km of their school might have reached significance in a larger sample size.

The influence of distance on active travel to school may be related to increased travel time and the effort associated with carrying heavy bags for a long time. In contrast with another study of Irish adolescents (Woods et al., 2010), increased travel time was not associated (in the adjusted analysis) with walking to school in this study. The perception of having 'lots of stuff to carry to school' was however inversely related to walking to school. This is consistent with the findings of other studies (Forman et al., 2008;

Larouche et al., 2013) but is possibly limited to younger adolescents (Nelson et al., 2008). The qualitative data suggested that students regularly carry items to school to participate in extra-curricular activities such as sports or music. The introduction of the e-books initiative to 1st years only was likely to be one of the primary reasons for the increase in the proportion of 1st years actively commuting to school. There was an absolute decrease (19 percentage points for cycling; 14 percentage points for walking) in the proportion of students that perceived they had 'lots of stuff to carry to school' at follow-up. It is also notable that there was a trend towards an increase in weekly minutes of active travel to all destinations for 1st years in both the transformed and untransformed data. However, irrespective of the lack of statistical significance, the effect size is very small. Ironically the prominence of curricular and extra-curricular sport in both the intervention and control schools may have inadvertently reduced the likelihood of active travel to school due to the extra gear required for participation. The particular emphasis on providing greater physical activity opportunities to the students in the control school may explain why there was an increase in MVPA in that school.

Road Safety

There is a dearth of studies that have examined the association between road safety and active travel separately for adolescent boys and girls (Pont et al., 2009). In the absence of sex specific analyses, it has been deducted that adolescents do not perceive road safety to be a major barrier to active travel even in car dominated cultures such as the US (Forman et al., 2008). Road safety was of greater importance to the adolescent girls in this study. Only a minority of students agreed that they had a safe walking (36%) or cycling (20%) route to school and having a safe walking route to school was independently associated with greater walking to school. This is in agreement with previous studies that concluded that both real and perceived road safety were important predictors of active travel for adolescent girls (Carver et al., 2005, 2008; Nelson & Woods, 2010). The importance of road safety was also confirmed in the qualitative narratives from younger girls especially. These girls appeared to be mainly projecting their parents' fears but still acknowledged that the lack of continuity of cycle lanes and drivers not respecting the delineation of cycle lanes contributed to making cycling dangerous. Interestingly, while few believed they had a safe route for active travel to school, the majority of students (58%) believed that cycling to school was safe at baseline. This aligns with Irish data that has shown that while being driven to school is slightly safer, active travel is becoming safer and that girls have a lower risk of fatality than boys (Road Safety Authority, 2012).

The cycle training may have contributed to the increase in the proportion of 1st year students actively commuting to school for several reasons. Firstly, the training was focused on increasing the girls' skills and confidence for cycling in real traffic situations as recommended by Ducheyne, De Bourdeaudhuij, Lenoir, and Cardon (2014). The students also got to practice their skills in real traffic situations in the town centre. Secondly, there was a significant within school increase in the perceived safety of the route to school for cycling but not for walking. There was also a significant within school decrease in the proportion of students that believed that cycling to school was not safe. Although these changes were not significant relative to the control school, there were no within school changes for these variables noted in the control school. Furthermore, in the absence of any infrastructural measures implemented on the primary routes to the intervention school, the cycle training is the most plausible explanation for the changes in attitudes to cycle safety. The cycle training may also have served to allay parental fears of road safety for cycling. These changes in attitudes did not however translate into behaviour change for cycling. The majority of the increase in active travel to school in the 1st years was attributed to an increase in walking. The contentious issue of helmet use may have been a major barrier and a step too far for students irrespective of their age. Indeed while perceptions of cycle safety increased, so too did their dislike for wearing a helmet, something which was confirmed by the qualitative data. The proportion of students that 'hated wearing a helmet' increased from 76.5% to 80.4%. This dislike of helmets may be due to wider social-environmental factors.

5.4.5. The influence of social environment on active travel

Friends

This study identified that adolescent girls have a greater number of psychosocial barriers to cycling to school compared with walking. At baseline over 80% of the students agreed that the school uniform made it hard to cycle. The other quantitative items indicated that while issues of hair, make-up and looking stupid were more salient for cycling, they were only barriers for a minority of students. However the qualitative data pointed to wider issues for older girls such as breaking with social norms and bringing undue attention from boys and other female colleagues. The qualitative data also confirmed that keeping their hair presentable is a significant barrier to cycling. These findings are broadly consistent with previous qualitative studies that included adolescent girls (Cavill & Watkins, 2007; Transport for London, 2008). The finding that bad weather reduced the likelihood of walking to school may be more related to the social environment than the physical environment. The qualitative data confirmed that bad weather affects a girl's appearance but it may also reduce opportunities for social interaction. Weather is one of the main factors that Belgian adolescents consider when deciding to walk or cycle (Simons et al., 2013).

A combination of the cycle training, the 4th year active travel module and the school wide social media campaign may have contributed to the positive changes in attitudes to cycling seen in this study. The latter two intervention components aimed to normalise cycling for transport amongst adolescent girls. The most notable of these changes was the 18.1 percentage point absolute decrease in those that believed 'other students would think they looked stupid' if they cycled to school. This is an important finding because alongside the provision of safe cycle routes, changing the attitudes of older adolescent girls might be one of the first steps in creating a modal shift to cycling. Nonetheless the shift in attitudes did not correspond with an increase in cycling.

The incentivised active travel challenge may have contributed to the behaviour change in 1st years and increased the students' perceptions of their friends walking and cycling to school. Social support from friends has previously been established as an important determinant of physical activity in adolescent girls (Graham, Bauer, Friend, Barr-Anderson, & Nuemark-Sztainer, 2014; Voorhees et al., 2005). Several studies (Panter et al., 2008) also support the idea that social connectivity is an important determinant of active travel but for adolescent girls the relationship is more established for walking (Carver et al., 2005; Kirby & Inchley, 2013). The incentivised challenge may have facilitated more social opportunities for younger students who participated to a greater extent and simultaneously created an awareness of others walking and cycling to school. Indeed a greater intervention effect might have been achieved if groups were formally organised to walk to school together on the designated days. This may have led to younger students being granted independent mobility to school (Brown et al., 2008). It is possible that the incentive of greater social connectivity on the commute to school is not enough for older girls. The older focus group participants in this study saw few if any advantages of active travel to school. Consistent with other qualitative studies, they did not see walking or cycling as credible alternatives that were superior to car travel (Simons et al., 2013; Transport for London, 2008). Given that the majority of students live beyond criterion distances for active travel and the barriers for active travel are typically greater for school than other destinations (Forman et al., 2008), it once again questions how successful active travel to school interventions can be.

Parents

Parents play a central role in facilitating passive travel amongst adolescent girls. It was established in section 5.4.4 that adolescent girls themselves are concerned about road safety on their journey to school. Parental perceptions of road safety are also associated with adolescent girls' active travel to school (Carver et al., 2005; Carver, Timperio, Hesketh, & Crawford, 2010; Hume et al., 2009). It was clear from the qualitative data that the parents of younger girls are restricting their active travel due to safety concerns. Indeed this may not have been confined to just younger girls. Only 28% of girls agreed that their parents supported them to cycle to school. The perceived and actual risk of cycling for adolescent girls certainly needs to be addressed but parents also facilitate passive travel for other reasons. The students themselves were arguably more likely to solicit a lift to school by car. The majority of students would prefer to travel by car and 76% said that driving to school is the easiest way. Similarly 70% of students agreed that their parents were happy to drive them. In the adjusted analysis, 'not being bothered to walk' and 'parents being happy to drive them' were the variables that showed the strongest relationship with walking to school after distance. Parental facilitation of passive travel is not frequently addressed in studies of active travel. In those that have, studies report similar associations (Emond & Handy, 2011; Forman et al., 2008). The odds ratios of 0.07 ($p<0.000$) for 'parents being happy to drive' in this study was considerably lower than the 0.81 ($p<0.01$) reported in US adolescents (Emond & Handy, 2011). There were no absolute changes in these variables. This is most likely because reducing car convenience wasn't a core message in the intervention and parents weren't specifically targeted. By the same token, these factors may have significantly limited the potential for modal shift.

5.4.6. The characteristics of effective active travel interventions for adolescent girls

This section will attempt to explain how the characteristics of the multi-component programme combined to only produce a small intervention effect. Parents appear to be an integral part of the solution to creating a modal shift from passive to active travel to school. Eliciting general parental support for active travel (Carver et al., 2014) or physical activity (Camacho-Miñano et al., 2011) is probably insufficient. For example, in this study 68% of children agreed that their parents supported them to walk to school yet only 14% of students actually did. Parental modelling of active travel behaviour is more important than parental support (Henne et al., 2014; Merom et al., 2006; Panter, Jones, et al., 2013). This is the case for primary school-children at least but it may also apply to younger adolescents. The data presented in the next chapter (chapter six) indicates that parents did not regularly model active travel behaviours. The schools intervention may have had a greater effect if parental perceptions of road safety and car convenience were addressed.

Empowerment should be a fundamental aim of all school active travel interventions (Chillón, Evenson, et al., 2011). There was a certain degree of empowerment achieved in the intervention school but in a manner unlikely to be sustainable. The delivery of the programme activities was almost exclusively facilitated by the 4th year students. Peer delivered physical activity interventions in schools have shown promise for adolescent girls (Camacho-Miñano et al., 2011). However there was only partial school-level empowerment achieved. The failure to implement the intervention activities under the umbrella of the Active School Flag committee was a major obstacle to achieving greater empowerment.

Ironically, the schools' efforts to achieve the Active School Flag may have precluded any potential intervention effect for active travel. Active travel interventions are more effective when they are not implemented simultaneously with other physical activity or PE interventions (Chillón, Evenson, et al., 2011; Christiansen et al., 2014). However, there was arguably a greater emphasis placed on physical activity in the control school at the same time. This is supported by the significant increases in school and leisure time physical activity in the control school. Presumably this would also have precluded any potential increase in active travel due to external influences (e.g. the wider community intervention). This unusual trend may be linked to the extra baggage associated with additional physical activity opportunities. There may be a greater synergistic effect between active travel and physical activity for non-school destinations (Goodman et al., 2011).

School based active travel interventions may have differential effects according to the age of students and the number of intervention components (Chillón, Evenson, et al., 2011). Older and younger adolescents have different motivations for engaging in active travel (Transport for London, 2008). The greatest behavioural intervention effect detected for active travel to school was for the 1st year cohort. This was expected as they (along with 2nd and 4th years) had the largest number of intervention components and they participated in the other components to a greater extent than older students. The absence of a significant concomitant increase in minutes of active travel for 1st years (or in the pooled data for 1st, 2nd and 4th years) could mean that the journey distances of new walkers were very short and that the intervention had no effect on active travel to non-school destinations. This is not unexpected because active travel to school was the main focus of the intervention. In this study there was a 6.7% increase (NS) in minutes of active travel in the 1st year cohort. This is negligible when compared with the 45% increase reported for all students attending a mixed school served by major new infrastructural measures in intervention town 2 (chapter four). It is possible that hard measures, while being more costly, offer greater potential for creating modal shift than soft measures do.

The absolute decrease in minutes of active travel for 3rd years is difficult to explain. There were significant within-school reductions in the proportions of students that walk or cycle to school for both 3rd and 6th years (state exam years) but this was the case in both schools. Incidentally, these were the only years where a reduction in active travel to school was detected. The P value of 0.047 was marginal and would not have been significant had a Bonferroni correction been applied. The addition of the curricular module on active travel in 4th year could explain the trend towards an intervention effect in this cohort. There was an absolute increase of 9.5 percentage points in the proportion of 4th years actively commuting to school. Although this was not significant according to the 95% confidence intervals, there was a parallel trend in the log transformed data for minutes of active travel. This module was delivered to the majority of 4th year students and the content addressed many of the perceived barriers to active travel for girls. It is very possible that this may have influenced both school and non-school active travel.

5.4.7. Study strengths and limitations

This research is one of the few examples of quasi-experimental studies examining the effectiveness of active travel interventions specifically targeting adolescent girls. Earlier chapters described the impact of wider-community measures on active travel in secondary school-children. This study described the impact of an intensive and targeted multi-component active travel intervention with one all-girls secondary school. It demonstrated positive intervention effects after a cooling period of almost five months. Measurement error was reduced by including a control school for comparison purposes and administering the surveys at the same time each year to avoid seasonal variations in travel behaviour. The measurement tool also included a continuous measure of total active travel which allowed conclusions to be drawn about the contribution of active travel to MVPA.

Equally, there were weaknesses inherent in both the intervention design and the research methods. However, this is an inevitable feature of real world interventions, where control over variables is limited and there are constraints such as limited budgets and time (Bamberger, Rugh, & Mabry, 2011). While acknowledging the limitations of real world evaluations, several researchers (Bauman, 2005; Chan & Tudor-Locke, 2008; Lawlor et al., 2003; Ogilvie, Mitchell, Mutrie, Petticrew, & Platt, 2006) have recommended a move away from a focus on individual behaviour change. The evidence provided by the evaluation of natural experiments in communities, however tentative, is likely to be of greater benefit to public health policy makers than cross-sectional research with higher internal validity.

Several of the limitations of the intervention design have already been eluded to in the previous section i.e. lack of parental involvement and empowerment, lack of emphasis on social interaction etc. Awareness of active travel promotion in school was significantly higher in the intervention school at baseline. This may have reduced other potential intervention effects that were not detected. Some of the weaknesses of the intervention design could have been addressed if the baseline data had been analysed before the intervention was designed. This would have clearly established the at-risk groups for walking and cycling based on criterion distances. Intervention strategies could also have been developed to reduce the convenience of car travel. The immediate analysis of the data was not possible because of limited personnel and financial resources. The researcher was the only person working on the project evaluation and he also happened to be the primary practitioner which was a source of bias in itself. The intensity of the intervention could also have been enhanced if there was greater stakeholder involvement and greater financial resources. The local authority did not fulfil their ambitions to audit the primary routes to school, to improve the related cycle lane infrastructure and to restrict cars from parking on them at busy times before and after school. Other stakeholders were wary of committing to the project.

The limitations of the research methods were associated with both the research instrument and the research design. The previously discussed limitations of repeat cross-sectional and quasi-experimental designs also apply here. The baseline differences between schools highlight the problems of only including one control school. However there were only two all-girl schools in intervention town 2, and in any case, resources only allowed for the inclusion of one control school. The fact that the intervention was nested within the wider community intervention was a potential confounder for the measurement of campaign awareness. However it is unlikely that this influenced the intervention because there was no change in the background awareness of the community intervention.

The attitudinal questions for walking and cycling had not been validated. Although there is at least one valid attitudinal instrument available it does not assess walking and cycling separately (Forman et al., 2008). After analysing the data it became apparent that asking students about confidence in their ability to cycle on a busy road would have been more relevant than confidence in their ability to cycle in general. There was a mistake made on the attitudinal scale for cycling. The original survey contained an item which asked whether 'driving was the coolest' way to travel to school. This was changed to 'driving is the easiest' after the pilot study. This was changed on the walking scale but not on the cycling scale. Many of the changes in the individual items in both scales at follow-up were deemed significant based on 95% confidence intervals. It was not possible to apply a Bonferroni correction but many of the variables that changed in the cycling scale also changed in the walking scale. This suggests that the results were not merely due to multiple testing. The instrument could have included a question about the number of cars per household. The convenience and preference for car travel only emerged after analysing the baseline data. The mode of travel home from school could also have been included but would have added to an already excessively long instrument.

Another limitation is the categorical measurement of active travel to school and the continuous measure of active travel. There are currently no validated measures of active travel to school (Herrador-colmenero et al., 2014). The use of just one question about usual travel mode may result in the misclassification of girls engaging in active travel (Ham, Martin, & Kohl, 2008; Pabayo et al., 2011). For example, many of the students who travelled to school by bus requested to be dropped off 1km from the school during the active travel challenge. This survey item would have classified them as passive travellers. The transport domain of the IPAQ-A does not provide any destination specific data which would be more informative. This has been done for adults (Adams et al., 2014) but not for school-children. The IPAQ-A may have overestimated minutes of active travel. The 1st question of the survey asks the participant to add up the total number of minutes of PE in the previous week. The next question asks about one typical day in the previous week. The majority of students may not have noticed the subtle change in instructions. This possibly explains the large standard deviations seen for the other sub-domains and the extent of data truncation outlined in the methodology. This is a major flaw in the IPAQ-A but it was still possible to measure the magnitude of change from baseline to follow-up.

5.4.8. Implications of the research findings

Implications for practice

The previous chapter highlighted several recommendations for increasing active travel for secondary school students. These included; introducing infrastructural measures before softer measures, reducing the convenience of car travel for the school run, promoting cycling as a time-efficient and independent mode of travel, designing interventions based on criterion distances, and introducing drop-off points. These are all supported by the findings from chapter five. Additional recommendations include the following;

- Sufficient time should be invested in creating the necessary structures for active travel interventions in secondary schools before they are implemented. Schools should be selected based on their willingness to engage. They should be empowered to take the lead on directing the project with external assistance from stakeholders with more expertise in the field of active travel. Projects should aim to increase active travel to both school and non-school destinations. This means that local sports partnerships and the local authority should be key stakeholders. There may be greater intervention effects if active travel projects are managed as a strand of larger sustainability or environmental projects in schools as opposed to being under the banner of sport and physical activity.

- Baseline measures of active travel to school and non-school destinations should be established at several time points before any intervention components are introduced. These baseline measures should allow for the creation of a community-wide map illustrating all the potential destinations for active travel within a 5km radius of the primary residential locations of students.
- The local authority should be engaged early in the process and before any soft measures are introduced. The safety of the primary routes to school and non-school destinations should be addressed before any soft measures are introduced. Comprehensive audits of these routes should be conducted by a sample of parents and students (separately) in consultation with the local authority. The creation of safe cycling routes should be a priority for the project team and local authority alike. Cyclists should have priority lights at traffic lights on the routes to school particularly when journey time is a key motivation for choosing active travel. Parking restrictions on cycle lanes or anywhere near the immediate vicinity of a school entrance should be enforced.
- At the school level, separate intervention approaches should be adopted for younger and older girls. For younger girls, strategies should provide greater opportunities for social interaction while walking and cycling for transport. The parents of younger adolescents should be targeted to allay their fears about the dangers of active travel. Older girls should be targeted with measures to present cycling as something that is consistent with social norms for girls and a fashionable way to travel. It should be presented as a form of transport that is quicker than being driven and one that offers older girls more independence. The exam years of 3rd year and 6th year should be particularly emphasised. Enforcing the use of helmets may be a major obstacle to behaviour change. Projects that establish a high level of road safety for cycling and address the relative safety of cycling with parents should not actively promote their use. Parents and students of all ages should be targeted to reduce the convenience of car travel in addition to promoting active travel.

- No year group in this study received the full complement of intervention components. Cycle skills training in real traffic situations, e-books, curricular modules, social media campaigns and incentivised challenges may all be important intervention components. Inevitably there is a certain synergy achieved by implementing them all together. One other addition that may offer some potential is identifying a group of approximately ten active travel champions in each year group. The design of bikes may be an important aspect of looking fashionable while cycling. Local bicycle retailers should be engaged in relation to providing female specific Dutch style bikes at an affordable price. These bikes should provide several options for carrying equipment and bags. The champions should be incentivised to cycle to school and other destinations on a daily basis. The cycle champions should also be tasked with organising a cycle fashion show in conjunction with a local clothes retailer.
- The multiple extraneous factors associated with real world evaluations need to be tolerated to a certain extent in order to identify the 'best available evidence' for the translation of active travel projects.

Implications for research

- The implications for research cited in chapter four also apply here. These include; the need for a validated destination specific self-report tool, more studies on the determinants of active travel for non-school destinations and an in-depth qualitative study with Irish adolescents. All future studies should report outcomes separately for boys and girls where possible.
- There is a need for more qualitative studies with adolescent girls in Ireland. These studies should address the advantages and disadvantages of each travel mode separately and for several categories of destinations. This should not be just limited to active travel but also examine car travel in detail. The data should be collected separately for girls aged 12-14 years and for girls aged 15-17 years.
- Further experimental studies of active travel should be conducted in all-girl secondary schools. These interventions should be designed and evaluation based on the findings reported in this study.
- Future studies are needed to provide objective measures of the effectiveness of e-book programmes. This could be done by weighing schoolbags before their introduction and several times thereafter.

- There is a need for further research on the enablers to embedding initiatives in schools (adoption, implementation and maintenance of interventions) and translational research in other schools and settings.

5.5. Conclusion

Consistent with global estimates (Hallal, Andersen, et al., 2012) adolescent girls in Ireland are considerably less active than their male peers (Woods et al., 2010). Active travel is an important source of physical activity for adolescent girls (Carver et al., 2008) but has declined considerably in recent decades (Central Statistics Office, 2012). This study is unique because of the paucity of multi-component, quasi-experimental studies of active travel interventions with adolescent girls. The study limitations make it difficult to draw clear conclusions about the effectiveness of the intervention. Nonetheless, the study findings indicate that the introduction of e-books as part of a broader multi-component active travel intervention may create a positive shift in attitudes but behaviour change is more difficult to achieve. The discussion identified the intervention components that potentially contributed most to the small intervention effect in 1st years and recommendations were made for the design of future interventions. This study also confirmed that active travel and particularly cycling for transport increases the likelihood of adolescent girls meeting the guidelines for MVPA. Two key issues for practitioners to address are; 1) present cycling as a superior form of transport that is a social norm for adolescent girls and 2) reduce the actual and perceived convenience of car travel collaboratively with parents. Greater effects may be detected in studies that empower relevant school committees to implement intensive multi-component interventions in partnership with key stakeholders such as the local authority and local sports partnerships. These studies should also simultaneously promote active travel to school and non-school destinations.

CHAPTER 6. THE IMPACT OF THE INTERVENTION ON ADULTS

6.1. Introduction

This chapter describes the impact of the community-wide active travel intervention (presented in detail in appendix 2) on adults in both intervention towns compared with the control town. Specifically, it examines the impact of the intervention on weekly minutes of active travel, total physical activity, and campaign awareness (all study 1) and on the number of pedestrians and cyclists in each urban centre (study 2).

6.2. Methodology

6.2.1. Research Design

This was a natural experiment conducted in two intervention towns and one control town, using cohort samples in both communities. The impact of the community-wide interventions was measured using identical self-report surveys at baseline in May 2011 and at follow-up in May 2013 (study 1). This data was supplemented by manual observed counts of pedestrians and cyclists in June 2011, 2012 and 2013 (study 2).

6.2.2. Research Questions

Study 1

1. Was there a difference in the characteristics of respondents and non-respondents at follow-up?
2. What impact did the intervention have on awareness of the 'Smarter Travel' campaign?
3. What impact did the intervention have on total daily minutes of active travel?
4. Was there an association between the change in active travel and changes in recreational and total physical activity?

Study 2

5. What impact did the intervention have on the number of observed pedestrians and cyclists in the communities?

6.2.3. Study Population and Sampling

Study 1: Self-report survey

At baseline, adult respondents were recruited by sending a sealed envelope home with every child participating in the primary and secondary school studies (chapters three and four). Specifically, these were 5th and 6th class primary school students and 1st, 2nd and 5th year secondary school students. The envelope contained two surveys (one pink survey for a female adult in the household and one blue survey for a male adult; appendix 6A), an information letter and a freepost business reply envelope. The information letter prompted the child's guardians or any other adult residing within the house to complete the enclosed surveys. Surveys returned before a specific date were entered into a draw for a new bike. At follow-up, those who consented to be contacted and had supplied contact details were sent the same survey again (via postal mail) and a freepost reply envelope. A €100 restaurant voucher was offered as an incentive to respond by a certain date. Personalised text messages were sent to all non-respondents one, two and three weeks after the return-by date. Additional hard and soft copies of the survey were mailed when requested. Details of the final samples sizes and attrition rates are outlined in figure 6.1.

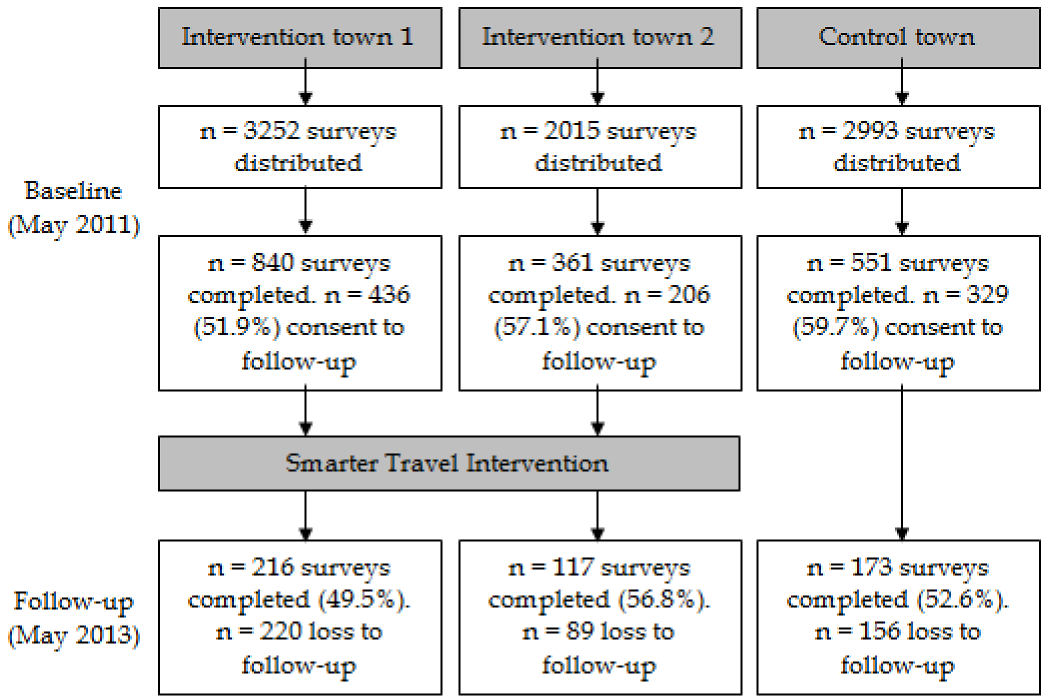


Figure 6.1 Participant flowchart

Study 2: Manual counts of pedestrians and cyclists

See section 6.2.5

6.2.4. Description of the community-wide intervention

As outlined in previous sections (1.7, 3.2.4, 4.2.4), the project in intervention town 2 was better resourced (despite being a much smaller town), facilitating the establishment of a dedicated project team. Consequently, the most intensive intervention was implemented in intervention town 2 and consisted predominantly of infrastructural measures (figure 6.2). A detailed inventory of the community-wide intervention is contained in appendix 2. An abridged version of the intervention components targeting adults is provided below.

During the intervention period in intervention town 1, the local authority completed a 12km orbital pedestrian/cycleway around the town, improved existing cycleways on the towns radial routes, improved the public realm and pedestrian infrastructure in the town centre, created a 1.6km river boardwalk and organised a comprehensive 'Smarter Travel' themed campaign on two occasions. In intervention town 2 an old railway track was converted into a separated walking and cycling path linking the town centre with many of the town's residential areas and schools and continuing to a nearby coastal resort. This was officially opened in 2011 after the baseline survey. The 'GO Dungarvan' brand was established in 2012 and a project team of four people were appointed (project-coordinator, community development officer, communications officer and programme technician). This project team introduced a comprehensive package of predominantly hard measures between 2011 and 2013.

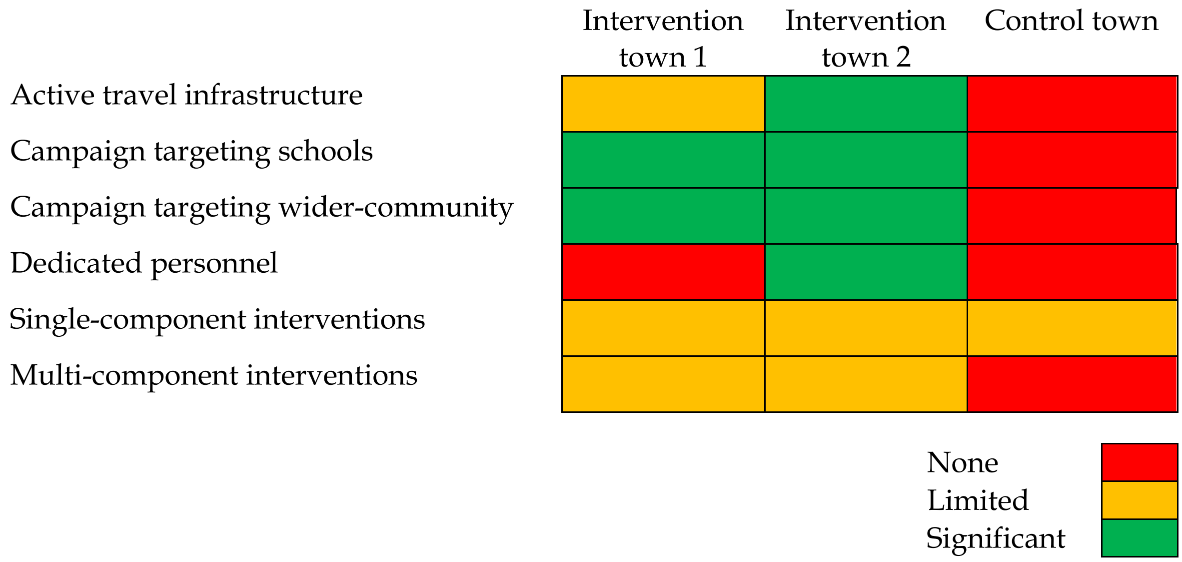


Figure 6.2 The extent of the intervention components targeting adults in each town

6.2.5. Data Collection Tools

Study 1: Self-report survey

Version two of the Global Physical Activity Questionnaire (GPAQ) was the first section of the survey. The GPAQ is used to assess domain-specific patterns of physical activity in adults. The GPAQ has 11 questions (some a+b) which assess the amount and intensity of physical activity in work, transport and leisure. One question assesses total sitting time. The main outcome measures from GPAQ are derived categories that reflect physical activity levels (high, moderate, low) and continuous measures of total physical activity within each domain (work, transport, leisure). The second and third sections of the survey assessed respondents' awareness of the 'Smarter Travel' campaign and their demographic details. The attitudinal statements were adapted from the Cycling Demonstration Town surveys of physical activity and cycling in the UK (Cavill et al., 2009).

Reliability and validity of the GPAQ

The GPAQ was developed by the WHO as a domain-specific physical activity surveillance measure and is used for the WHO STEPwise global surveillance programme (WHO, 2015). It was developed to provide an intermediary option between the short and long forms of the International Physical Activity Questionnaire (IPAQ) that provides domain specific estimates of physical activity (Bauman et al., 2009). The reliability and validity of the IPAQ is comparable with other physical activity questionnaires (Craig et al., 2003). Equally, the reliability and validity of the GPAQ is comparable to IPAQ. However a study that assessed its criterion validity with pedometers and accelerometers (Bull, Maslin, & Armstrong, 2009) concluded that it was fair to poor (Spearman's rho 0.06-0.35). Although the GPAQ was not developed for testing intervention effects (Bauman et al., 2009), a recent Irish study concluded that the instrument is a valid measure of change for MVPA (Cleland et al., 2014).

Study 2: Manual counts of pedestrians and cyclists

An adapted version of a count form developed by the National Pedestrian and Cyclist Documentation Project (National Bicycle and Pedestrian Documentation Project, 2014) based in the US was used (appendix 6B). This was a standard screenline count form that allowed the user to record the number and sex of both cyclists and pedestrians that cross an imaginary screenline on a street. The form was adapted to capture data from two imaginary screenlines (labelled A+B). Research assistants recorded the date, time period, weather conditions (at end of data collection) and the exact location of screenlines A and B on the top of their form. Every pedestrian and cyclist that crossed the screenline was recorded. Those using scooters, flickers, skateboards etc. were recorded as 'other'. Detailed instructions for using the form are listed in appendix 6B.

6.2.6. Data Collection Method

Study 1: Self-report survey

See section 6.2.3

Study 2: Manual counts of pedestrians and cyclists

The manual counts were conducted on the last Tuesday in May in 2011, 2012 and 2013. Two count days were conducted in 2013 due to unexpected bad weather on the first day. The count periods were 8.15am-9.30am and 3pm-6pm. Senior engineers in each town identified suitable locations for screenlines on streets considered to be main thoroughfares in their respective towns (figures 6.3-6.5). Research assistants were recruited and received training to conduct the manual counts in each town (four locations in town 1 and three locations in both town 2 and the control town). The majority of locations required the monitoring of two screenlines (A+B). They were given photos of their exact screenline locations and asked to conduct a pilot data collection period from 7.45am-8am. The same three research assistants acted as co-ordinators for the data collection in each town from 2011-2013. Locations two and three in intervention town 1 (figure 6.3) proved to be exceptionally busy and the research assistants first questioned the accuracy of their data in 2011. A second research assistant was assigned to location two to conduct an independent count for comparison purposes.

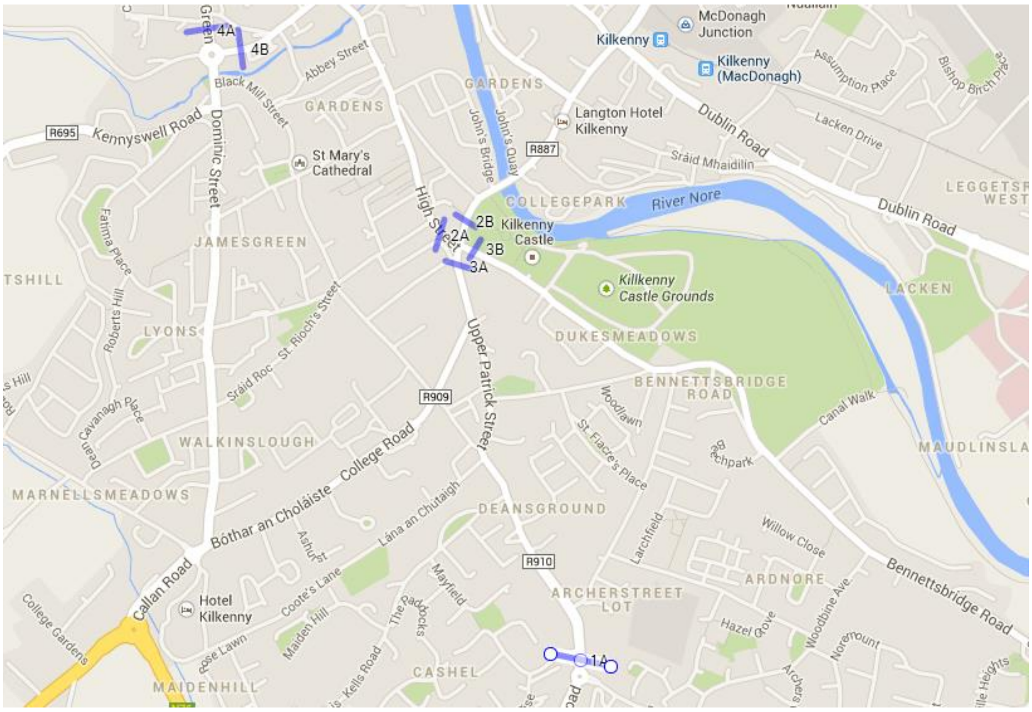


Figure 6.3 Screenline locations in intervention town 1

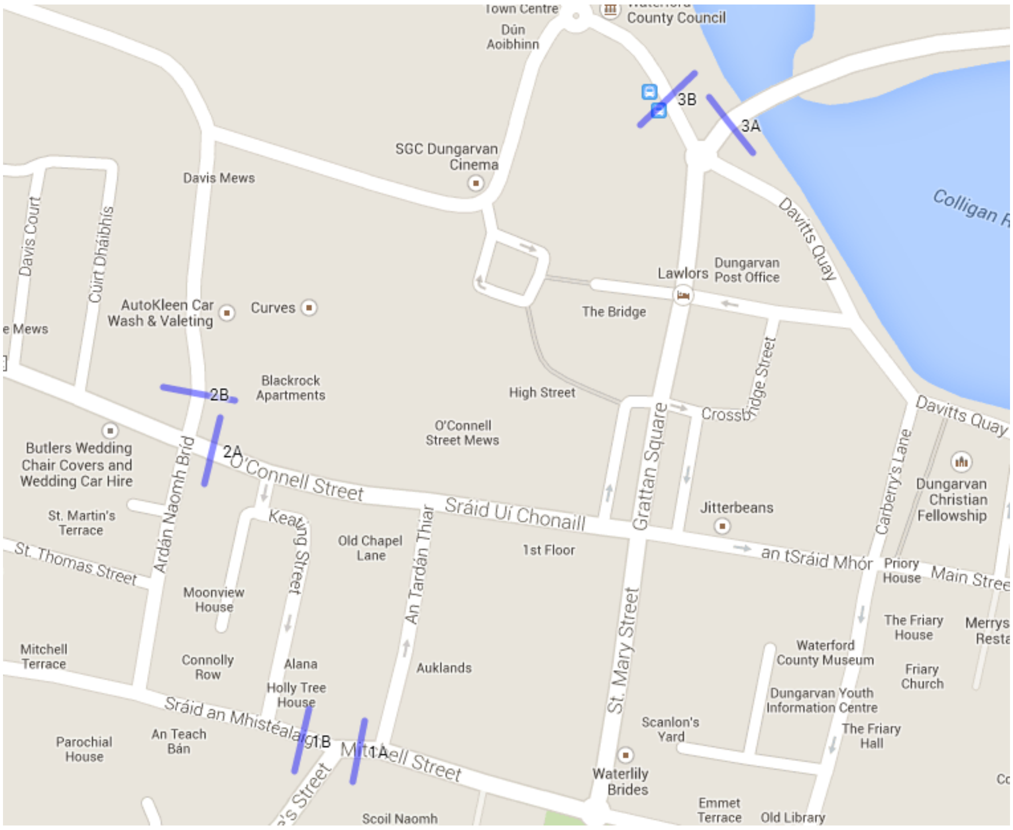


Figure 6.4 *Screenline locations in intervention town 2*

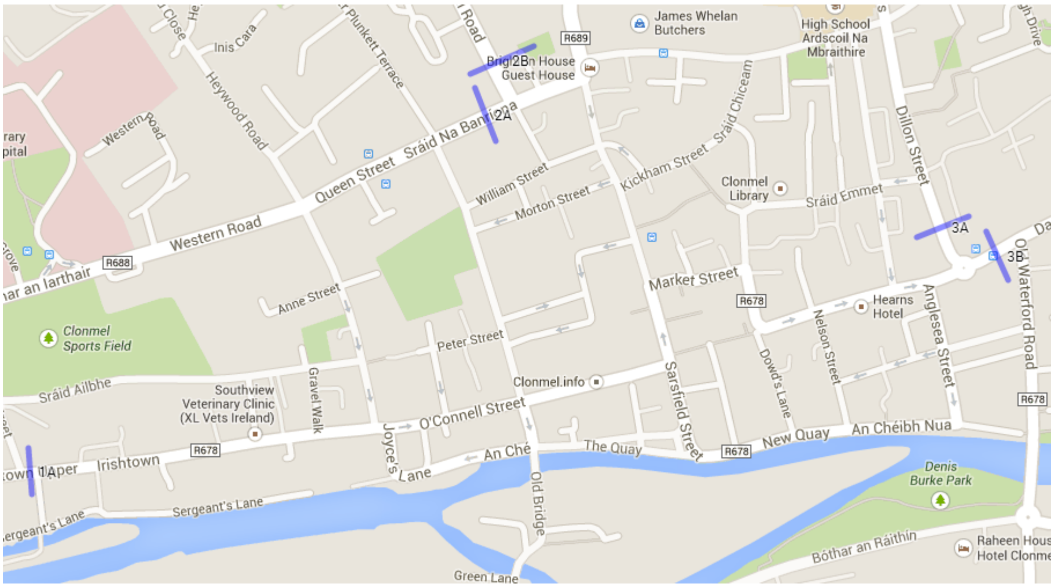


Figure 6.5 *Screenline locations in control town*

6.2.7. Data Analysis

Study 1: Self-report survey

The physical activity outcome variables were calculated based on the scoring, cleaning and truncation rules provided in the GPAQ analysis guide (World Health Organisation, n.d.). Notably, data were truncated where daily minutes of activity within any specific domain or intensity exceeded 16 hours. Log10 transformed data is reported within this chapter but the untransformed data are available in appendix 6C. Independent t-tests and chi-square tests were used to test for differences between those that agreed or declined to be followed-up at baseline and between respondents and non-respondents at follow-up. Binary logistic regression was then used to estimate the adjusted likelihood of agreeing to be followed-up at baseline and responding at follow-up. All predictor variables were tested for multi-collinearity and there were no tolerance values below 0.1.

A repeated measures analysis of variance (ANCOVA) was conducted to examine the differences in active travel and physical activity from baseline to follow-up while controlling for baseline measures. Effect sizes were calculated and interpreted for any differences based on the work of Cohen (1988). A two-way ANCOVA was conducted to assess the potential interaction effect between sex and town. Descriptive statistics and binary logistic regressions were used to analyse the responses to questions about the awareness of the project. A reliability analysis was conducted on the scales measuring attitudes to the campaign at baseline and follow-up. Items one, five, and seven were reversed and the Cronbach alpha coefficient was 0.72 for 2011 and 0.74 for 2013. A mixed between-within Anova was used to examine the difference in the change in the overall scale. The absolute change in proportions (difference in differences) for each individual item was calculated using 95% confidence intervals consistent with previous research (Goodman, Panter, et al., 2013).

Multiple regressions were used to examine the association between the change in log transformed daily minutes of active travel with the change in recreational physical activity. Data for each category were truncated at 180 minutes per day (6-12 cases). The change in recreational activity was entered into the regression model as an outcome variable. The exposure variable was change in active travel categorised into three groups; those that increased, maintained or decreased their volume of active travel. Maintainers were classified as anyone who didn't change at all or only changed within the range of ±2 minutes. The change in daily minutes of active travel was also categorised according to the magnitude of change using cut points of ±2, ±15, ±30 and ±45 minutes per day. Seven cases with residuals greater than three standard deviations were removed from the model. The analysis was adjusted for age, sex, highest level of education and employment status. A statistical significance level of 0.05 was used in all analyses.

Study 2: Manual counts of pedestrians and cyclists

The percentage change in pedestrians and cyclists over the three count periods (2011, 2012, and 2013) was calculated. The data from the first count day in 2013 (bad weather) was not included. A separate independent count was conducted on the busiest intersections in order to assess inter-rater reliability (see 6.2.5). The intra-class correlation co-efficient was 0.98.

6.3. Results

Study 1: Self-report survey

Was there a difference in the characteristics of respondents and non-respondents at follow-up?

There were several differences in socio-demographic variables and levels of physical activity between respondents and non-respondents[12] in each town. In the unadjusted analysis (appendix 6C), more females and those with 3rd level education responded in intervention town 1. In the control town more females responded and respondents were also older than non-respondents. Respondents in the control town and intervention town 1 engaged in more minutes (log10 transformed) of recreational physical activity per day than non-respondents. In the untransformed data (appendix 6C) non-respondents in the control town engaged in more daily minutes of work-related physical activity than respondents. In the adjusted analysis (table 6.1) participants from intervention town 1 were less likely to respond than those in the control town. There were also several within town differences. Participants from intervention town 1 who engaged in any recreational physical activity and had 3rd level education were more likely to respond. In the control town, those who engaged in any active travel or recreational physical activity were more likely to respond. In the same town, females and those over 45 years of age were also more likely to respond.

[12] See appendix 6C for analysis of differences between those that agreed and declined to be followed-up

Table 6.1 Multivariate odds ratios of responding at follow-up

		Intervention town 1[a]			Intervention town 2[a]			Control town[a]		
Variable		OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Sex	Female	1.0	Ref		1.0	Ref		1.0	Ref	
	Male	0.75	0.53, 1.07	0.11	0.68	0.41, 1.12	0.13	0.62	0.41, 0.94	**0.03***
Age (years)	<45	1.0	Ref		1.0	Ref		1.0	Ref	
	>45	1.30	0.92, 1.84	0.14	0.97	0.59, 1.60	0.91	1.70	1.13, 2.55	**0.01***
Tertiary education	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	1.91	1.30, 2.80	**0.00****	1.23	0.75, 2.01	0.42	1.15	0.75, 1.76	0.52
Employed	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	0.91	0.56, 1.52	0.73	0.99	0.50, 1.96	0.97	1.06	0.61, 1.83	0.85
Sufficiently active	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	0.83	0.52, 1.32	0.43	0.75	0.39, 1.45	0.40	0.93	0.55, 1.59	0.80
Any work PA	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	1.44	0.98, 2.10	0.06	1.47	0.85, 2.54	0.17	0.90	0.57, 1.41	0.64
Any active travel	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	1.02	0.71, 1.47	0.92	1.10	0.65, 1.84	0.73	1.60	1.04, 2.45	0.03*
Any recreational PA	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	2.38	1.47, 3.86	**0.00****	1.57	0.86, 2.87	0.14	2.46	1.41, 4.31	**0.00****

	Total Sample[b]		
Intervention vs control			
Control town	1.0	Ref	
Intervention town 1	0.72	0.56, 0.93	**0.01***
Intervention town 2	1.01	0.74, 1.37	0.95

*p<0.05, **p<0.01; [a] adjusted for all other variables in table (except intervention vs control); [b] adjusted for all other variables in table

What were the baseline characteristics of the matched sample used in the analysis?

There were no differences in the socio-demographic characteristics of the sample between towns (table 6.2). The average age (±SD) of those in all towns was 45.1 years (±6.8). In contrast to national census data for a similar age group, the majority of the sample were female, had tertiary education and were employed full-time. There was also no between town difference in the amount of physical activity that participants engaged in.

Table 6.2 Sample characteristics at baseline[a]

	Intervention town 1 (n=215)	Intervention town 2 (n=116)	Control town (n=173)	P value	National census data 2011 (30-55 year olds)
Age (years ± SD)	44.9 (5.9)	45.6 (7.1)	44.9 (7.5)	0.653	
Sex (%)					
Male	38.9	37.6	37.6	0.956	49.8
Female	61.1	62.4	62.4		50.2
Education					
Primary	1.9	2.6	3.5	0.147	6.5
Secondary	25.5	35.9	34.3		56.3
Tertiary	72.7	61.5	62.2		37.1
Employment					
Unemployed	13.2	17.9	15.7	0.755	18.2[13]
Part-time	28.8	29.9	30.8		
Full-time	58.0	52.1	53.5		69.5
Physical activity (log10 mins/day ± SD)					
Total PA	1.80 (0.64)	1.85 (0.66)	1.81 (0.64)	0.95	
Work	0.85 (1.04)	1.00 (1.08)	0.80 (1.02)	0.37	
Recreation	1.29 (0.66)	1.26 (0.72)	1.35 (0.70)	0.52	
Travel	0.68 (0.80)	0.75 (0.84)	0.74 (0.80)	0.92	

*p<0.05; [a] for those that responded at both baseline and follow-up

[13] 'Unemployed' included the following categories; unemployed, unemployed due to illness or retired (i.e. not unemployment rate). 'Employed' was calculated excluding those minding relatives, looking after the home or students for the purpose of comparability. CSO data did not differentiate between part-time and full-time work.

What impact did the intervention have on awareness of the 'Smarter Travel' campaign?

The intervention had a significant impact on increasing campaign awareness in intervention town 2. The data in table 6.3 shows that there was an increase in awareness from baseline to follow-up in each town. The smallest increase was in the control town (12.0%) and the largest was in intervention town 2 (36.3%). There was a 21.3% increase in intervention town 1 but this was not greater than the increase in the control town. Only in intervention town 2 was there an absolute increase in awareness relative to control. The awareness of the 'Smarter Travel' campaign was highest in this town at follow-up (80.7% aware at follow-up, $p<0.05$). This is supported by the data in tables 6.4 and 6.5. These data show that at follow-up, when compared with control, respondents from intervention town 2 were both more likely to have heard of the campaign and to have noticed changes in their town to make it easier to walk or cycle. Almost 94% of them reported having noticed changes in their town. The most frequently cited changes were new cycle lanes. Interestingly, those who were employed were almost six times more likely to have noticed these changes. In intervention town 1, although the effect was smaller, they were also more likely to have heard of the campaign than those in the control town. Furthermore, women and those with 3rd level education were more likely to have heard of it. Approximately 81% of those in the town had noticed changes but the responses were more varied than those given in intervention town 2.

Being aware of the campaign did not translate into a positive shift in attitudes to active travel in the intervention towns (table 6.6). There was no difference in the change between towns when the eight items were analysed together as one scale ($p>0.05$). The only positive within town effect was an 18.8 percentage point increase in respondents from intervention town 2 that agreed that the campaign made them want to walk more. This equated to an absolute percentage point increase of 22.4 which was close to being significant (95%CI; -5.4, 50.3). The proportion of respondents that said the campaign made them walk more decreased in intervention town 1 and the control town. The proportion of respondents that agreed the campaign made them want to cycle more or give cycling a try decreased (trend only, not significant) in both intervention towns. It should be noted that these estimates are low in statistical power because of the small sample size on which they are based and must be treated with caution.

Table 6.3 Percentage of respondents that were aware of a walking or cycling campaign in their community

	Baseline %	Follow-up %	% Diff (95% CI)	Difference in differences (int vs control; 95%CI)
Intervention town 1	43.3 (n=215)	64.6 (n=209)	**21.3 (11.9, 30.3)**	9.4 (-3.7, 22.5)
Intervention town 2	44.4 (n=117)	80.7 (n=114)	**36.3 (24.1, 46.9)**	**24.3 (9.5, 39.1)**
Pooled (town 1+2)	43.7 (n=332)	70.3 (n=323)	**26.6 (19.1, 33.7)**	**14.6 (2.9, 26.4)**
Control	19.8 (n=172)	31.7 (n=167)	**12.0 (2.7, 21.1)**	

Table 6.4 Multivariate odds ratios of being aware of a walking or cycling campaign at follow-up

		Intervention town 1[a] (n=344)			Intervention town 2 [a] (n=206)		
Variable		OR	95% CI	P	OR	95% CI	P
Sex	Female	1.0	Ref		1.0	Ref	
	Male	**0.47**	**0.25, 0.86**	**0.02***	0.42	0.15, 1.15	0.91
Age (years)	<45	1.0	Ref		1.0	Ref	
	>45	1.48	0.77, 2.82	0.24	0.95	0.33, 2.74	0.92
3rd level	No	1.0	Ref		1.0	Ref	
	Yes	**2.0**	**1.04, 3.84**	**0.04***	0.52	0.16, 1.65	0.27
Employed	No	1.0	Ref		1.0	Ref	
	Yes	1.30	0.54, 3.15	0.56	2.90	0.88, 9.58	0.08
Sufficiently active	No	1.0	Ref		1.0	Ref	
	Yes	1.07	0.53, 2.16	0.85	1.11	0.36, 3.41	0.86
Any active travel	No	1.0	Ref		1.0	Ref	
	Yes	0.93	0.50, 1.71	0.81	0.99	0.36, 2.70	0.98
		Total Sample [b]					
Intervention vs control							
Control town		1.0	Ref				
Intervention town 1		**4.04**	**2.58, 6.34**	**0.00****			
Intervention town 2		**9.52**	**5.29, 17.16**	**0.00****			

*p<0.05, **p<0.01; [a] adjusted for all other variables in table (except intervention vs control); [b] adjusted for all other variables in table

Table 6.5 Multivariate odds ratios of having noticed changes in their town to make it easier to walk or cycle (asked at follow-up only)

		Intervention town 1[a] (n=344)			Intervention town 2[a] (n=206)		
Variable		OR	95% CI	P	OR	95% CI	P
Sex	Female	1.0	Ref		1.0	Ref	
	Male	0.53	0.25, 1.12	0.10	0.44	0.07, 2.65	0.37
Age (years)	<45	1.0	Ref		1.0	Ref	
	>45	1.04	0.47, 2.29	0.93	1.78	0.29, 11.11	
Tertiary education	No	1.0	Ref		1.0	Ref	
	Yes	**2.27**	**1.05, 4.88**	**0.04***	2.63	0.38, 18.10	0.33
Employed	No	1.0	Ref		1.0	Ref	
	Yes	0.51	0.14, 1.89	0.32	**5.82**	**1.03, 32.76**	**0.05***
Sufficiently active	No	1.0	Ref		1.0	Ref	
	Yes	2.03	0.92, 4.48	0.08	1.40	0.19, 10.19	0.74
Any active travel	No	1.0	Ref		1.0	Ref	
	Yes	1.24	0.59, 2.59	0.58	0.17	0.02, 1.57	0.12
		Total Sample[b]					
Intervention vs control							
Control town		1.0	Ref				
Intervention town 1		1.15	0.67, 1.95	0.62			
Intervention town 2		**4.10**	**1.79, 9.40**	**0.00****			

*p<0.05, **p<0.01; [a] adjusted for all other variables in table (except intervention vs control); [b] adjusted for all other variables in table

Table 6.6 Percentage of respondents that agreed with attitudinal statements related to the active travel campaign

	Intervention town 1			Control town			Absolute change
	Pre % (n =91)	Post % (n=127)	% Diff (95%CI)	Pre % (n=32)	Post % (n=54)	% Diff (95%CI)	Difference in differences (95%CI)
Made me think about walking & cycling	89.0	78.7	**-10.3 (-19.6, -0.1)**	93.8	70.4	**-23.4 (-37.3, -6.0)**	13.1 (-4.5, 30.7)
Didn't tell me anything new	41.4	36.5	-4.9 (-18.0, 8.2)	48.4	48.1	-0.3 (-21.5, 20.8)	-4.6 (-30.5, 21.4)
Made me want to cycle more	53.5	45.5	-8.0 (-21.2, 5.7)	54.8	38.0	-16.8 (-36.9, 5.1)	8.9 (-17.1, 34.9)
Made me want to walk more	71.4	62.4	-9.0 (-21.3, 4.1)	62.5	58.8	-3.7 (-23.6, 17.6)	-5.4 (-30.4, 19.7)
I didn't take much notice of campaign	29.1	29.7	0.6 (-12.2, 12.8)	22.6	18.9	-3.7 (-22.8, 13.1)	4.3 (-17.8, 26.4)
Made me give cycling a try	27.3	25.6	-1.6 (-14.0, 10.3)	23.3	18.4	-4.9 (-24.5, 12.4)	3.3 (-18.9, 25.6)
Local authority shouldn't be spending money on cycling	8.2	11.4	3.2 (-5.6, 11.2)	19.4	15.7	-3.7 (-22.2, 12.3)	6.8 (-12.1, 25.8)
Made me see cyclists point of view	48.4	52.5	4.1 (-9.3, 17.3)	45.2	53.8	8.7 (-13.0, 29.2)	-4.6 (-30.6, 21.4)

	Intervention town 2						Absolute change
	Pre % (n =43)	Post % (n=85)	% Diff (95%CI)	Pre % (n=32)	Post % (n=54)	% Diff (95%CI)	Difference in differences (95%CI)
Made me think about walking & cycling	89.6	81.2	-8.4 (-19.7, 5.2)	93.8	70.4	**-23.4 (-37.3, -6.0)**	15.0 (-4.1, 34.0)
Didn't tell me anything new	29.8	28.0	-1.7 (-18.3, 13.6)	48.4	48.1	-0.3 (-21.5, 20.8)	-1.4 (-29.0, 26.1)
Made me want to cycle more	66.7	55.3	-11.4 (-27.3, 6.4)	54.8	38.0	-16.8 (-36.9, 5.1)	5.5 (-22.6, 33.6)

Made me want to walk more	51.1	69.9	**18.8 (1.3, 35.4)**	62.5	58.8	-3.7 (-23.6, 17.6)	22.4 (-5.4, 50.3)
I didn’t take much notice of campaign	20.5	11.0	-9.5 (-24.4, 3.2)	22.6	18.9	-3.7 (-22.8, 13.1)	-5.8 (-28.5, 16.9)
Made me give cycling a try	43.2	34.9	-8.2 (-25.6, 9.0)	23.3	18.4	-4.9 (-24.5, 12.4)	-3.3 (-29.1, 22.5)
Local authority shouldn’t be spending money on cycling	13.3	14.6	1.3 (-12.9, 12.9)	19.4	15.7	-3.7 (-22.2, 12.3)	5.0 (-16.3, 26.2)
Made me see cyclists point of view	54.3	55.4	1.1 (-16.2, 18.5)	45.2	53.8	8.7 (-13.0, 29.2)	-7.6 (-36.1, 20.9)

	Pooled intervention towns						Absolute change
	Pre % (n =134)	Post % (n=212)	% Diff (95%CI)	Pre % (n=32)	Post % (n=54)	% Diff (95%CI)	Difference in differences (95%CI)
Made me think about walking & cycling	89.2	79.7	**-9.5 (-16.7, -1.6)**	93.8	70.4	**-23.4 (-37.3, -6.0)**	13.9 (-2.7, 30.5)
Didn’t tell me anything new	37.3	33.2	-4.1 (-15.5, 6.1)	48.4	48.1	-0.3 (-21.5, 20.8)	-3.8 (-28.4, 20.7)
Made me want to cycle more	58.0	49.5	-8.5 (-19.0, 2.4)	54.8	38.0	-16.8 (-36.9, 5.1)	8.3 (-16.3, 33.0)
Made me want to walk more	64.3	65.4	1.0 (-9.2, 11.6)	62.5	58.8	-3.7 (-23.6, 17.6)	4.7 (-19.2, 28.7)
I didn’t take much notice of campaign	26.2	22.0	-4.2 (-13.8, 5.1)	22.6	18.9	-3.7 (-22.8, 13.1)	-0.4 (-20.9, 20.0)
Made me give cycling a try	32.6	29.5	-3.1 (-13.3, 6.9)	23.3	18.4	-4.9 (-24.5, 12.4)	1.9 (-13.3, 6.9)
Local authority shouldn’t be spending money on cycling	10.0	12.7	2.7 (-4.8, 9.3)	19.4	15.7	-3.7 (-22.2, 12.3)	6.4 (-12.1, 24.8)
Made me see cyclists point of view	50.4	53.7	3.3 (-7.4, 13.9)	45.2	53.8	8.7 (-13.0, 29.2)	-5.4 (-30.0, 19.3)

What impact did the intervention have on total daily minutes of active travel?

There was some evidence of a small intervention effect detected for the cohort samples in the intervention towns (table 6.7). In the control town, there was no change in daily minutes of active travel (transformed or untransformed) at follow-up. There was a significant increase in the log10 transformed minutes of active travel in intervention town 1 and the pooled data for both intervention towns. However there was no difference in the change between these samples and the control town. In intervention town 2 there was a similar increase in the log10 transformed data which approached significance but again there was no difference in the change when compared to the change in the control town. The within town increases in the log10 transformed minutes of active travel were paralleled by increases in the untransformed data although neither were significant. There was no change in the proportion of respondents from the control town that did any active travel while there was a 7.9 (95%CI; -6.8, 21.9) and 8.3 (95%CI; -8.8, 24.7) percentage point increase in intervention town 1 and 2, respectively (no absolute effect). There was no interaction effect between town and gender for a change in active travel (transformed or untransformed, $p>0.05$). Equally, there was no gender difference in the volume of active travel at either baseline or follow-up ($p>0.05$). Interestingly, 53.7% of the total sample did not walk or cycle for transport for at least 10 minutes in a usual week. There was no difference between towns ($p>0.05$).

Table 6.7 Change in total daily minutes of active travel in intervention towns versus control from baseline to follow-up

	Intervention town 1 (n=194)			Intervention vs control
	Baseline	Follow-up	Difference (95% CI)	P value
Log10 Minutes (±SD)	0.68 (0.80)	0.82 (0.83)	**0.14 (0.01, 0.27)**	0.27
Minutes (±SD)	22.6 (46.7)	29.0 (52.9)	6.4 (-1.81, 14.56)	0.25
	Intervention town 2 (n=104)			
Log10 Minutes (±SD)	0.75 (0.84)	0.86 (0.85)	0.11 (-0.06, 0.27)	0.33
Minutes (±SD)	28.1 (58.5)	33.1 (56.6)	5.0 (-7.24, 17.22)	0.18
	Pooled intervention towns (n=298)			
Log10 Minutes (±SD)	0.70 (0.81)	0.83 (0.83)	**0.13 (0.03, 0.23)**	0.22
Minutes (±SD)	24.5 (51.1)	30.4 (53.7)	5.9 (-0.89, 12.68)	0.15
	Control town (n=153)			
Log10 Minutes (±SD)	0.74 (0.80)	0.76 (0.81)	0.02 (-0.12, 0.16)	
Minutes (±SD)	22.8 (41.5)	23.4 (35.6)	0.6 (-6.11, 7.27)	

Was there an association between the change in active travel and changes in recreational and total physical activity?

The results of the linear regression models examining the association between the change in active travel and recreational and total physical activity as separate dependent variables are presented in table 6.8 below. There was no association between the change in active travel and the change in recreational activity and therefore no evidence of activity compensation. Conversely, there was strong evidence of an association between the change in active travel and the change in total physical activity. Those that decreased their active travel had a significant decrease in total physical activity compared with maintainers. Similarly those that increased their active travel had a concomitant increase in total physical activity. Figure 6.6 illustrates the relationship between the change in active travel and the change in physical activity according to the magnitude of the changes. The data is indicative of a dose response effect.

Table 6.8 The association between changes in active travel and changes in recreational activity (average mins/day)

	n	Baseline (±sd)	Follow-up (±sd)	Difference (95%CI)	Regression coefficient* (95%CI)
		Recreational Physical Activity			
Active travel decreased	84	1.31 (0.81)	1.30 (0.74)	-0.01 (-0.17, 0.14)	-0.02 (-0.15, 0.12)
Active travel maintained	260	1.29 (0.63)	1.36 (0.64)	0.07 (-0.01, 0.14)	0
Active travel increased	98	1.35 (0.71)	1.38 (0.80)	0.03 (-0.08, 0.15)	0.07 (-0.06, 0.20)

**adjusted for age, sex, education and employment

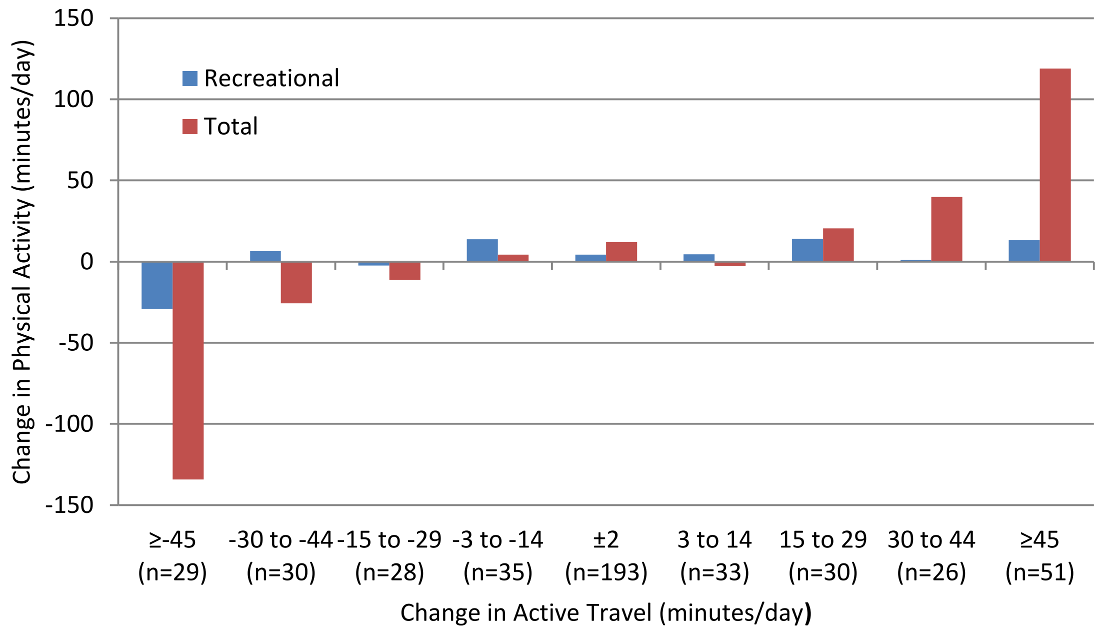


Figure 6.6 The association between subcategories of change in active travel and change in recreational and total physical activity (average mins/day)

Study 2: Manual counts of pedestrians and cyclists

What impact did the intervention have on the number of observed pedestrians and cyclists in the communities?

The manual count data in table 6.9 below suggests that there was no intervention effect for walking or cycling in either town. Indeed, the most notable change was a 36% increase in cyclists in the control town albeit starting from a very low base.

Table 6.9 Manual counts of pedestrians and cyclists 2011-2013

	2011	2012	2013[14]	% Change 2011-2012	% Change 2012-2013	% Change 2011-2013
Intervention town 1 (pop. 24,423)						
Pedestrians	8904	9486	7105	6.5	-25.1	-20.2
Cyclists	501	571	542	14.0	-5.1	8.2
Intervention town 2 (pop. 9,427)						
Pedestrians	2756	2503	2467	-9.2	-1.4	-10.5
Cyclists	237	275	234	16.0	-14.9	-1.3
Control town (pop. 17,908)						
Pedestrians	2093	2195	2105	4.9	-4.1	0.6
Cyclists	125	169	170	35.2	0.6	36.0

[14] Weather was poor in intervention town 1 for a portion of the data collection times in 2013

6.4. Discussion

6.4.1. Summary of results

This study evaluated the impact of a natural experiment conducted in two intervention towns and one control town, using cohort samples in both communities. Significant intervention effects were detected for campaign awareness in intervention town 2 only. There was an absolute increase in campaign awareness of 24% in this town and participants were four times more likely to have noticed changes to make it easier to walk or cycle places compared with participants from the control town. Nonetheless, these positive effects did not translate into a positive shift in attitudes. The only positive within town effect for attitudes was evident in intervention town 2. This was a 19% increase in the proportion of participants who agreed that the campaign 'made me want to walk more'. There was a significant increase in total daily minutes of active travel (log10 transformed) in intervention town 1 and in the pooled intervention town data. However the change was not significantly greater than the change in the control town and the trends were not supported by the manual count data. In the total sample, there was no evidence that an increase in active travel was associated with a commensurate decrease in recreational physical activity.

6.4.2. Evidence for an intervention effect on campaign awareness and attitudes to active travel

Campaign awareness

The awareness of the active travel campaigns was 65% and 81% at follow-up in intervention town 1 and intervention town 2, respectively. This was higher than that normally reported for travel behaviour campaigns where 20-40% is more common (Pucher, Dill, et al., 2010). The high baseline levels of awareness (approximately 44% in both towns) may have contributed to this. In intervention 1, a highly publicised and controversial one-way traffic system was trialled in 2010 and became synonymous with the 'Smarter Travel' initiative (more detail in chapter seven). Similarly, the construction of the converted railway track in town 2 had commenced before the baseline data were collected. The high baseline levels might also be explained by the generic nature of the question 'have you ever heard of a campaign to promote walking or cycling in (town name)'? The higher level of campaign awareness in town 2 (81%) is comparable with the awareness of the 10,000 steps campaigns in Ghent (63%) (De Cocker, De Bourdeaudhuij, Brown, & Cardon, 2007) and Rockhampton (95%) (Brown, Mummery, Eakin, & Schofield, 2006) and higher than in the cycling demonstration towns which ranged from 21% to 53% (Cavill et al., 2009). Campaign awareness was also high in the control town in this study. Cavill et al. (2009) reported that awareness in the comparison town was 20% which was identical to that reported in this study. The significant within town increase in awareness in the control town in this study is unusual although similar findings have been reported elsewhere (Brown et al., 2006). It is possible that participants may have interpreted the question to include awareness of campaigns for recreational walking or cycling.

The greater level of awareness at follow-up and the significant increase in campaign awareness in intervention town 2 compared to town 1 could be due to several factors. Intervention town 2 is considerably smaller than town 1. De Cocker et al. (2007) postulated that the smaller size of Rockhampton might explain why it achieved higher awareness than the Ghent campaign. The greater intensity and extensiveness of the mass media campaign in town 2 is another likely explanatory factor. The campaign developed a brand identity (GO Dungarvan) in year two of the intervention as advocated by Bauman and Chau (2009). Awareness of the 'GO Dungarvan' brand in town 2 was promoted through media sponsorships, social media, websites, newsletters, signage and mass participation events in a sustained manner. Importantly these measures were complimented by the introduction of several infrastructural measures which garnered a lot of positive media attention (appendix 7D). The campaign targeting adults in intervention town 1 could be described as stand-alone and periodic. The effectiveness of this approach is questionable (Bauman & Chau, 2009; Brown, 2012). The main focus of the campaign in town 1 was the active travel themed 'family fun day'. This event was advertised extensively and included a mailshot of approximately 10,000 households but the campaign surrounding the event was only implemented over three weeks in June each year. The campaign was not complimented by a range of other measures in the town. The promotion of events by household flyer drops may not be the most effective approach to increase awareness. An Australian study reported that after distributing 50,000 leaflets to increase community awareness of a new walking and cycling trail, only 9% reported having received one at follow-up (Merom et al., 2003).

There were several socio-demographic differences in campaign awareness in this study and particularly in intervention town 1. In agreement with previous studies (Brown et al., 2006; De Cocker et al., 2007), females were more than twice as likely to be aware of the campaign at follow-up compared with males (significant in town 1 and pooled data). Also in intervention town 1, those with 3rd level education were more than twice as likely to be aware of the campaign or to have noticed changes in their town compared with those without. The implications of this are that the reach of stand-alone periodic campaigns may be limited to specific segments of the population. In intervention town 2, those who were employed were almost six times more likely to have noticed changes in their town to make it easier to walk or cycle. The newly converted railway track connected many of the major residential locations in the town to the periphery of the urban centre. People who were employed may have taken more notice of the new infrastructure and opportunities for active travel as part of their daily work commute. Habit is a consistent determinant of passive travel (De Witte et al., 2013) and the introduction of new infrastructure can be an important trigger for creating a modal shift to active travel (Christensen, Redfern, & Hardin, 2012).

Campaign messages

The results for the intermediate attitude statements reported in this study at follow-up were very comparable to those reported by Cavill et al. (2009) for the cycling demonstration towns and in many cases were more positive. In this study 87% of respondents disagreed that the local authority shouldn't be spending money on active travel compared with 75% in the demonstration towns. Although, like Cavill et al. (2009) the follow-up data suggests that it is easier to make people think about active travel than actually change their behaviour. This inconsistency between supporting government investment in active travel while not actually engaging in active travel is evident in other car dependent countries like the US (Gase, Barragan, Simon, Jackson, & Kuo, 2015). Cavill et al. (2009) concluded that the attitudinal data provided a strong platform to continue the intervention. However the change in attitudes from baseline to follow-up in this study tells a different story. The intervention had no effect on changing intermediate attitudinal statements and in many cases the trend was in the wrong direction. Fewer people in both intervention towns thought about walking and cycling at follow-up. Similar trends were evident for cycling in both towns despite the fact that cycling for transport was promoted to a greater extent than walking for transport. The only positive effect was a 19 percentage point increase in the proportion of respondents in town 2 that said the campaign made them want to walk more. The lack of intervention effect is compounded by the fact that those who were unaware of the campaign made a natural skip pattern for the attitudinal statements. Less than 2% of those who were unaware of the campaign actually answered the question.

It is difficult to explain why attitudes to and intention to cycle had decreased at follow-up. In intervention town 1, the campaign messages developed for the family fun day event attempted to address many of the known determinants of active travel. However as discussed in the previous section the campaign was only periodic and certain population groups were less likely to be aware of it. Naming the event 'family fun day' may have created the impression that active travel was something primarily for school-children and less about adult travel behaviours. In intervention town 2, the campaign was more extensive and sustained but the messages were less behaviourally specific than those in town 1. The main focus was on brand awareness. Bauman and Chau (2009) state that mass media campaigns for physical activity need to go beyond awareness raising and towards 'calls to action'. Therefore an explanation for these unexpected trends might be the lack of a sustained campaign in intervention town 1 and the lack of behaviourally specific messages (calls to action) in intervention town 2.

The 19 percentage point increase in the proportion of respondents in town 2 who indicated the campaign made them want to walk more might be attributable to the greater number of females in the sample. The creation of the flagship converted railway track may have appealed more to walkers than cyclists in intervention town 2 (Goodman, Sahlqvist, et al., 2013). That is plausible considering that walking for either recreation or transport is a more common activity than cycling for either purpose in Ireland (Irish Sports Council, 2014). Women tend to cycle less than men in countries where levels of cycling for transport are low (Garrard et al., 2008; Geus et al., 2014; Goodman et al., 2012; Heinen et al., 2010; Hutchinson, White, & Graham, 2014; Panter et al., 2011; Vandenbulcke et al., 2011) and Ireland is no different (Central Statistics Office, 2012; Commins & Nolan, 2010, 2011). Although the intervention predominately targeted cycling for transport, Goodman et al. (2013) found that both cycling and walking to work increased in the cycling demonstration towns in the UK. The selection bias associated with only sampling parents of school-children may help to further explain the positive effect on intention to walk. Having children has been identified as inversely associated with levels of active travel in adults (Bopp, Kaczynski, & Besenyi, 2012; Panter, Corder, et al., 2013; Vandenbulcke et al., 2011). This has also been reported in an Irish context but for cycling only (Commins & Nolan, 2011). Despite the significant investment in infrastructural measures in town 2, the barriers to cycling for parents of school-children may not have been adequately addressed. Childcare has been identified as a significant life challenge that necessitates commuting by car (Goodman et al., 2012) potentially due to greater trip chaining (Smart et al., 2014).

6.4.3. Evidence for an intervention effect on active travel

The magnitude of the change in active travel

In this study there was a significant within town increase in total daily minutes of active travel (log10 transformed) in intervention town 1 (+6.4 mins) and in the pooled intervention town data (+5.9 mins). There was a trend towards significance in intervention town 2 (+5.0 mins). The proportion of respondents that engaged in active travel at least once a week also increased by 7.9 and 8.3 percentage points in town 1 and town 2, respectively (decreased by 0.7% in control town). The intervention effect was small considering no absolute change was detected for either variable compared to the control town. Similarly modest intervention effects have been found by other international studies of town or community-wide interventions for walking and cycling (Goodman, Panter, et al., 2013; Heath et al., 2012; NICE, 2012; Ogilvie et al., 2007; Sloman et al., 2009). The small intervention effect is still important considering it occurred during a period when car ownership increased (appendix 2D). Car ownership has been shown to be an inverse correlate of active travel (Commins & Nolan, 2010). Passive travel to work also increased during the same time period (Central Statistics Office, 2012).

It is unlikely that the intervention effect was overstated. There was no change in active travel detected in the control town and this mirrored secular trends in active travel. Outside of Dublin, walking for transport remained static from 2011 to 2013 coupled with only a modest increase in cycling (Lunn & Layte, 2009). Nonetheless, there was some evidence that the intervention effect detected in this study was greater than what has been reported for similar interventions. The 5.9 min/day increase of walking and cycling in the intervention towns is greater than the 15-30 min/week increase reported for controlled studies of walking for transport interventions (Ogilvie et al., 2007). Also the increase in the proportion doing any active travel in this study (7.9% + 8.3%) was greater than the 3.3 percentage point increase in those cycling for at least 30 minutes or more per month in the cycling demonstration towns in the UK (Sloman et al., 2009).

Factors that contributed to an intervention effect

The greater investment in infrastructural measures including the flagship railway track conversion may have caused an increase in active travel in town 2. Unlike for walking (Adams et al., 2013; Sugiyama et al., 2012), street connectivity and the presence of cycling infrastructure is extremely important for cycling (Heinen et al., 2010; Panter & Jones, 2010; Van Holle et al., 2012). Several cities have experienced significant increases in cycling immediately after the introduction of on-road cycle lanes (Pucher, Dill, et al., 2010). Females in intervention town 2 may have been particularly attracted to the greater perceived safety afforded by the separated railway track (Garrard et al., 2008). Although the attitudinal data suggests that the increase in active travel is more attributable to walking than cycling. Despite the greater emphasis placed on the promotion of cycling compared to walking in the town, the intervention may have influenced walking also as was the case in the cycling demonstration towns (Goodman, Panter, et al., 2013). In the longitudinal data from the Commuting and Health in Cambridge Studies, distance was neither a predictor of uptake or maintenance of active travel (Panter, Griffin, et al., 2013). Having a convenient cycle route predicted uptake of cycling and a pleasant route predicted maintenance of walking. The separated railway track would appear to be a perfect example of both a convenient cycling route and a pleasant walking route. Major changes to the physical environment such as this flagship project may have acted as a trigger to travel behaviour (Christensen et al., 2012).

The timing of the follow-up surveys and the sampling strategy may have resulted in an underestimation of the intervention effect. There was an intervention effect detected two years after the introduction of the flagship infrastructural measures in the iConnect study but none after only one year (Goodman et al., 2014). The follow-up data in this study was collected only 18 months after the opening of the railway track so it's possible that a greater effect could have been detected at a later date. A more likely reason for any underestimate of the effect was not stratifying the sample by distance from the railway track. The intervention effect in the iConnect study was only detected for those living within 1km of the new infrastructure. Other studies have reported intervention effects only for respondents that live in close proximity to new walking or cycling tracks and trails (Dill et al., 2014; Merom et al., 2003).

The positive change in active travel in intervention town 1 is more difficult to explain. There were no significant interventions targeting adults and the extent of cycling infrastructure introduced was considerably less than town 2. There was however, a significant investment in improving the public realm which may have had a positive effect of walking. Another possible explanation is the secular trends in active travel for areas of higher population density. While national trends for active travel remained relatively static from 2011-2013, they increased significantly in Dublin (Central Statistics Office, 2012; Irish Sports Council, 2014). While it is true that the local authority in Dublin invested heavily in the promotion of cycling from 2011 to 2013, it is also possible that areas of greater population density show the greatest propensity for modal shift to active travel (Glazier et al., 2014). Intervention town 1 has a greater population density (appendix 1A) than intervention town 2 (and the control town) so may have changed in line with secular trends for towns of a similar population density or may have needed a less intensive intervention.

Factors that attenuated the intervention effect

The extent of the infrastructural provision for cycling was probably insufficient in intervention town 1 and while it was more extensive in town 2, at the time of the follow-up surveys it did not represent a comprehensive joined-up network for active travel. The provision for walking and cycling in the urban centre was poor and the redevelopment of the town square in the urban centre only went to public consultation after the follow-up surveys were completed. Therefore this research may have only measured an incomplete active travel project. A fully completed and integrated system is necessary to create a modal shift to active travel (NICE, 2012; Pucher, Dill, et al., 2010). Completed systems tend to have greater synergy and the impact is greater than the sum of its individual parts (Pucher, Dill, et al., 2010). It is very plausible that an intervention effect could be detected with a longer duration of follow-up. Nonetheless, initial effects also need to be detectable to create enough leverage to sustain and replicate these interventions. Also, some studies have examined the effectiveness of new cycle lanes and failed to demonstrate increases in active travel (Dill et al., 2014; Yang et al., 2010). Other studies highlighted how new infrastructure tends to only attract existing walkers and cyclists (Merom et al., 2003; Rissel, Merom, et al., 2010) and those from higher social classes (Goodman et al., 2014; Goodman, Sahlqvist, et al., 2013). It is possible that the converted railway track was being used frequently since its opening but perhaps for recreational purposes and by those who would normally have walked or cycled elsewhere. This is also applicable to the orbital route for walking and cycling around intervention town 1.

Another reason for the small effect size may be the reasonable cost and availability of car parking in both town centres and their accessibility for car travel (appendix 2B). It is unlikely that the convenience of car travel would have changed in either town between 2011 and 2013. Cycling policies in Dutch, German and Danish cities tend to use more measures to encourage cycling than either town in this study did but they also include many car restrictive measures (Pucher & Buehler, 2008). There is a strong evidence base to support the use of such policies. For example the availability of a car and free or subsidised workplace car parking are strongly associated with passive travel (Carse et al., 2013; Dalton et al., 2013; De Witte et al., 2013; Jones & Ogilvie, 2012; Panter, Grif, et al., 2013). The national framework for the evaluation of the 'Smarter Travel Area' programme outlines 12 categories of measures that could be adopted to create a modal shift to active travel. One of the categories contains 14 measures related to car parking such as increasing prices and removal of spaces. The low price and good availability of car parking in the intervention towns might be undermining other intervention components. This is supported by Martin, Suhrcke, and Ogilvie (2012) who state that financial incentives, either positive or negative, are underused but potentially effective measures.

Christensen et al. (2012) stated that new infrastructural measures for active travel are important triggers for modal shift but that behavioural (softer) measures that target the mediating factors for active travel are also necessary. Both towns failed to consider the influence of habit on travel decisions. Habit, although infrequently studied (De Witte et al., 2013), is very strongly associated with passive travel. Commuting by car is more the result of an automatic response and less about decision making. These behavioural measures such as workplace travel plans and personal travel planning, specifically targeting adults, had not yet been implemented in either town. These additional measures were included in the 'Smarter Choices, Smarter Places' programme in Scotland (Norwood et al., 2014) and the 'Cycling Towns and Cities' programme in England (Goodman, Panter, et al., 2013). These programmes also tended to focus on specific neighbourhoods or groups, which was not done in either intervention town in this research.

The association between the change in active travel and changes in recreational and total physical activity

In this study there was no significant difference in minutes of recreational physical activity between respondents that increased, maintained or decreased their volume of active travel. This mirrors the findings of Sahlqvist, Goodman, Cooper, and Ogilvie (2013). In both studies, those that increased their active travel also increased their total physical activity. This also supports previous cross-sectional research which reported a relationship between active travel and total physical activity (Dombois et al., 2007; Gordon-Larsen et al., 2005; Sahlqvist et al., 2012; Sisson & Tudor-Locke, 2008; Wen et al., 2006; Yang et al., 2012). This is important from a public health policy perspective because it suggests that adults who switch to active travel will do so in addition to their existing recreational physical activity and not in place of it.

6.4.4. Study strengths and limitations

The main strengths of this study include; the use of a panel design, the inclusion of a control community and the measurement of active travel and physical activity as continuous measures. There is a paucity of controlled longitudinal evaluations of community-wide active travel interventions (Krizek, Forsyth, et al., 2009; NICE, 2012) and previous studies have mostly used repeat cross-sectional designs (Ogilvie et al., 2012) which prevent causal inferences being made. The timing of the baseline data collection is a frequent source of measurement error in natural experiments of new active travel measures (Chapman et al., 2014). In this study, the administration of the baseline survey six months prior to the opening of the converted railway track in intervention town 2 established a true baseline of active travel. Measurement error was further reduced by collecting data at the same time each year to avoid seasonal variations in travel behaviour.

The limitations of the research methods were associated with both the research design and the research instrument. The respondents that provided data at both time points were not representative of all parents or of adults aged 30-50 years in Ireland. It was not possible to access the electoral registers to use stratified random sampling. Parents of school-children were sampled as a result and although this method has been used elsewhere (Dill et al., 2014), their behaviour may have been more difficult to change (Mitra, 2013). It is plausible that an intervention effect may have been detected had a more representative sample of adults been recruited. The sampling of parents also prevented the calculation of baseline response rates. More than one envelope may have been brought home to the same household where several siblings participated in the study. However the response rates for follow-up, two years later were comparable with similar studies (Chapman et al., 2014; Panter, Griffin, et al., 2013; Sahlqvist et al., 2013). The respondents at follow-up were biased towards females, those with third level education and those who engaged in more recreational physical activity. Although similar patterns have been observed elsewhere (Batty & Gale, 2009; Chapman et al., 2014; Eagan, Eide, Gulsvik, & Bakke, 2002; C. Foster, Brennan, et al., 2011; Volken, 2013), these differences greatly limit the generalisability of the results. It was also highlighted in the previous section how the intervention (particularly town 1) and control communities differed in terms of population density which is a known determinant of active travel. Realistically studies of this nature should aim to identify control communities that are broadly comparable (Ogilvie et al., 2006). Financial constraints prevented the inclusion of control communities that would be better matched to both intervention towns. Selection bias of this nature is very common in multi-component community intervention studies (Baker, Francis, Soares, Weightman, & Foster, 2011). Importantly, there were no baseline differences in socio-demographic variables or physical activity between towns.

Unlike randomised control trials, there is a greater selection bias inherent in natural experiments (Petticrew et al., 2005). Although they have greater external validity the selection of intervention communities may be biased towards areas with strong leadership for example (Goodman, Panter, et al., 2013). This was a confounding factor in this study and may have contributed to the high levels of baseline awareness in the intervention towns. Both intervention communities were implementing active travel measures before they were awarded any 'Smarter Travel' funding, albeit to a much lesser extent than afterwards. Another weakness of natural experiments is the lack of control over the intervention design and timing. It only became apparent that the railway track was going to be the main outcome measure in intervention town 2 after the baseline survey was complete. The intervention effects of this measure may have been underestimated because proximity to the railway track was not considered in the sampling strategy. Another limitation of the research design was the inconsistency between the self-reported survey data and the manual count data. The screenline counts in intervention town 1 were much larger than observed in the other communities. In 2013, the weather was poor in intervention town 1 and may have contributed to the decline in pedestrians. The research assistants in intervention town 1 also expressed their concern over the accuracy of the count data because of the high volume of pedestrians and cyclists. Additional resources would have allowed research assistants to monitor only one screenline and separately for pedestrians and cyclists. It would also have facilitated an increased number of data collection days. Greater emphasis was placed on the survey data for this reason and also because previous research has established that cycle count data is route specific and may not accurately reflect community-wide changes in cycling (Sloman et al., 2009).

Finally, there were several limitations associated with the data collection tool itself. The problem of respondents making a natural skip pattern has already been mentioned. In relation to the physical activity data, studies have shown that the self-reporting of active travel data results in over-reporting when compared to objective monitoring (Kelly et al., 2013; Panter, Costa, et al., 2014). The GPAQ is not an exception to this. It has high variance and recall bias (Bauman et al., 2009) and results in over-reporting of minutes of physical activity (Rzewnicki, Vanden Auweele, & De Bourdeaudhuij, 2003). Other issues with the GPAQ are that it doesn't differentiate between walking and cycling or trip purpose which would have been desirable in this study. The GPAQ doesn't include trips that are less than ten minutes in duration. These are often the type of trips that are most susceptible to change in active travel interventions (Stopher et al., 2009). Nonetheless it is a validated tool that includes a transport domain and any amendments to it would have reduced its validity. Financial constraints prevented the addition of objective monitoring such as accelerometry, GPS, GIS and motion sensors. Other items that could have been incorporated into the survey include car ownership, travel mode and distance to work, cost of parking at work, trip chain information, and Verplanken and Orbell's (2003) index of habit strength. Additional attitudinal items could have been included such as perceptions of safety, traffic volume, traffic speed, footpath condition and lighting, cycle lane provision, aesthetics, neighbourhood crime and places to walk or cycle to. However considering attrition is a major problem associated with panel studies it was decided to prioritise the GPAQ data and keep the survey as short as possible.

6.4.5. Implications of the research findings

Implications for practice

- Towns that aim to replicate the measures described in this study should begin by auditing the existing active travel infrastructure in their area. The audit should be specific to individual neighbourhoods and be cognisant of key travel destinations. Comprehensive infrastructural measures for active travel such as on-road and separated cycle lanes should be introduced on a phased basis in individual communities to link residential areas with key destinations in the neighbourhood and the urban centre.
- 'Smarter Travel' projects should aim to include some level of car restrictive policies (such as increased parking charges or removal of cars) in urban centres particularly in areas of high population density. In such areas, the establishment of a well-considered and complete 'shared space' zone, a public bike sharing scheme and a bus service to the urban centre should all be considered.
- Active travel campaigns should be implemented once a project brand has been developed. The campaign should be developed in partnership with an academic institution and the first phase should focus on raising awareness of the brand and of the new infrastructure. The next phase should disseminate targeted health messages related to the known mediators of active travel. The messages should target men and women separately and by using different media channels.
- Individualised travel planning should be implemented in neighbourhoods with new infrastructure for walking and cycling that connects the neighbourhood to the main employment centres in the town.

Implications for research

- Further evaluations of multi-component active travel programmes in several other towns are required before conclusions about their generalisability can be drawn. Evidence is also required for adults without school-aged children.
- The evaluation of these studies by self-report survey should aim to assess walking and cycling separately as continuous measures and for different trip purposes (i.e. to and from work, for business purposes, to and from a place of study, for shopping and personal business and to visit friends or family or for other social activities). Objective measures of physical activity and active travel

such as GPS, GIS, motion sensors and accelerometry should be used concurrently.

- Further quantitative research is needed on the influence of trip chaining and habit strength on the travel behaviours of parents of school-children. This research should be complimented by an in-depth qualitative study that focuses on men and women separately.
- Evaluations of the effectiveness of flagship infrastructural measures should only sample the population that live in close proximity to the new measure.

6.5. Conclusion

In summary, these findings indicate that for a cohort of parents, the 'Smarter Travel' measures were somewhat effective in both towns. The effect size was small but comparable with other similar evaluations of natural experiments. However the absence of an absolute intervention effect suggests that the findings are not definitive and may not be generalizable to other towns in Ireland. Further interventions in several other Irish towns should be designed and rigorously evaluated based on the implications for practice and research provided in section 6.4.5 above. The main implication of these findings is that creating a modal shift from passive to active travel may be easier and less costly to achieve in areas of high population density.

CHAPTER 7. THE INFLUENCE OF KEY STAKEHOLDERS ON ACTIVE TRAVEL POLICY

7.1. Introduction

This chapter presents data from an in-depth qualitative study which sought to identify the mechanisms and processes that shaped the implementation of active travel policy in both intervention towns. The study predominantly relates to adults and is the only study that does not measure the impact of the intervention. The research was done by conducting semi-structured interviews with key stakeholders who included employees in the local authority, traders and community advocates. An analysis of the local print media was also conducted to provide further context for the results described in this chapter (and for the entire thesis). The methods for this media analysis are described in this chapter and the results are available in appendix 7D.

Process evaluations, while not frequently reported, can help to explain why physical activity interventions fail to have greater measureable effects (Pate et al., 2003). In addition, mixed methods research is necessary to understand the implementation process to allow an intervention to be reproduced (Nutbeam, 1998). Initially, the sole aim of this process evaluation was to help explain the intervention effects (or lack of) in both towns. This aim evolved once it became apparent that the 'potential negative impact of active travel measures on retail trade' was a dominant theme in the initial stakeholder interviews (2011, intervention year 1) and in the local print media (2010, pre-intervention). Although the wider economic benefits of walking and cycling policies are well established (Davis, 2010; Goodwin, 2010), their potential impact on retail trade has received less attention. This is relevant to both adult and children-focused active travel interventions, and was carried out as exploratory analysis of some of the potential issues that may have occurred in the intervention towns in the earlier chapters, and potentially contribute to an understanding of the complexity of achieving active travel intervention effects at the population level.

An extensive literature review was conducted on this issue to help explain the qualitative data in this chapter (see appendix 7E). This literature review is background to this chapter, but is outside the scope of the intervention literature review carried out for earlier chapters. In summary, this literature review found that traders overestimate the importance of the car to their retail trade and have the power to shape the direction of sustainable transport measures in urban centres. The best available evidence suggests that these fears are unfounded. On the contrary, there is an argument that areas with high levels of car accessibility (to the detriment of the walking and cycling environment) are harmful to retail trade. Parking restraint policies, improvements to the cycling and pedestrian infrastructure and full pedestrianisation have all been shown to have no negative impact on retail trade. There is also strong evidence to suggest that pedestrianisation and improved walkability will have a positive impact on retail turnover and rents. The characteristics of the most successful active travel projects include; implementing a suite of complementary measures; making bold decisions; fostering community empowerment; getting a representative view of traders opinions; developing targeted campaigns for the public and traders; identifying a community champion; partnering with local media and trialling new measures at times when retail footfall is expected to be high. The projects with limited financial or human resources are typically less successful.

Research questions

1. What were some of the factors associated with the implementation that contributed to the limited observed intervention effects described in chapters three, four and six?
2. How do retail traders (shopkeepers) describe their fears associated with the reduction in car accessibility in urban centres that might result from active travel initiatives?
3. What lessons can be learned to moderate the dissonance between retail traders and local authorities when introducing active travel measures in other towns?

7.2. Local efforts to improve accessibility of urban centres for cyclists and pedestrians.

This section provides some context to the development of active travel measures that created some resistance amongst local retail traders.

Intervention town 1

The Kilkenny City Mobility Management Plan 2009-2014 (The Councils of the City and County Kilkenny, 2009) proposed several measures to be introduced in the city centre streets (High street, John street, Kieran street and Rose-Inn street). These included full pedestrianisation; a pedestrianised plaza, a one-way system; reduced speed limits (to 30kph); widening of footpaths; improved public realm, improved bike parking, park and ride facilities; shuttle buses, paid parking policies[15] and intelligent signage for car parks. To date (2015), full pedestrianisation, the shuttle buses and the park and ride facilities are the only measures not to have been adopted. Improvements to the public realm and bike parking facilities in the urban centre were introduced during the intervention timeframe evaluated in this research (May 2011 – May 2013) and described in appendix 2A.

Several of the more significant measures were introduced prior to the baseline surveys in May 2011. A total of 85 car parking spaces were removed from an area in the city centre in 2009 to facilitate the creation of a pedestrianised plaza. The 30kph speed limits were introduced in 2010. These streets were subsequently designated as 'shared space' zones (see figure 7.1; no street infrastructure or signage was removed). A one-way system was introduced on a trial basis on High Street (main retail strip) and John Street on April 6th 2010 (see figure 7.1). It was this measure which proved to be the catalyst for local trader opposition to 'Smarter Travel' and pedestrianisation. It also proved to be a central theme in the stakeholder discussions around the implementation of the Kilkenny intervention. City centre traders lobbied councillors for the abandonment of the trial after only two days, citing anecdotal evidence of reduced footfall and retail trade. The mounting political pressure and negative media attention forced the reversal of the one-way system on John Street one week after it commenced. The one-way system on High Street was reversed on November 8th, seven months after its introduction. Although observation periods were short, a review of the one-way system (The Councils of the City and County Kilkenny, 2011) indicated that the number of pedestrians increased on High Street (12,610 during March 2010; 13,482 during May 2010,) and the number of cyclists on adjacent streets increased (280 during March 2010; 521 during May 2010). Vehicular traffic volumes dropped significantly on High Street (4,963 during March 2010; 2,699 during May 2010). The negative aspects were that delays were experienced exiting car parks and traffic was displaced to nearby streets. It is thought that the lack of a second vehicular bridge limits the potential to avoid congestion from displaced traffic. The construction of this new bridge received planning approval following a period of public debate and opposition. Construction work commenced in the summer of 2014 but

[15] The current price of parking (all types) in town 1 is low when compared to similar sized towns and cities in Ireland (see appendix 2B)

was interrupted by public demonstrations and suspended due to its potential environmental impact.

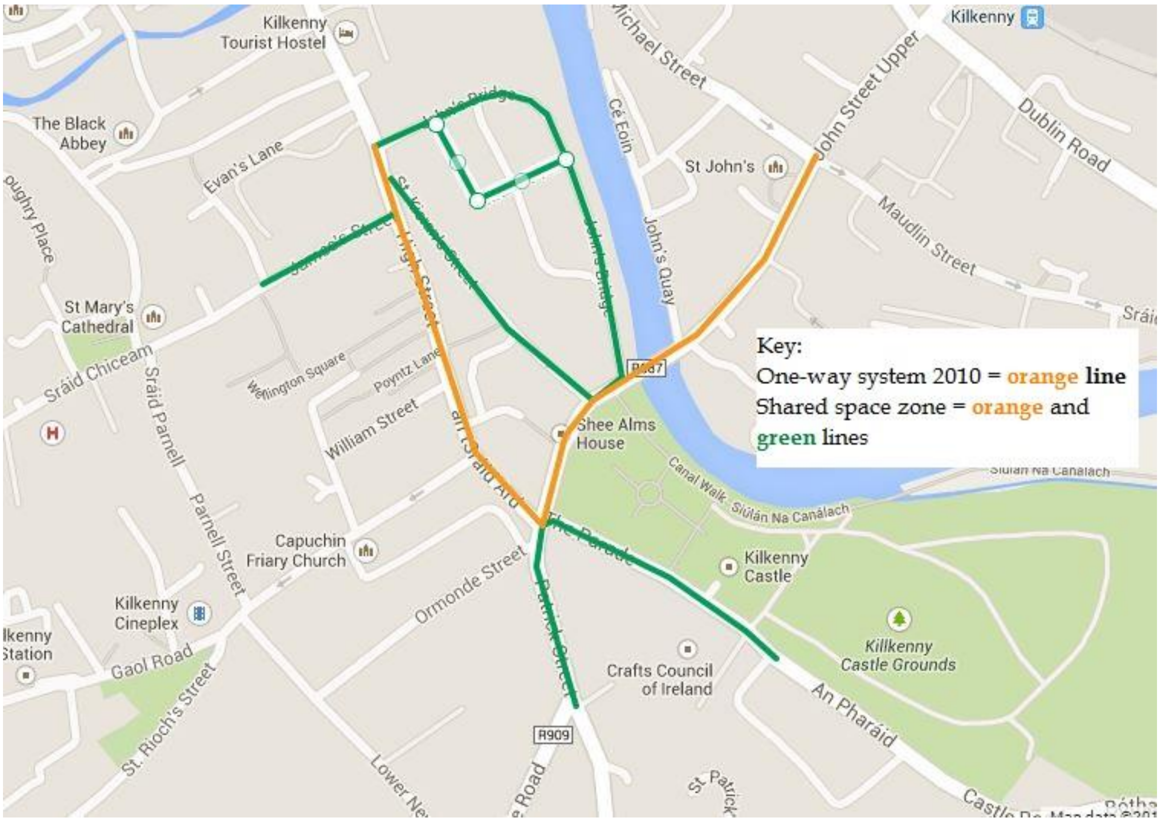


Figure 7.1 Streets designated as 'shared space' zones and one-way during 2010 trial

Intervention town 2

The GO Dungarvan project proposal identified several infrastructural measures for the town centre that would be addressed if they were successful in the National 'Smarter Travel' competition. These measures included; urban landscaping; increased pavement allocation; priority of movement and pedestrian zone (raised crossings/ retractable bollards); traffic management review; reduced car parking; priority parking for bikes, electric vehicles and high occupancy vehicles and reallocation of parking spaces (GO Dungarvan, 2010).

After being awarded the funding to become a 'Smarter Travel Area' in 2012, an extensive pre-consultation phase was launched in 2013 to develop a proposal to redevelop four areas of the town centre. Grattan Square is the commercial and retail heart of the town and was one of these areas proposed for redevelopment. The final proposal for Grattan Square (see figure 7.2) that was brought to statutory consultation was met with strong resistance from the local retail traders in the square. This resistance manifested itself in the creation of a petition to abolish the proposal, lobbying of councillors, customer surveys, a social media campaign and coverage in the local and national media. Currently, 82% of the square's surface area is occupied by car parking and road surface with limited space for social interaction. There is a long standing tradition of free short-term parking in the square. The final proposal aimed to improve the walkability of the area. The new measures included; reducing the speed limit to 30kph, reducing the width of the road, removing 18 car parking spaces (17% reduction), increasing the width of the remaining spaces, creating two new civic spaces, introducing new pedestrian crossings, increasing the bike parking spaces from 7 to 40 and maintaining the free short-term parking (Kieran Boyle Consulting, 2013).

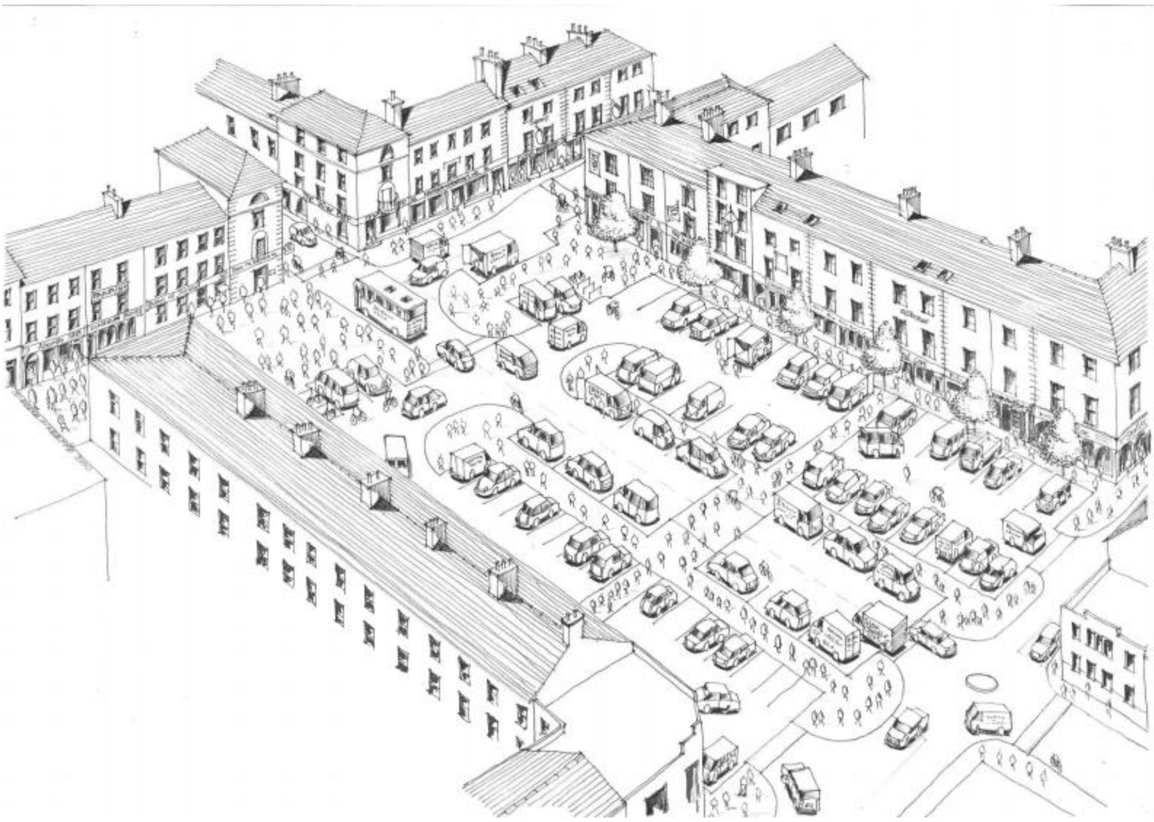


Figure 7.2 Proposed redevelopment of Grattan Square, intervention town 2

These issues expressed in the two intervention towns sets the context for the barriers posed by retail traders, and the potential influence of that in reducing the capacity of the active travel interventions to be implemented as planned.

7.3. Methodology

7.3.1. Research design

This study consisted, primarily, of a series of qualitative semi-structured interviews with key stakeholders in both intervention towns. The interviews were conducted at two time points. The first series of interviews were conducted in December 2011 before the allocation of 'Smarter Travel' funding to either town. The second series of interviews were conducted in November and December 2013 during the implementation of the 'Smarter Travel' programme. The interviews examined stakeholders' experiences of the implementation process. These conversations would contribute to our understanding of the mechanisms and processes that contributed to the effectiveness of the programme in both towns. An analysis of the local print media was also conducted to provide further context for the results described in this chapter. The methods for the local print media analysis are described separately in section 7.3.7.

7.3.2. Theoretical framework used

The theoretical framework chosen for this study was grounded theory. Grounded theory is a methodology for collecting and analysing qualitative data which was developed by Glaser and Strauss in the 1960's (Glaser & Strauss, 1967). Glaser and Strauss (1967) suggest that the researcher should conduct qualitative research without any preconceived ideas in order to generate a theory that is grounded in the data. They explain that the theory which emerges from the data is already there and waiting to be discovered. There have been several refinements to this original work (Charmaz, 2006; Corbin & Strauss, 1990; Strauss & Corbin, 1998) but all have largely retained the underlying principles of grounded theory. Hennink, Hutter, and Bailey (2011) outline these principles;

- The data is analysed in a non-linear manner i.e. tasks may be repeated, overlap or be conducted simultaneously. The data collection and analysis are usually interlinked.
- The analytical concepts are derived and constructed inductively from the data and not deductively from pre-existing theories.

- The constant comparison method is used to refine codes and categories during data analysis. Memo writing is also used to record the researchers thoughts and ideas during this process providing a trail of the analytical decisions made.
- Finally, the analysis of the data aims to go beyond mere description of the data and towards the development of a theory.

Glaser and Strauss' (1967) assertion that theory is only waiting to be discovered creates an assumption that, irrespective of who analyses the data, the same theory will be discovered. This is contested by Charmaz (2006) who advocates for a more constructivist approach where the experience of the researcher is acknowledged. She describes the process of using grounded theory as "consisting of systematic, yet flexible guidelines for collecting and analysing qualitative data to construct theories grounded in the data themselves. The guidelines offer a set of general principles and heuristic devices rather than formulaic rules" (Charmaz, 2006, p. 2). This approach emphasises the interpretation of knowledge by both the researcher and the interviewee.

This study adopted the general ethos of grounded theory and used a social constructivist stance as advocated by Charmaz (2006). This approach was chosen because the focus of this study was on interpreting stakeholders' unique understanding and experience of promoting active travel in their communities. Not all components of grounded theory were adopted, in that the development of a new theory was not a specific aim of the study.

7.3.3. Sample and ethical considerations

A total of 14 semi-structured interviews were conducted (seven in 2011 and seven in 2013). Summary details for each interviewee can be found in table 7.1 below. Six baseline interviewees were selected using purposive sampling from three pre-defined categories; local authority project leaders, community advocates and those who were opposed to certain elements of 'Smarter Travel' policy. They were selected based on their knowledge of the intervention design and implementation process in both towns. One interviewee was selected from each category in each town. The local authority project leaders were already known to the researcher. Community advocates were suggested by the project leaders and the respective Chambers' of Commerce provided the contact details of local traders known to oppose certain elements of 'Smarter Travel' policy. A further interview was conducted with a more experienced project leader in town 1 resulting in a total of seven interviews in 2011. These interviews were conducted before the allocation of 'Smarter Travel' funding. The purpose of these interviews was to identify the mechanisms and processes that shaped the implementation of active travel policy in both intervention towns.

The same procedure was adopted for selecting the seven follow-up interviewees. However, after analysing the baseline interviews, it emerged that the dominant themes related to the dissonance between the local authority and local traders. The proposals for the redevelopment of Grattan Square in town 2 also offered the opportunity to explore this dissonance in more depth. This prompted the use of theoretical sampling to further elaborate and refine these categories as advocated by Charmaz (2006). Consequently, the six follow-up interviewees consisted of a new project officer, two new trader representatives (interviewed together at their request), a new community advocate in town 2 and a new community advocate in town 1.

Participants were advised that their involvement in the study was entirely voluntary and that they were free to withdraw from the study at any stage. Furthermore they were made aware that all identifying data in the interview transcript would be replaced with pseudonyms ensuring their anonymity. All of the approached interviewees agreed to participate. Ethical approval was granted by the Waterford Institute of Technology Research Ethics Committee (Appendix 1B).

Table 7.1 Characteristics of interviewees

Category of stakeholder	Role / Position	Date of interview
Intervention town 1		
Local authority advocate (project co-coordinator)	Senior engineer who is one of two project co-ordinators promoting 'Smarter Travel' as part of their wider brief	November 2011 & December 2013
Local authority advocate (engineer)	Executive engineer who assisted with the design of hard measures as part of his wider brief	November 2011
Community advocate (A)	Green party councillor and ex-Mayor of the town. Advocate for sustainable transport	November 2011
Community advocate (B)	Green party councillor and ex-Mayor of the town. Advocate for sustainable transport	November 2013

Local trader	High street trader and ex-Chair of the local traders association. Resistant to local authority proposals for 'Smarter Travel'	December 2011 & November 2013
Intervention town 2		
Local authority advocate (project co-ordinator)	Senior engineer who later became the full-time project co-ordinator	December 2011
Local authority advocate (project officer)	Community development worker employed as a full-time project officer	November 2013
Community advocate A	Local school principal	November 2011
Community advocate B	Citizen of the town who has supported the plans for redeveloping Grattan Square	December 2013
Local trader A	Trader with a business on a street adjacent to Grattan Square	November 2011
Local trader B*	Trader with a business in Grattan Square. Spokesperson for Grattan Square traders	November 2013
Local trader C*	Trader with a business in Grattan Square	November 2013

*Interviewed together

7.3.4. Data collection methods

The interview schedule

Interviews are an effective research approach to elicit an individual's experience of a particular phenomenon (Hennink et al., 2011). In this instance, the phenomenon of interest to be explored in the interviews was their experience of local efforts to promote 'Smarter Travel'. Interviews also allow the researcher to examine attitudes to a phenomenon in greater depth and with greater complexity than surveys can.

The questions included in the 2011 interview schedules (Appendix 7B) were semi-structured. They were designed based on the researcher's knowledge of the factors likely to influence 'Smarter Travel' policy in each area. Although the initial intention was to conduct predominantly semi-structured interviews the majority of participants were able to provide rich data on their experiences of efforts to implement 'Smarter Travel' policies in each town. This allowed for a more unstructured interview style guided by the following key questions;

- Describe your experiences of active travel promotion in Kilkenny/Dungarvan
- How successful have efforts to promote 'Smarter Travel' been to date?
    - Explain

The questions for the 2013 interviews (Appendix 7B) were adapted to reflect the core categories that emerged after analysing the baseline data.

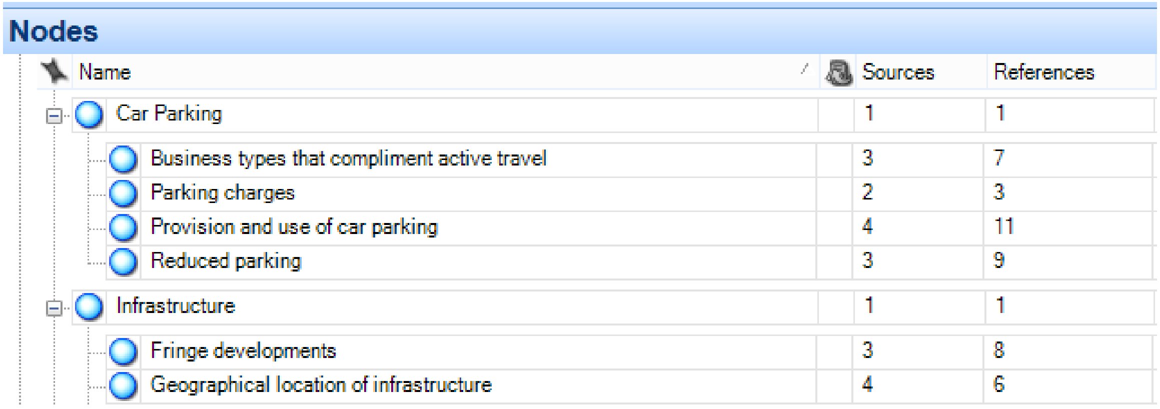
7.3.5. Data collection procedure

All 14 interviewees were contacted by phone or email to request permission to conduct the interview and to agree a suitable time and venue. The nature and purpose of the study was also explained to them. The interview schedule and consent form (Appendices 7A & 7B) were emailed to each participant one week prior to the interview. The interviews took place in the interviewees' place of work or a local hotel with the exception of the 2013 interviews with the trader and project co-ordinator in town 1. These interviews were conducted via telephone. The participant signed the consent form before the interview commenced. The interviews were recorded using an Olympus DS-2300 digital voice recorder.

7.3.6. Data analysis

All interviews were transcribed verbatim using Microsoft Word 2010, anonymised and imported into the qualitative data analysis software package, NVivo (version 10). Strauss and Corbin (1998) explain how the collection and analysis of data in grounded theory is a cyclical and not a linear process. For that reason the 2011 interviews were fully analysed before theoretical sampling for the follow-up interviews could begin. Several memos were written immediately after conducting and listening to each individual baseline interview. These memos helped capture ideas on the creation and explanation of analytical codes and provided direction for guiding subsequent baseline interviews. This process of memo writing was maintained throughout the data analysis both after conducting the interviews and while reading the transcripts. The analysis was conducted using only two types of codes (initial and focused codes) as advocated by Charmaz (2006). The third type of codes associated with grounded theory (axial codes) can be overly prescriptive. Applying a formal analytical frame to the data can restrict the creation of analytical codes and thereby impedes understanding of the data (Charmaz, 2006). This approach was adopted for the current study.

Each transcript from the 2011 interviews was read within the NVivo software on two occasions to allow the researcher become familiar with the data. Both 'line by line' and 'incident to incident' were considered as potential approaches to the development of initial codes. After using both approaches on one transcript it was decided that 'line by line' was not suitable because the data was not sufficiently detailed. After completing the initial coding process within NVivo, the initial codes had been created and refined using constant comparison methods. However it was felt that the codes were largely descriptive in nature and that the use of NVivo may have contributed to this (figure 7.3).


Nodes

Name	Sources	References
Car Parking	1	1
Business types that compliment active travel	3	7
Parking charges	2	3
Provision and use of car parking	4	11
Reduced parking	3	9
Infrastructure	1	1
Fringe developments	3	8
Geographical location of infrastructure	4	6

Figure 7.3 The (overly) descriptive nature of initial codes created in NVivo

As a result, the initial coding process was repeated using hard copies of the transcripts and with a greater emphasis on using more action-oriented language, applying greater analytical depth and identifying several 'In Vivo' codes (terms used by participants). No pre-determined codes were used. The next phase of coding used was focused coding. The most significant and frequent initial codes were selected and raised to be the focused codes. This was done to synthesise and explain larger segments of the data and again used constant comparison methods (Glaser & Strauss, 1967). A codebook was developed to list and define the properties of each focused code (appendix 7C). Each transcript was then recoded in NVivo using this codebook. The final step of the data analysis was selecting the most significant themes across several codes and raising them to categories in order to create a hierarchical relationship between all the data. This process was repeated using the 2013 interviews with the aim of adding greater depth to the previously created codes but particularly the dominant category of 'unsubstantiated economic fear of reducing accessibility for cars'.

7.3.7. Analysis of local print media stories

An analysis of the local print media was conducted to provide further context for the results described in this chapter (and for the entire thesis). The research design was a quantitative content analysis of the framing of local print media stories related to active travel in both intervention towns. The frame of a story refers to the themes contained within the article and whether they are considered positive or negative. The study sought to identify if there was any change in the frequency of reporting or framing of messages before and during the intervention. The search was restricted to articles published in the 'Dungarvan Leader' and 'Kilkenny People' newspapers during three time periods; May 2010 – April 2011 (pre-intervention), May 2011 – April 2012 (intervention year one) and May 2012 – April 2013 (intervention year two). The internal search engines of both newspapers were searched for articles that included at least one of the following search terms; 'smarter travel', 'active travel', 'active transport', 'walking', 'walk', 'walker', 'pedestrian', 'footpath', 'bicycle', 'bike', 'cycling', 'cycle', 'cyclist', 'cycle lane'. Articles that did not contain any of the key words were included if the content was related to active travel as a central theme. Exclusion criteria were news articles that related to; areas outside of the urban centres, charity walks or cycles, organised group activities for leisure or fitness, sports, news in brief (active travel only mentioned in passing). Once the final sample was identified, the author coded them individually as either positive or negative and categorised them according to their principal themes. It was decided to present the descriptive results of this study in appendix 7D. They are, however, referred to throughout the thesis.

7.4. Results

The commitment of the local authority

'Smarter Travel' advocates

Both towns had a history of promoting active travel long before the emergence of the 'Smarter Travel' concept. The promotion of active travel is not a statutory requirement so the reason for their relative success is largely due to advocates within the local authorities. The promotion of 'Smarter Travel' is dependent on 1-2 advocates in both local authorities who became the project co-ordinators due to their interest in the area. These individuals believe in the concept and are extremely enthusiastic about its potential. This is despite it not being a core element of their day to day work initially, almost an optional extra. Many other towns in the South-East do not prioritise active travel in their area and are not obliged to. The towns differ in regard to senior management support. In town 1, the Director of Transport Services not only supports the initiative but plays an active role in the project steering committee. This helped to "push this agenda further than what would happen normally; because normally the agenda isn't pushed from the bottom up, it has to come from the top down" (engineer, town 1). It has also helped that several Town Mayors during the establishment and implementation of the project have been active travel advocates. In town 2, despite having the blessing of senior management, the project co-ordinator was frustrated with the lack of dedicated human resources to prepare the 'Smarter Travel' funding bids. This was rectified but only "because of change in the organisation and that person sees the need for this to be done".

The project co-ordinators in both towns cite having children as something that motivated them to pursue the 'Smarter Travel' funding. It is very obvious that they are passionate about their towns and want to see children grow up in an area where cycling and walking is actively encouraged. 'Smarter Travel' offers the project co-ordinator in town 2 a chance to make a real difference to the town. He doesn't "just come in here from 9-5 to get paid at the end of the week…it's very difficult sometimes to make a difference especially working in the local authority, you never get a clean bill of health".

Valuing the roles of the project team

The commitment of the project co-ordinators is not enough on its own. The co-ordinators both value and acknowledge the contributions made by the members of the wider project steering group. The co-ordinators (both engineers) had very little knowledge or expertise in behaviour change strategies and were not convinced of their importance to begin with as highlighted by the project co-ordinator in town 2; "when I bought into this I wasn't really entirely au fait with the softer measures in behavioural change (mass media interventions, mass participation events etc.) but now I can see that it's an absolute crucial thing". In the 2013 interviews it became apparent that the project co-ordinator in town 1 still did not see behaviour change as a central part of the local authorities' work. Behaviour change strategies were addressed separately by other key stakeholders such as the local health promotion service or sports partnership. The creation of a full-time 'Smarter Travel' project team in town 2 required the local authority to take more ownership of the behaviour change components.

This is important because addressing behaviour change strategies was a requirement of the 'Smarter Travel' funding competition so the input of the wider steering group was invaluable from the outset. They provided a context to active travel which was broader than just infrastructural change. In town 2 particularly, bids for subsequent stages of the funding competition evolved to be more focused on behaviour change with the infrastructure being "a secondary element, crucially important, but a secondary element" (project co-ordinator, town 2). The synergy between the project co-ordinators and the steering group members emerged more by default than by design. The formation of the steering group was predicated on pre-established working relationships, sharing adjacent offices and coincidental new appointments. In terms of group membership, it is more important to have committed individuals than ensuring key stakeholder groups are represented. The people that co-ordinate and steer projects are as important as the policy measures they adopt.

The efficacy of hard and soft measures

Moving beyond infrastructure

Most stakeholders agree that facilities and infrastructure (hard measures) should be prioritised before behaviour change is addressed (soft measures). The community advocates in town 1 had opposing views on this. They suggested that soft measures such as 'park and ride' facilities and shuttle buses are required before pedestrianised streets are introduced. All stakeholders do however acknowledge that changing behaviour is possibly the more difficult task but one made more difficult without prior investment in hard measures. The traders in both towns were more reluctant to discuss the efficacy or need for infrastructural change although this was more evident in town 2.

Both co-ordinators expressed satisfaction in the progress being made in providing the necessary infrastructure in their respective areas from 2011 to 2013. The only exception is that town 1 is "probably short one piece of vital infrastructure to put the whole thing into place and that is another bridge [which would give you] a circular pattern and then we might just be able to change things" (project co-ordinator, town 1). Without this new central access road, the project co-ordinator is not hopeful for the successful implementation of 'Smarter Travel' policy. The provision of infrastructure mostly related to cycling and for the safety of children cycling to schools. There is a discrepancy between what the local authority and community advocates perceive to be adequate provision of infrastructure to schools. The co-ordinator in town 1 stressed the importance of rectifying cycle lanes that end abruptly before intersections or other physical constraints. He believes there needs to be a certain amount of infrastructure in place particularly around the schools. This does not go far enough for the community advocate (A) in town 2. He is concerned about promoting active travel with children without having the necessary hard measures in the urban centre from the outset. Interestingly, the project officer (town 2) and the community advocate (B, town 1) don't necessarily believe that cycling infrastructure is necessary for children's' safety per se but it's more important to create an illusion of safety for their parents. This may be more important in town 2 where congestion is not a major issue, resulting in increased traffic speeds, thereby posing a greater risk to children.

> *So you go through the entire town with no protection, no bit of a separation from traffic. If I was a parent I wouldn't be thrilled about sending off my younger child anyway. Certainly, my older one maybe, but you know and then you have to cycle the majority of the journey with no support whatsoever until you hit the road in here again for the last leg of the journey. So it's just not joined up. It's like what they did with the Luas* [light rail system]*, the two lines are not joined up and until they join them up it's not going to make much sense* (community advocate A, town 2)

Signposting new infrastructure

As highlighted already, both project co-ordinators acknowledge the importance of behavioural change components but supporting the efficacy of softer measures did not translate into understanding them however. In 2011, the general consensus among the community advocate in town 2 (A) and the project co-ordinators is that behaviour change measures are introduced to inform the community about the existence of new cycling facilities. The engineer in town 1 takes the very simplistic view that "you can provide all the stuff in the world but that if people don't know about it then they're not going to use it". The project co-ordinator takes this a step further by suggesting that the task involves "persuasion and raising awareness among people, that this is actually a better way to do things". This emphasis on 'persuading' the public to use the facilities is also highlighted by the community advocate in town 2. More specifically, the project co-ordinator in this town explains that awareness-raising may typically consist of trying to "piggy back on the infrastructure" by issuing press releases for the radio and print media. Once the new facilities start being used it is this visibility that will help active travel become "contagious and people will hopefully buy into it".

In town 2, there was a major shift in the local authority's understanding of the purpose of soft measures by 2013. Making the public aware of the existing facilities was still a central feature of soft measures but addressing barriers is equally important; "awareness isn't enough alone because there's people who will still have barriers, perceived or otherwise, so in schools that could be heavy school bags, not wanting to wear cycle helmets, bad weather, nowhere to store their bike" (project officer). The local authority in town 1 had a very narrow interpretation of what soft measures are. This is not to say they didn't consider them but instead equated them to educating and informing the public. They don't appear to view travel behaviour change as a generic process. They discuss the process of managing vehicular traffic and parking with considerable authority. These discussions are centred on how softer measures such as pricing policies and traffic flow systems influence the public's use of the car. There is a possible disconnect between their understanding of how to reduce car dependency and promote active travel. They are almost seen as distinct and separate entities.

Understanding 'Smarter Travel'

Diverging definitions of 'Smarter Travel'

Stakeholders have diverse opinions in terms of what the purpose of 'Smarter Travel' is. The perceived purpose of 'Smarter Travel' also varies by location. The discussions in town 1 focused on creating a modal shift from the car to walking and cycling in order to address the town's congestion and accessibility problems. According to the project co-ordinator, reducing car dependency offers a potential solution because the city's medieval streetscape precludes a road based solution. Another important driver of 'Smarter Travel' policy in the town was the "number of pinch points in the city streets which make it quite a challenge for pedestrians, people with mobility issues and the aged" (project co-ordinator). The "knock on" benefits for the local authority of pursuing this 'Smarter Travel' policy was more active lifestyles for individuals, less travel costs for households and increasing the vibrancy and vitality of the urban centre for businesses and tourists. The community advocates recognise the need to address the town's congestion but hold a broader vision for the need to pursue such policies. They cite several important purposes such as reducing CO_2 emissions, promoting population health, protecting the medieval integrity of the city, stimulating economic activity and impeding commercial developments on the fringe of the city. The trader who is generally supportive of its ethos describes a more narrow understanding of 'Smarter Travel' which relates to the promotion of retail and tourism and maintaining the flow of traffic. Regrettably there are fears that 'Smarter Travel' is at risk of being defined as the unsuccessful one-way system in the town.

In town 2, there is not the same level of shared understanding of 'Smarter Travel'. This can be attributed to the absence of significant congestion in the area and the conversion of an old suburban railway line to a walking and cycling path. This has been to the detriment of implementing 'Smarter Travel' measures in the town centre. While the project co-ordinator and project officer cite population health, accessibility, safety and aesthetics as the drivers behind the project, the community advocates emphasise the importance of promoting the health of young people. The traders equate 'Smarter Travel' to recreational cycling but not cycling for transport. This also adds to their confusion over why there are no cycle lanes in the final town centre proposal;

> *There are a lot of people who use the cycle tracks after work, you know when they finish work, when they have done their day and it's used mostly for recreational purposes. There are loads of people using the tracks out the Clonea road but that's recreational exercise* (trader B, town 2)

The town centre proposal forced the traders to further examine the purpose of 'Smarter Travel' and they believe that the town "isn't big enough for such a project" (trader A, town 2). While admitting that congestion would damage their retail trade, they question the value of implementing a policy developed before the economic downturn;

> *Mass congestion - that didn't happen, it's not happening, certainly not in a town like Dungarvan. You look out there onto the square and you don't see any congestion you don't see anything like what drove them* (to develop the 'Smarter Travel' policy) *they had to if the trend that they identified in 2008-2009 continued, they had to do something* (trader B, town 2)

In 2011, before town 2 received the 'Smarter Travel' funding, the co-ordinator pre-empted the resistance from traders and reluctantly suggested that the project can be successful even if the urban centre was never addressed; "so even if you never touch the town centre you know you can still provide facilities and stuff and you don't have to worry about it but I suppose it would be the cherry on the cake to try and deliver that, to try and have the focus in that location". Also in 2011, the co-ordinator spoke of the need to improve the accessibility of the urban centre for pedestrians. 'Smarter Travel' offered an opportunity to chase funding that would boost the budget for providing better footpaths and consequently a more accessible urban centre. When the funding came to fruition and the proposed town centre redevelopment was progressed in 2013, the accessibility and safety of the area for pedestrians was one of its main purposes. This rationale was contested by the traders; "there have been no pedestrian accidents to date, we have safe pedestrian access around the four corners of the town. There is no call for it, there has been no public outcry" (trader B, town 2).

Prioritising schools

The prioritisation of schools as a setting is the one area that all stakeholders in both towns agree on. The general sentiment is that it's just the right thing to do although the reasons differ slightly by town. In town 1, it is seen as a key setting for two reasons. Firstly, because the schools are not in the immediate town centre it offers an opportunity for the project to be successful even if the town centre was never addressed. Secondly, although the project officer is unsure about its merits; "the feeling amongst ourselves as teams would be that if you can get them when they are younger you will develop that habit and make it kind of second nature". In town 2, the community advocate (B) offers a more strategic reason for targeting schools;

> *The biggest issue for me is that 80% of the car journeys in the city begin and end within the ring road of the city. Right? Which means they are internal traffic, by and large. I suppose this is a huge point of frustration for me. By and large those are school related or work related, but a huge number of them are school related and I try to point out to people you know in the first week in June and in the first week in September the difference there is in the traffic and you know it's trying to find a strategy but breaking that kind of car addiction with parents* (is difficult)

Breaking with conventional design

The decision of the local authority in town 2 to initially develop radial routes for active travel prompted very little resistance from the community. The only exception was some minor concerns about the new infrastructure being a focal point for anti-social behaviour. The local authority is reluctant to introduce radical change in the town centre and the traders would prefer no change at all. In town 1, the introduction of the one-way system and the long-term ambition of pedestrianising the urban centre have prompted the engagement of the traders in suggesting new, less traditional approaches to traffic management and 'Smarter Travel'. Two factors that have facilitated their voices being heard is the failure of the one-way system and that the local authority is unsure of best practice in the area;

> *The traders are mad for us to do High Street. We would love to do it ourselves because it is due a change, but what do you do? Which design do you go with? Do you spend a couple of million now to find that in five years' time that we should have done something different. It is a very difficult decision* (project co-ordinator, town 1)

In 2011, the traders hoped that the local authority would engage in "pretty radical thinking" which "could be tried in a low key way" i.e. trialled in certain areas. The traders support the introduction of a 'shared space' concept with many "counter-intuitive measures" where the road infrastructure and signage is largely removed whereby it is "almost confusing the driver. They know that the minute they looked at the space that it wasn't a space for cars". The introduction of safe speed limits specific to the town centre would be a central feature of shared space whereby pedestrians and cars can interact safely with each other. This, traders believe is the most cutting edge approach to protecting the vibrancy of the city centre while also being compatible with reducing congestion and maintaining accessibility for cars. The project co-ordinator is dismissive of this approach saying it was just a radical suggestion from an English campaigner for the concept.

In 2013, the project co-ordinator in town 1 reflected on the introduction of the shared space zone with muted response. While believing that congestion is reduced in the centre since its introduction he is unsure whether this is attributable to the shared space or other factors. There is a sense that shared space was introduced because of the lack of a viable alternative due the space restrictions imposed by the town's medieval architecture. Furthermore, the cyclists in the town do not know how to use the facility;

> *I believe myself the cyclists don't know how to cycle the shared space. I heard people saying that they find that some of the streets are so restricted that they can't pass cars. Well if the cars are stopped, the cyclist should be stopped behind them you know. The normal rules apply. You're in the queue just the same as everybody else. So by and large people don't know what is expected of them in a shared space scenario. So it prompts me then to say that maybe we should do something to raise awareness again and maybe a bit of educational stuff that bicycles are not in against the kerb anymore they are now out in the middle of the carriageway and they have equal rights to the road space* (project co-ordinator, town 1)

This assertion is rejected by the trader in town 1 as being disingenuous. He doesn't believe that the shared space concept was ever trialled in the town "and it's kind of a pity that they haven't introduced it. Even though they call it that, it's not that". He feels this was a pity because the majority of traders in High Street were supportive of its introduction in its entirety and that is something which is rare. He states that the local authority's reluctance to embrace the concept is derived from their backgrounds in engineering and preoccupation with the safety of citizens. He concedes that this preoccupation with safety is necessary for them but there is little evidence to suggest that shared space is unsafe for road users.

Stakeholder communication and relationships

Adopting a 'nanny state' approach

According to the traders in town 1, the local authority's use of didactic decision making is largely responsible for the strained relationship between both parties. They believe that the local authority has failed to provide the community with a choice of strategies to implement 'Smarter Travel' policy. This has resulted in the local authority retaining control and ownership of the initiative. Although, evident in both towns, this sentiment was more strongly felt in town 1 where the trader commented:

> *If I look at the original submission that Kilkenny County Council made, the wording of that was very interesting, the wording of you know how it is they are going to position the application. For example their objective was to educate the public on the benefits of 'Smarter Travel'. I would say that is coming from a very directive point of view. It's a point of view that you know that in some way that there is somebody that knows better. One of the things that we encouraged them to do is to demonstrate the benefits of 'Smarter Travel', in other words to use a much more carrot approach than the stick approach. The stick approach is very evident across the types of implementation that they have*

Irrespective of the approach to decision making traditionally taken by the local authority in town 1, the introduction of the trial one-way system appears to have created a shift in their approach. The reversal of the one-way system demonstrated evidence of a less didactic local authority and one which recognised the importance of shared-decision making. We "didn't want to force this down people's necks" (engineer, town 1). It is unclear to what extent this has continued since 2011. In 2013, the project co-ordinator emphasised the dilemma facing them in relation to how best to 'persuade' the traders that the one-way system or pedestrianisation would be good for business.

Mistrust of the local authority

The traders in town 2 strongly expressed their mistrust of the local authority. They greatly fear the economic and social impact of redeveloping the town centre to the extent they would support it if they could trust the local authority. There are several sources of this mistrust. The project team are not from the town and therefore they may be less concerned about the impact on its residents. They are concerned that the redevelopment is "purely the jewel in the crown to show the authorities 'look what we have done in Dungarvan we're so brilliant' and I think it's a career based thing" trader C, town 2). The local authority doesn't appear to be championing many of the 'Smarter Travel' strategies with their own staff (in other departments). The traders are also uneasy about how the funds are being used by the local authority and that they obtained them under false pretences i.e. by stating they had trader support for their strategic plan. The traders' most pressing concern was the lack of transparency associated with the pre-consultation phase for the town centre redevelopment. The project officer stated that for this phase there was a blank slate;

> *So we went in with absolutely no preconceptions whatsoever. What we did give was a guide as to the 'Smarter Travel' objectives. So we said pedestrian permeability, connectivity, safety, improvement in public realm, so it was just to bear those kinds of things in mind but there were basically six blank drawings of the town centre area that were put in front of people* (project officer, town 2)

This concept of a blank canvas was strongly contested by the traders who stated that they knew that their strategic plan was funded on the basis of addressing the town centre redevelopment and that it specifically stated that parking capacity should be reduced by 17%. They do not believe that it was a coincidence that this is what was achieved in the final plan. Ultimately they feel that "it's like we don't matter. They have no regard for us, we don't matter. We are an experiment, do you know" (trader C, town 2).

Inadequacy of statutory consultation

In 2011, the local authority and traders had conflicting definitions of consultation. The traders suggest that an objective measure of the effectiveness of any consultation exercise should be based on the number of actions taken as a direct result of the consultation process. The project co-ordinator reiterates this view that is held by stakeholders, that is; "if you are not prepared to run with or take their suggestions on board then it's not consultation….So whether it is seen to be consultation or not depends on the outcome". The project co-ordinator also explains that there is a broader picture where "other constituents have to be considered' which precludes many suggestions being actioned. Despite the traders having a relatively narrow definition of consultation, the community advocate (B) understands and explains their unrest. He believes that "the Irish model of public consultation is to my mind a farce". People generally don't read the notices for public consultation. The trader in town 1 takes this a step further and believes that the local authority adopt "political tactics" when planning consultation exercises to keep different stakeholders separate. This precludes the stakeholders from finding common ground and allows the local authority to block requests based on the supposed needs of other stakeholders. There is general consensus amongst all parties that going beyond statutory consultation has its merits. The project co-ordinator believes that there needs to be a greater emphasis on pre-planning in the future.

Investing greater energy in pre-planning is not always a guarantee of success. The extensive pre-planning in town 2 was resource intensive for the local authority and resulted in delays for the projects implementation. The project officer believes that it was a relative success in that more people bought into the process. The downside of giving greater ownership of the plan to the stakeholders was that the views of those with the least powerful voices were diluted. Despite trying to control the membership of the stakeholder group the project officer stated that the number of traders outweighed other stakeholders as they reacted to the initial designs. In contrast to the views of traders in town 1, the traders in town 2 were upset that they were divided up amongst all the other stakeholders. They suggested that this was a 'divide and conquer' strategy and that, like in town 1, 'political tactics' were adopted when designing the seating plan for the consultation evenings.

The power of the trader lobby

The traders are supportive of the 'Smarter Travel' ethos but have strongly resisted steps towards the pedestrianisation of both urban centres. It is clear that the traders have the power to both shape the implementation of 'Smarter Travel' policy and dictate the pace of its implementation. In town 1, the one-way system was trialled for only a very short period before "the political ramifications had gone too far at that stage and they decided to pull the plug on it" (engineer, town 1). As a result "the council members certainly wouldn't have any great stomach for any other sort of trial run because they really got a hard time [from traders] the last time" (project co-ordinator, town 1). There is also evidence that the traders in town 1 have greatly influenced 'Smarter Travel' implementation strategies. They lobbied for the introduction of a 'shared space' concept instead of pedestrianisation or a one-way system. This 'shared space' concept was subsequently adopted (albeit without fully implementing it) despite the project co-ordinator expressing strong reservations about its efficacy. One community advocate (B) reflected that;

> *up until last year with the introduction of the local property tax, the only people who contributed to the coffers in the city centre were the business people with the result that business people think they own the council and they own the councillors…their attitude is well it's my concerns and what I want is going to be the agenda in this city and to an extent you can understand, you can understand why*

Nonetheless, the other community advocate (A) in town 1 is of the opinion that traders' concerns need to be adequately addressed before any further progress is reached.

It is a long held aim of the local authority in town 2 to pedestrianise the town square but traders have vehemently resisted it for years. Their resistance has predominantly manifested itself in the lobbying of council members to prevent any reduction in the allocation of parking spaces in the square. Their lobbying efforts have been equally as effective to the extent that the project co-ordinator feels powerless to discontinue the local policy of providing the first 30 minutes of parking free in the square. Similarly the project officer feels it is a legacy issue in the town which is outside the remit of 'Smarter Travel' and unlikely to be reversed. Notably, only the project co-coordinator in town 2 accepted that the policy is counter-productive to the aims of 'Smarter Travel'. The provision of cheap town centre parking is an important issue for the traders and local authority in town 1.

The initiation of the pre-consultation phase for the town centre redevelopment (town 2) in 2013 was a catalyst for intense resistance from traders. They adopted several strategies to block the project or influence its design. This included lobbying of local councillors, TD's (politicians elected to national government), social media campaigns, a poster campaign on the economic value of a parking space, customer surveys, petitions and media advocacy (both print and broadcast). Although the traders do not believe these efforts were successful, the project officer believes they greatly shaped the final design which resulted in a design centred primarily on the traders' views. This, he believes, was at the expense of other stakeholders whereby the voices "of the traders started to get stronger and the voice of the other people, while it didn't vanish altogether it just started to fade a little bit more into the background". This was an extremely frustrating experience for the community advocate (B) who questioned why their opinions should carry greater weight than other stakeholders. She also suggested that whilst they have a right to fight for their business interests they shouldn't have such a hold over something that is owned by the community.

Unsubstantiated economic fear of reducing accessibility for cars

The economic importance of accessibility for cars

Pedestrianisation of the urban centres has been a long-standing aim of both local authorities. However neither local authority has made any significant progress in achieving this aim. This is largely due to trader resistance in both areas. They equate car accessibility to increased retail trade and they are not at all comfortable with the term 'pedestrianisation'. They strongly believe that the presence of both cars and parking spaces in the urban centres are associated with improved retail trade. The traders in each town do however have conflicting views on the economic importance of on-street parking.

The traders in town 1 have no on-street parking on High Street and would not want this to change. In contrast, the large supply of parking spaces in Grattan Square in town 2 is fiercely protected by the local traders. In 2011, the project co-ordinator described their plans to remove a small number of the car spaces in lieu of one space for a bus. The move was blocked by the traders because they saw any reduction in parking spaces as having "a direct link to customers". In 2013, the project officer was also apprehensive of a radical move towards full pedestrianisation and recognises that the traders have a legitimate concern. He is almost reluctant to test the philosophy that it wouldn't harm retail trade without full trader support. The traders in town 2 not only equate parking spaces to footfall (and jobs) but also say that they are an essential facility for older adults and people with a disability. Removing the parking spaces would deprive these groups of the opportunity to 'people watch' and would force others to cancel their trips to town in lieu of other supermarkets on the periphery. This stance is a source of annoyance to the community advocate (B) here who believes that the provision of an alternative car park (Scanlon's Yard) very close to the square is more than adequate to service the town's demand for parking. This is contested by the traders who believe that people will not be willing to use this car park and that certain people prefer to just observe the atmosphere in the square from their cars. The community advocate points to a discrepancy in their argument in that "they want it as a market square but it's not a market square it's a car park for the traders around the square".

In town 1, the traders are more concerned with ensuring that cars can access the town centre easily. The community advocate (B) does not understand how the presence of cars on High Street equates to footfall for traders. He recalls an argument frequently used by the traders during the debate on introducing the one-way system;

> *How will this 70 year old woman get down to 'Goods' to get her bra? It was funny but there was a genuine point there in that they have a lingerie section which has a personal fitting service. I actually asked the traders on the high street 'when was the last time that one of your customers parked on the high street and walked into your shop?' and they freely admit that it doesn't happen*

The project co-ordinator offers an explanation for their resistance to reducing the accessibility for cars. He believes that they are fearful that any move towards permanent pedestrianisation, regardless of what the long-term impact might be, could have a negative impact on trade during the construction period. "They couldn't afford to take any downturn in trade even if it was only short-term. They were more interested in a solution that would have brought more cars, or a car based solution and the cars equating with business". This is not supported by the traders' comments. Similar to the traders in town 2, the traders here believe that shoppers will not attempt a trip to town if they know that finding a space will be difficult and time consuming. Interestingly, the traders are more supportive of partial pedestrianisation than the project co-ordinator is aware of. Their primary concern is that during quieter periods of the retail calendar they need the presence of cars driving outside their shops as a sense of security. This is a view shared by the traders in both towns. The trader in town 1 states that "on the November Tuesday, or whatever it is, you actually want cars driving up and down the street just to give the impression there are people around and there are things happening". Similarly the trader in town 2 recalls a time when parking was prohibited in the square to facilitate a local civic reception;

> *They stopped putting the cars in the square and quickly they cleared out but there was an eerie silence on the square that was very, very frightening. That when the cars weren't in there and people* (weren't there) *there was just a lack of life you know. It was an example of my god if they make a third of the square like this*

Meeting the requirements for pedestrianisation

The prospect of significant pedestrianisation (temporary or permanent) in Grattan Square in town 2 is remote even in the medium term according to all stakeholders in the area. Currently temporary pedestrianisation is more imminent in town 1 but only subject to certain prerequisite conditions. There is little agreement between the three categories of stakeholders as to what these pre-requisite conditions might be. The project co-ordinator states that permanent pedestrianisation will never be realised without the additional vehicular bridge. He is concerned that even temporary pedestrianisation of High Street could displace traffic into the adjacent residential areas without the development of an in-depth traffic management plan for the wider area. While the project co-ordinator focuses on maintaining the flow of traffic, both community advocates maintain that pedestrianisation must be implemented simultaneously with softer measures to reduce congestion. Specifically, they consider the provision of a shuttle bus and park and ride/stride facilities as crucial elements. They (community advocate B) argue that improvements to the public realm of the area should be done before any pedestrianisation is introduced.

The traders in town 1 accept the potential positive economic impact of pedestrianisation but are more receptive to the idea of temporary pedestrianisation. They would object to any permanent pedestrianisation of High Street based on conditions which are non-modifiable;

> *Yeah I mean if somebody came along with a plan and said look we are going to do it from the middle of July to the end of August…and we are going to do it on Saturdays and…there were feasible ways of actually managing traffic under those conditions and access to car parks and stuff like that, I would actually vote in favour of it but..the concern is that probably only 15-20% of the time it would be appropriate* (trader town 1)

Using subjective or contested evidence

The debate about reducing accessibility for cars is not helped by the lack of robust evidence on either side. There is also a lack of evidence in an Irish context to inform the implementation of policy. Anecdotal evidence is frequently being called upon and it is also possible that evidence is being withheld or used strategically to support stakeholder agendas. Neither side can produce robust evidence to demonstrate a relationship between 'Smarter Travel' measures and retail activity.

The absence of robust evidence is a feature of the narratives amongst the local authorities and advocates in both towns. The traders forced the reversal of the one-way system in town 1 citing the decimation of their business as necessitating it. The project co-ordinator is adamant that there was no evidence provided to the local authority to support that assertion. The community advocate (B) suggested that the timing of the introduction of the one-way coincided with the beginning of the economic downturn rendering it impossible to differentiate between the economic downturn and the introduction of 'Smarter Travel' measures. The project officer in town 2 concedes that both sides can possibly draw on at least "partial evidence" but that ultimately the outcome is likely to be unique to town 2. He hopes that it will still be of value for other towns consistent with the ethos of being a demonstration town.

The absence of robust evidence is exacerbated by the alleged withholding and manipulating of evidence. The traders in town 2 calculated that the removal of one parking space would result in three lost jobs in the town. This is based on an average stay of 45 minutes per car representing 12 lost car visits per day and an average of 36 lost shop and restaurant visits. The community advocate (B) likened these calculations more to scaremongering than the creation of evidence. She felt that it was bound to have a very negative impact on the community and indeed would have influenced herself at an earlier point in her life. Likewise in town 1, the project co-ordinator is dubious about the content of an unpublished report examining the visitor experience to the town commissioned by the traders association. He was also irritated by the non-cooperation of the private car parks in relation to data provision at the time of the one-way system;

That really wasn't worth the paper it was written on…the traders quite frankly didn't embrace it and they gave no evidence whatsoever to back up their claims. One could be cynical and say they didn't have evidence but they didn't in any way provide any evidence to the group and...the report was quite limited as a result...but the key questions weren't dealt with and…there was no evidence provided because they wouldn't provide it and if one wants to be cynical one could say that possibly they didn't want to release that information because it might not have been helpful to their case (project co-ordinator, town 1)

They were most unhelpful, all of them…The three major private operating car parks in the city centre would not divulge any information as to whether they had an increase in business (project co-ordinator, town 1)

Understanding what shoppers want

There is inconsistency between what the traders perceive shoppers want in their town centre and what they actually want according to the community advocate (B) in town 1. The traders (particularly in town 2) highlight the example of Waterford City (in addition to Dundalk, Sligo and Dun Laoghaire) where traders believe that "the heart is gone out of it…it's not even inviting anymore to go in, it's impossible. We aren't making that up, we are hearing that from the public". The community advocate (B) in town 1 challenges this assertion claiming that this is purely the sentiment from traders and that "on the other hand all we hear from shoppers is that they are delighted with it".

Nevertheless the traders in town 2 believe that they "have a very good feel of what the locals want…like everyone says 'the cycling tracks are great but for god sake' in their words 'keep away, don't touch it' (Grattan Square)". The shoppers in town 2 value the convenience of the parking available to them so much so that "if you could have a drive-in business you would fly it…convenience is what drives us all…we are all time poor…we want to get it over and done within the least amount of time" (trader B, town 2). However the community advocate (B, town 2) considers that the traders have an inaccurate perception of what their customers want. She cites the example of how they collected names for their petition to support the preservation of Grattan Square in its present state. She was concerned about "the way that it was worded, I could see how some people would sign it, whereas you need to sit down…and really understand (the proposal)".

In town 1, the problem of not understanding customers is due to traders not having a history of making customer-centred decisions according to the community advocate (B).

He cites the example of the one-way measure where surveys conducted three weeks after the reversal of it indicated that shoppers wanted more walking and cycling accessibility and a one-way system. Similarly he quotes a finding from the Fáilte Ireland study citing congestion as the main negative aspect of visiting the town. The tendency to be less customer-centred is possibly related to the relative recent focus on tourism in the town;

> *I tried to make the point to the traders that it is not in your interest to be against what your customers want…tourism is very new here…now you have a situation where tourism is the leading employer so that gives us huge leverage like you said we can now say if the tourists don't like it well then it's not working for the city* (community advocate B, town 1)

Lesson learning

Engaging the wider community

The project co-coordinator in town 1 acknowledges that the economic crisis, although unwelcome, should make it easier to engage the wider community in 'Smarter Travel'. The co-coordinator talks about the existence of a large volume of unharnessed support for 'Smarter Travel';

> *When among all the public furore we reversed the one-way in its totality after six months it was only then, what will we say, the silent majority started to ring and say why did you abandon it, it was great. But those people are sort of very silent, they are not vocal advocates one way or the other. It's the people who are in opposition who are normally more vocal*

Nonetheless the local authority in town 1 is uncertain about exactly how to engage with these people and give them a voice. This is also the case in town 2 although the redevelopment of the old railway line which had been blighted by anti-social behaviour created a "groundswell of support for 'Smarter Travel'" (project officer, town 2). The community advocate (B) in town 1 has more concrete ideas about how to translate support for 'Smarter Travel' into advocacy for 'Smarter Travel'. There needs to be a city users group or forum established and the "biggest thing you've to do is get the citizens on board, give them the sense that 'this is your agenda, what do you want to happen with your town'" (community advocate B, town 1). Parents of school-children should be encouraged to experience cycling to school with their children to dispel myths about safety. This is necessary to create a culture of regular cycling to schools because "cycling once a week" initiatives are not spilling over onto other days. He is also states that it's a case of "practicing what you preach". The local authority would have more credibility if they promoted it in their own workplace and cycled as part of their working day;

> *It is not to be seen to be telling people what to do but to actually be leading people in doing it. I mean I went around last year with the Mayor's chain hanging off the handlebars of the bike literally, in a case on the handlebars on the bike and the number of both visitors and locals that commented on it was huge you know* (community advocate B, town 1)

> *There's also an extent to which politicians are getting called out because…when somebody gets up and speaks about cycle lanes the first question you are asked is 'well do you cycle yourself'…the other local authority officials should be cycling, the County Manager should be cycling, the directors should be cycling, the local engineers should be cycling and you know if they were seen to be doing that, they would have far better credibility with people and I mean if the County Manager or the town engineer drives down and parks outside your shop and tries to tell you there should be a 'Smarter Travel' policy you know it's…*(community advocate B, town 1)

Engaging traders

The discourse on how to engage traders focused on several key strategies; creating and selling the business case for 'Smarter Travel', demonstrating its effectiveness, better consultation and addressing trader concerns.

As previously highlighted, the absence of robust evidence in relation to the impact of Smarter Travel on retail trade is problematic. Only the community advocate (B) in town 1 offers suggestions about how to address this. The one-way system failed because the local authority "took on too much and the difficulties that we knew were there really came to the fore. We should have done it incrementally" (project co-ordinator, town 1). Conversely, the community advocate claims that the problem relates to the poor job done of selling it to the business community. The customer surveys indicating support for the trial should have been done six months before its implementation. There should also be better use made of case studies such as Grafton Street where the traders who initially opposed it, later called for its extension. More importantly, local case studies should be used where possible. In town 1, there is an example of a street (Kieran Street) which was pedestrianised and subsequently hailed a great success by its traders. These traders should be engaged with to help sell the business case.

The creation of evidence in a local context and incremental manner is important to all stakeholders. While the traders in town 2 would prefer a scenario of no change the traders in town 1 are more proactive and want the local authority to demonstrate the effectiveness of 'Smarter Travel' in order to win them over. They want to see a radical approach to 'Smarter Travel' but that should be in the form of "pretty radical thinking" where measures are "tried in a low key way".

In terms of pedestrianisation, the project co-ordinator in town 1 suggests that temporary pedestrianisation should be introduced on two weekends during times where footfall is expected to be good such as festival weekends and be accompanied by efforts to create greater vibrancy and atmosphere in the area. "The downside of that of course is that it gives a false impression as to what the impact would be from a commercial point of view but I think we are going to have to start somewhere" (project co-ordinator, town 1). It is interesting to note that the trader envisages the implementation of temporary pedestrianisation for a considerably longer period. In town 2, pedestrianisation is not a word the traders will entertain. This is recognised by the local authority who concede that taking an incremental approach to changing trader attitudes is a slow process;

> *It's 30 or 40 years of a really strongly car based society that has brought us to that way of thinking so I don't think that even within a five year period that 'Smarter Travel' is going to change that. What it can do is that this town centre plan…can be seen possibly as a stepping stone…what we should almost be looking at doing is having a 40 year vision that you work towards* (project officer, town 2)

Aiming for better consultation should be an important goal of any 'Smarter Travel' policy. According to the traders, better consultation involves speaking to traders face to face and not presuming that umbrella organisations such as the Chambers of Commerce represent all business interests. The process should not allow the power to be retained in the centre (with the local authority) but rather that all stakeholders should be facilitated together to generate an agreeable solution. Whatever the outcome, once there is consensus the trial or measure is more likely to be successful. The local authority is acutely aware of this. In town 1, a non-statutory traffic forum was established after the trial one-way system. Although the project co-ordinator is non-committal about its efficacy, it was established under the premise that if they were going to "develop a strategy that it would be unanimous or that it would certainly have greater than majority support". The community advocate (B) in town 2 supports the notion of having regular dialogue with traders and going beyond tokenistic consultation;

With the landscaping and the public realm improvements, we sat down and we met with the traders once a week while that work was going on. We did it about four times before it started. We showed them the plans, we gave them an input and they were able to tweak things. It wasn't just show them plans and tell them to feck off…the traders had some very sensible suggestions…and they felt like they were part of the process and the end result was when the work happened none of them could complain…the reaction has been overwhelming positive and…they know exactly what we are out to achieve and we have been quite clear about what we are up to in the sense that the public realm improvements in high street are to lead to some, at least partial pedestrianisation.

Addressing traders concerns appears to be an essential feature of making progress in delivering 'Smarter Travel' policy. In town 2 the local authority has been shown to be more proactive in this regard. They recognise the perceived importance of customer parking to the local traders and have attempted to address this in two ways. After conducting a parking audit they realised that approximately 30% of the parking spaces were occupied by employees themselves. This provided the local authority with an opportunity to suggest alternative business parking directly adjacent to the retail area of the town and thereby increasing customer parking in Grattan Square. This also provided them with the opportunity to remove a number of spaces in order to make the areas outside their shops more accessible and more attractive. The project co-ordinator stated that these ideas "seemed to go down okay" and consequently became part of the 'Smarter Travel' pan. The final plan for the town centre also attempted to address parking concerns by greatly increasing the capacity for bike parking, thereby increasing the total capacity for parking in the square.

7.5. Discussion

7.5.1. Summary of results

The prioritisation of active travel policies in both towns is largely due to the commitment of active travel advocates working in the local authority. These advocates were town engineers who became project co-ordinators for 'Smarter Travel' by default. They had very limited understanding of soft measures, equating them to merely signposting the presence of existing infrastructure. It was the work of other stakeholders. In town 2, the eventual formation of a dedicated 'Smarter Travel' team enhanced the local authorities understanding of soft measures and it became a core part of their work. The concept of 'Smarter Travel' is typically associated with a focus on schools. A shared understanding of the concept is less likely in areas without significant traffic congestion (town 2). Both local authorities emphasised the importance of going beyond statutory consultation, although this was only conducted in town 2. This was considered to be a successful approach to introducing hard measures but resulted in a slow process and a diluted outcome.

The dissonance between traders and the local authority is the principal factor dictating the pace of the implementation process in both towns. In town 1, the traders are working proactively to try and address the congestion problems in the town centre. They would however, not be agreeable to any permanent pedestrianisation of the town centre because they equate the presence of cars on the streets as being good for business even if it only creates an illusion of increased vibrancy. The traders from intervention town 2 do not accept the local authority's assertion that the town centre needs to be made more accessible for pedestrians. They are more reactive in nature and strongly resist any attempt to reduce the number of spaces in Grattan Square. Another contributory factor to the dissonance between both parties is the absence of robust evidence on the potential impact on retail trade of reducing car accessibility.

The stakeholders agreed that any future efforts to reduce the accessibility for cars in either town centre will need to be achieved in an incremental manner where traders and the community alike can experience the benefits for themselves. There should also be considerable resources invested in creating and presenting a business case for any future strategic action.

7.5.2. The local authorities' limited use of soft measures

Chapter six described the impact of the intervention on active travel behaviour in adults. There was no absolute change in intermediate attitudinal statements or in active travel behaviour. It concluded, therefore, that the intervention effects were small at best. Several explanations were provided to explain the lack of a greater intervention effect. These included; the lack of behaviourally-specific campaigns, the greater emphasis on hard measures (community and infrastructural design) and not adopting a broader range of soft measures that included car restrictive policies. The qualitative data in this chapter helps to explain why these were not addressed during the intervention period from 2011 to 2013.

The fact that the project co-ordinators in both towns were engineers by profession was important. Their commitment and passion for promoting active travel may not have compensated for their (self-confessed) lack of experience in using a full range of pricing, programming and policy measures specific to active travel. This lack of technical expertise in active travel was also cited by Australian planners and engineers (Cole, Burke, Leslie, Donald, & Owen, 2010). The creation of a wider project steering group in town 2 convinced the project team to prioritise behaviour change activities as a core part of their work. However the 'Smarter Travel' project became synonymous with recreational physical activity, signposting new infrastructure and 'something' for schools. In town 1, the project co-ordinators did not see behaviour change activities as a core part of their work but more aligned to the work of external agencies. This may have been partly due to financial constraints and the lack of a dedicated 'Smarter Travel' team. Nonetheless it may also explain why there was not a broader range of soft measures adopted in the town.

The dependency of participants on car travel was a key theme throughout this research. It was the main mode of transport to school for both primary and secondary school-children (chapters three, four and five) and the preferred mode of travel for the latter (chapters four and five). Furthermore, the majority of adolescent girls stated that their parents were happy to drive them to school (chapter five). Only the community advocate in town 1 spoke of the need to break this 'car addiction' as opposed to persuading people to walk or cycle. However neither town introduced any pricing policies for car parking between 2011 and 2013. The pricing policies for car parking in both towns (appendix 2B) may have undermined their active travel policies. The free 30 minutes parking in the square in town 2 (which was not applied in adjacent car parks) and the relatively cheap cost of parking in the urban centre of town 1 did little to discourage car use. Parking restraint measures (such as pricing policies) are the least politically feasible measures and should be complimented by measures that incentivise active travel by removing barriers (Ryley, 2008; Simićević, Vukanović, & Milosavljević, 2013). Nonetheless, considering their potential to influence travel behaviour, it was not identified as a priority action area for either local authority. Only the local authority in town 2 recognised this dilemma but felt powerless to address it. In town 1, it is conceivable that the local authority was torn between the competing purposes of parking changes; generation of revenue, reducing congestion and improving the vitality and vibrancy of the area.

7.5.3. Factors that precluded radical change in the urban centres of both towns

The project co-ordinators stated that reducing car accessibility in the urban centre (removal of car parking and introducing pedestrianisation) was a long-term aim of both local authorities. These aspirations were not realised in either town during the intervention period. The introduction of such radical change was precluded by the power of the trader lobby against any measures to reduce car accessibility. This may have been particularly important in intervention town 2. It may help to explain why there was an increase in campaign awareness but no change in behaviour or attitudes to active travel given the extent of infrastructure investment there. The focus of the infrastructure investment on the perimeter of the town may have reinforced the view that 'Smarter Travel' was about promoting recreational physical activity. The source of the traders' resistance to active travel measures is discussed as follows.

The relative economic value of cars and car parking and bicycles

The traders in both intervention towns stressed the value of car parking provision and car accessibility to retail trade. The traders in each town differed in relation to the importance of on-street parking in that it is fiercely protected in town 2 while in town 1 the absence of it is supported. The traders in town 1 were more proactive and supportive of 'Smarter Travel' policy due to the town's congestion and its medieval streetscape, whereas their counterparts in town 2 couldn't see the need for change. They did agree, however, that any parking restraint policies or measures to make their town centres less accessible for cars will result in customers cancelling their trips or else shopping elsewhere.

In town 2, the traders' estimation that every car space lost will equate to three lost jobs is calculated on the premise that customers will cancel their trip to the town centre or choose an alternate destination. This assertion is not supported by the available literature. There is no evidence that parking supply is related to retail turnover in retail strips (Mingardo & van Meerkerk, 2012). This is only a concern where alternative shopping destinations on the periphery of the town exist or where there is inconsistent application of parking charges applied in the extended urban area (Banister, 2009; Burd-

Eden & Shiftan, 2001; Marsden, 2006). Both towns are fortunate in this respect in that there are no other viable retail alternatives on the periphery. Their calculation is also flawed based on the proposal for the town centre redevelopment which provides for a net increase in total parking spaces once new bike parking spaces are included. The alleged use of parking by employees of Grattan Square businesses and the development of the adjacent Scanlon's Yard car park should be considered in this calculation too. The greater economic value of cyclists and bike parking relative to car drivers and car parking has been well established (Clifton, Currans, Ritter, Morrissey, & Roughton, 2013; Kåstrup, 2013; Lee & March, 2010). The traders appeared unaware or unconvinced of the economic value of cyclists and didn't believe there are any viable alternatives to car transport for locals. The higher individual trip spend by car drivers found in these studies undoubtedly makes it difficult for the local authority to sell the business case for removing car parking.

The perceived impact of pedestrianisation on retail trade

Pedestrianisation in town 2 is not something the traders would entertain or that the local authority would pursue for several decades given the current conflict over the proposed 17% reduction in car parking. The introduction of at least temporary or partial pedestrianisation was a distinct possibility in town 1. Here traders were more likely to equate cars to retail trade in 2011, but by 2013 their tone was decidedly more positive about the ethos of 'Smarter Travel' and reducing car accessibility. Their primary concern was that town 1 was not large enough to accommodate permanent pedestrianisation all year round. The project co-ordinator, perhaps unaware of the trader support for temporary periods of pedestrianisation, was less enthusiastic about its efficacy. He also perceived traders would have fears about a potential downturn in trade during the construction phase for the introduction of 'Smarter Travel' measures. From the local authority's perspective he was concerned about the potential for traffic to be displaced onto adjacent streets in the absence of a town-wide traffic management plan and an additional vehicular bridge in the town. The latter was not seen as a genuine obstacle to pedestrianisation by the community advocates. Unlike the traders' resistance to parking restraint in town 2, the literature would support many of the arguments presented above. The traders in town 1 believe that the potential impact of pedestrianisation would be positive for the retail sector. This assessment is supported by the literature both in conditions where full pedestrianisation has been introduced (Banister, 2009; Hass-klau, 1993; Parkhurst, 2008; Sandahl & Lindh, 1995) and also where the urban environment has been made more walkable (Commission for Architecture and the Built Environment, 2007; Lawlor, 2013).

Parkhurst (2008) cited several potential mechanisms to explain why pedestrianisation schemes are so successful, many of which were highlighted in the debate on pedestrianising High Street in town 1. One of these mechanisms is the assertion that cars in transit are not shoppers. This is a logical assessment according to the project co-ordinator and not disputed by the traders in town 1 (where there is no on-street parking). Although cars in transit do not increase retail sales per se, they give traders a sense of security and create the illusion that there is an element of vibrancy in the town centre. This is also supported by the traders' comments in town 2 who described the eerie silence in Grattan Square when cars were removed for a civic reception. This subjective intuition cannot be entirely dismissed. Indeed most of the literature on pedestrianisation presented in appendix 7E referred to cities with population densities 2-3 times greater than both intervention towns (appendix 1A). Traders argued that both towns were not big enough to consider permanent pedestrianisation. There is little evidence to refute this claim. In light of this, calls for only temporary pedestrianisation in town 1 seem to be well calculated and consistent with the available literature. Even temporary pedestrianisation is not without risk. Studies have consistently shown that traders experience a short-term downturn in trade typically lasting 1-2 years (Banister, 2009; Hass-klau, 1993). This fear, which was acknowledged by the project co-coordinator in town 1, represented a significant implementation barrier during the intervention period being evaluated in this research.

A potential solution to this dilemma may be focusing on another of Parkhurst's (2008) mechanisms to explain the success of pedestrianisation; the attractiveness of urban centres. Consistent with other international studies (Fleming, Turner, & Tarjomi, 2013; Sustrans, 2006), the traders in town 1 considered the accessibility of the town centre for cars as the key factor determining customer trips. Conversely, customers tend to consider the attractiveness of the town centre and the mix of retail shops to be at least as important as its accessibility (Fleming et al., 2013; Thull & Mersch, 2005). Traders did not seem to consider the extent to which improvements in the public realm could positively impact on their trade. This is surprising considering the emphasis traders in town 2 placed on the market heritage of the square and how it was commonly used for people watching. The proposed civic space in the new town centre proposal is likely to enhance social interaction in the square. It is difficult to envisage pedestrianisation or walkability improvements working in either town without the local authority simultaneously investing in other areas of the public realm. Adopting such a strategy could mitigate any short-term negative impact of 'Smarter Travel' measures. It is possible that traders may come to value investments in public realm as is the case in Denmark and Germany where traders contribute financially to urban space public sector improvements (Parkhurst, 2008).

7.5.4. The level of engagement with the wider community

The active travel interventions in both towns emanated from the publication of 'Smarter Travel', the National Sustainable Transport Policy (Department of Transport, 2009b). They were not community-led projects and did not adopt a bottom-up approach to addressing local need. This may have been a barrier to implementing a more comprehensive suite of bolder measures in both towns. The creation of a rationale for doing so was likely to be more difficult in town 2 in the absence of significant traffic congestion. Generating public support for active travel measures requires skills which are not normally required by engineers and town planners such as community engagement and collaboration with stakeholders beyond the traditional transport-related sectors (Cole et al., 2010). The wider communities in both towns were largely supportive of 'Smarter Travel' policy but they were not vocal in their support and there were no advocacy groups in either town. The wider communities were not empowered and neither project team offered a solution to the dilemma. The project team in town 2 may have achieved some level of engagement using initiatives such as awarding prizes to the best 'Smarter Travel' themed float in the annual St. Patrick's Day parade. Although this may have engaged the wider community and raised awareness for the project, it is unlikely to have enhanced the public's understanding of the concept or changed their attitudes to active travel. The mass media may have been a more appropriate platform to generate public support for the 'Smarter Travel' project. Neither town identified the media as important stakeholders to help change public attitudes to 'Smarter Travel'.

The importance of engaging the local media as project stakeholders is underlined by the results of the media analysis (appendix 7D). During the first year of the intervention in town 1, there were four newspaper articles all portraying political resistance to 'Smarter Travel' (related to the one-way street trial). This was significant because the media are known to both reflect and construct reality (Kline, 2006). In total there were only eight negatively framed stories about 'Smarter Travel' published between 2010 and 2013 in town 1. The nature of these stories (political resistance to; one-way system, cycle lanes and 'Smarter Travel') may have eroded some support for the project in the wider community. In contrast, there were 34 negatively framed stories in town 2 but they mostly highlighted the poor quality or absence of pedestrian infrastructure in certain areas. Overall there were more positive stories in both towns but the nature of the stories (new infrastructure, funding announcements, school activities e.g. walk to school days) did not convey the need for active travel measures and were unlikely to change public attitudes or behaviour.

Community advocacy, empowerment and creating partnerships with the local media were key ingredients of the success of the Living Streets and Ciclovías projects in South America (Sagaris, 2009; Sarmiento et al., 2010) and the United States (Zieff, Hipp, Eyler, & Kim, 2013). Stakeholder groups tend to become organised in response to any potential threat posed by infrastructural change. Intervention town 1 was well placed to establish a 'city users group' to fulfil this role as suggested by the community advocate (B). The town's chronic congestion could have helped to mobilise participants. Although the local media in town 1 could have been engaged to facilitate this, their importance cannot be overstated in town 2. Engaging the silent majority would have been challenging without the project objectives being clearly communicated to them. In the absence of chronic congestion in town 2, safety concerns over traffic speeds and creating a more vibrant town centre needed to be emphasised. The local authority has a history of adopting this approach. For example, the anti-social behaviour on the old railway track was curbed by upgrading the track to a walking and cycling facility. This was a success but partnerships with the local media were not developed to raise community awareness of the need to redevelop the town centre or to change community attitudes to active travel.

In addition to awareness raising activities, the trialling of 'Smarter Travel' measures in an incremental manner was also considered effective in changing public attitudes. This was emphasised by the majority of the stakeholders in this research and is something which is supported by the literature (Wallar, n.d.; Winslott-Hiselius, Brundell-Freij, Vagland, & Byström, 2009). The community advocate (B) in town 1 particularly emphasised the need to adopt this approach to reducing school-related congestion in the town. He believed children will never regularly walk or cycle to school unless parents get to experience it themselves. By doing so, they can experience the benefits of active travel and may in effect become champions of 'Smarter Travel'. The Civitas (2011) review identified that creating champions of active travel was a characteristic of successful demonstration projects across Europe and may have been a factor that contributed to the small increase in the proportion doing any active travel in the intervention towns (chapter six). Championing the practice of 'Smarter Travel' gives more credibility to the local authority according to the community advocate who did so himself as Mayor of town 1. He contests that there are not enough local authority employees embracing their own 'Smarter Travel' policy. This was mirrored in the comments of the traders in town 2. The project team in town 2 deliberately identified active travel champions in the community. They included; a high profile local sports star, a celebrity chef from the local area and a family who exchanged their car for a cargo bike.

Ultimately, engaging and empowering the wider community is a long and complex process that requires local authorities to implement bolder and more comprehensive measures. Without multi-level policies that go beyond infrastructural change there is a risk that 'Smarter Travel' will fail as was seen in relation to cycling in Sweden (Robertson & Aretun, 2013).

7.5.5. The level of consultation with key stakeholders

The level of community consultation differed in both towns. In town 2, the 'Smarter Travel' team conducted a resource intensive pre-consultation phase before the statutory phase. They aimed to give stakeholders genuine power to shape the proposal for the town centre. Traders felt the process was strategically managed to dilute their voice. They expressed mistrust of the local authority and questioned whether a blank slate ever existed. The traders in town 1 also believed that the local authority strategically managed consultation exercises and were reluctant to empower stakeholders. This mistrust of the local authority manifests itself in displays of power against the local authority and not necessarily against 'Smarter Travel' per se.

The community advocates in town 1 spoke of the need to address the traders concerns and not to take a didactic approach with them. Other stakeholders questioned the equity of attaching greater weight to the concerns of traders at the expense of more vulnerable groups. Irrespective of any perceived inequities, the available evidence suggests that traders have the ability to block, impede or accelerate active travel projects (Ginty, 2012; Moutou & Mulley, 2012). The trialling of the one-way system and the proposal for the redevelopment of the town centre in town 2 highlighted the power of the trader lobby. In town 1, the trial was reversed as a result of the intense pressure applied to councillors. The project co-ordinator questioned why the traders hadn't disclosed relevant data in order to objectively evaluate the impact of the trial on retail sales. Similarly in town 2, the traders successfully influenced the final town centre proposal by outnumbering other stakeholders towards the latter stage of the consultation process. They also co-ordinated a campaign to preserve the current quota of parking spaces in Grattan Square. The campaign utilised misleading calculations to equate the loss of one parking space to three jobs. Nonetheless, the campaign harnessed considerable community support for their cause. Moutou and Mulley (2012) conclude that the first step in engaging traders is to acknowledge their potential to influence projects. The evidence provided in this study reinforces this and provides some direction to addressing their concerns.

Engaging in meaningful consultation with traders is likely to slow the implementation process but in turn will ensure that the final outcome will be more successful (Civitas, 2011). The project officer in town 2 was disheartened about the diluted final proposal for the town centre redevelopment that was produced after the pre and statutory consultation phases. Given the traders' staunch opposition to losing parking spaces it could be argued that the final proposal would have been unachievable without pre-consultation. The attempt to address traders concerns by increasing the total number of combined bike and car parking spaces is likely to have helped the process too. The importance of conducting less tokenistic consultation was also evident in town 1 whereby the community advocate (B) described the success of the public realm discussions. The key to this success was holding regular meetings with the traders (and not their umbrella body) most likely to be effected by the measures and empowering them to shape the proposal on the understanding it would lead to partial or temporary pedestrianisation. This strategy was most likely adopted based on the stakeholders' negative experiences of statutory consultation. Both local authorities understand they will never win over all traders but it could be argued that they did little to get a representative view of all traders and didn't sell the business case for 'Smarter Travel'.

Previous studies have provided guidance on how to engage traders before the implementation of active travel measures (Civitas, 2011; Clean Air Partnership, 2009; Wallar, n.d.). The most important pre-implementation tasks for the local authority should be to develop a campaign using case studies of other areas and measure the perceived impact of the measure from all traders. Taken together these tasks should foster a good working relationship with traders and give the local authority a more representative view of how supportive the wider trader community are. Not all traders will benefit equally from pedestrianisation for example. The retail and the restaurant sectors are likely to fare better than stores selling heavy goods (Hass-klau, 1993). The use of these strategies was not apparent in either town unfortunately and ultimately may have greatly contributed to the dissonance between both parties. The community advocate (B) in town 1 did identify this failure and suggested a number of other sensible strategies to build a business case and pre-implementation campaign. He suggested hearing from traders in areas where pedestrianisation has worked and bringing the views of customers to the traders. This would have made it easier to win over the traders from town 1. Previous studies have demonstrated the likely efficacy of these strategies indicating that traders often have false perceptions of their shoppers preferences (Fleming et al., 2013; Sustrans, 2006; Thull & Mersch, 2005) and many traders are more supportive of active travel measures than the local authority is aware of (Clean Air Partnership, 2009, 2010).

The local authority in town 1 is fortunate in some respects to have such an engaged group of traders compared with the scenario in town 2. This was facilitated by the presence of a mutually agreed problem with congestion and also the failed introduction of the one-way system. Although the one-way system was catastrophic according to the local authority, it served to mobilise the trader community and forced them to be more proactive to shape the direction of 'Smarter Travel' policy. Neither of these conditions was present in town 2. Indeed, the conversion of the suburban railway line may have inadvertently created a further barrier to the redevelopment of the town centre. While the work on the railway line generated community support for 'Smarter Travel' it may have defined the initiative as 'recreational cycling' for the traders. As a result of the different conditions in both towns, it could be argued that a campaign specifically targeting traders was more important in town 2. Connecting the town centre with the converted railway track would have resulted in a more integrated and complete active travel network. This could have potentially created a modal shift to active commuting considering those who were employed had a greater awareness of the active travel infrastructure in the town (chapter 6). Correspondingly, the local authority in town 1 may have missed an opportunity to promote 'Smarter Travel' through the creation of a meaningful 'shared space' zone. Considering, the traders' unanimous support for the measure, the emerging evidence on its efficacy and the community advocate's suggestion of introducing shuttle bus and park and stride / ride facilities; this may have been a risk worth taking. Active travel measures introduced with majority trader support are rare and likely to be more successful. The decision not to fully adopt the 'shared space' concept was another possible factor that limited the impact of the intervention.

7.5.6. Limitations of study

- As with any qualitative research study, these findings are not representative of a stakeholder group but merely of the interviewees from each stakeholder category.
- The political sensitivity of the debate may have made it difficult for the local authority to admit any failings or for the traders to admit to the potential positive outcomes of 'Smarter Travel'.
- The researcher is an advocate of 'Smarter Travel' and has previously facilitated community 'Smarter Travel' interventions.

7.5.7. Implications of the research findings

Implications for research

- An attempt should be made to measure the impact of a proposed 'Smarter Travel' measure on retail trade using objective data in co-operation with the local traders and an independent research body. Care should be taken to measure the relative impact on various categories of business.
- Lack of empirical research is a problem. The impact of 'Smarter Travel' may be geographically specific. Case studies should be conducted on the business impact

of parking restraint policies, pedestrianisation and improvement to the walking and cycling infrastructure specifically in Ireland.

- A national study of urban towns should be conducted to examine trip spends and spends over time by the category of transport used to access the town.
- Considering the traders support for the 'shared space' concept there should be a full trial comprehensively evaluated in an Irish context.

Implications for practice

- Engaging the wider community should be a goal of all 'Smarter Travel' teams and can be achieved by identifying local champions, forming 'town user' forums and active travel lobby groups and making the local media partners in the project.
- Car parking pricing policies should be considered as part of a wider suite of 'Smarter Travel' measures. At very least, they should not be counter-productive to 'Smarter Travel' policy.
- A dedicated 'Smarter Travel' project team should be appointed to facilitate the local authority to move beyond infrastructural provision and to deliver a more comprehensive and multi-strategic suite of measures. These project teams should have access to ongoing training and support for using these measures.
- Selling the business case to traders and going beyond statutory consultation are likely to be necessary tasks for successful projects. A toolkit should be produced for local authorities on how to create a business case for 'Smarter Travel' measures based on the recommendations for research cited above.
- As part of this toolkit, a stated preference survey tool should be developed to gauge shoppers' responses to potential 'Smarter Travel' measures. Most importantly they should be asked what impact the measure would have on their frequency of visits to the town, the perceived attractiveness of the town and their spending habits.
- Many towns have local examples of pedestrianised streets or where parking has been removed. The traders in these areas may be supportive of the measures and should be engaged by the local authority.

- The introduction of 'carrot' measures such as improvements to the public realm and accessibility for cyclists should be introduced before 'stick' measures such as increasing parking charges or removing cars from a town centre.
- 'Smarter Travel' measures should be introduced incrementally such as introducing temporary pedestrianisation or gradually reducing parking supply thereby demonstrating the benefits of the measure to stakeholders.
- Local authorities should consider reducing commercial rates for all traders during the construction phase of 'Smarter Travel' measures to allay fears of short-term downturns in trade.

7.6. Conclusion

Earlier chapters in this research (three, four and six) reported that the wider community intervention was successful in raising awareness of the campaign but only had a weak to modest effect on active travel behaviour. The chapters on school-children (three, four and five) highlighted the extent to which the car is the most dominant and preferred mode of travel to school and that parents facilitate these trends. It was suggested that greater intervention effects may have been detected had the project teams used softer measures in a more behaviourally specific manner and created a more complete active travel network by reducing car accessibility in the urban centres. The data in this chapter contribute to an explanation of why these strategies were not adopted during the intervention period (2011-2013).

Creating a modal shift to walking and cycling is a relatively new concept in Ireland. It demands skills such as technical expertise on active travel measures (hard and soft), collaboration with new agencies and community engagement. These are not skills typically associated with town planners and engineers and may have contributed to the over-emphasis on infrastructural measures and the use of softer measures as predominantly awareness raising activities. There was a reluctance to adopt car restrictive policies in the urban centres during the intervention period. These policies were under-valued by the project team to an extent. However their reluctance to introduce significant change in the urban centres was more likely due to the power of the trader lobby and the dissonance between both parties.

There were several missed opportunities for introducing more radical change in both towns during the intervention period. The dissonance between traders and the local authority was less in relation to the ethos of 'Smarter Travel', but rather the local authorities' inexperience in using behavioural change strategies and selling the business case for 'Smarter Travel'. The task in town 1 was made easier by the existence of congestion which both the local authority and the traders believed had a negative impact on retail trade. Considering the unique situation that existed where traders had been mobilised and were working proactively to promote 'Smarter Travel', the local authority could have embraced their support. It is unlikely however that a more comprehensive, multi-level policy alongside community empowerment will ever be implemented without the formation of a dedicated 'Smarter Travel' team. The local authority in town 2 was in the more favourable position in that they had a dedicated and well-resourced 'Smarter Travel' team. However the absence of chronic congestion and limited pedestrian or cyclist related accidents had precluded radical change in the urban centre and car restrictive policies created more resistance among traders. The traders in town 2 saw no reason to redevelop their town centre and equated car parking to retail trade. Despite an extensive and relatively successful pre-consultation exercise, the local authority did not implement a targeted campaign at the traders to sell the business case for removing car parking spaces. This could have muted the trader resistance to the proposal and facilitated the implementation of more radical change during the intervention period.

CHAPTER 8. CONCLUSION

8.1. Introduction

Ireland's 'Smarter Travel' programme was designed to meet agreed targets for CO_2 emissions by reducing car dependency (Kelly, 2011). The programme presents an opportunity to increase population levels of physical activity by creating a modal shift to walking and cycling for transport. The aim of this research was to determine the potential of the 'Smarter Travel Area' and 'Active Travel Town' initiatives to increase walking and cycling for transport. This was achieved by measuring the impact of active travel initiatives in two Irish towns on active travel behaviour and evaluating the processes that shaped their implementation. The overall aim of this chapter is to synthesise the key findings of the thesis in order to determine whether the expansion of the 'Smarter Travel' programme has the potential to increase active travel. The chapter also outlines the original contributions of the study and opportunities for further research.

8.2. Main conclusions

The main conclusions were derived from the synthesis of the study's empirical findings in the context of the reviewed literature and the aim and objectives of the research.

8.2.1. The contribution of active travel to physical activity

The efficacy of promoting active travel is based on the premise that any increase in active travel is not associated with a commensurate decrease in recreational physical activity. This study supports this assertion. Small increases in active commuting (particularly cycling) to any destination may help to increase the proportion of adolescent girls that meet the guidelines for MVPA (chapter five). In the adult cohort (chapter six), there was no significant difference in minutes of recreational physical activity between respondents that increased, maintained or decreased their volume of active travel. This is important from a public health policy perspective because it suggests that adults who switch to active travel will do so in addition to their existing recreational physical activity and not in place of it.

8.2.2. Promoting active travel in school-children

There were no significant intervention effects on active travel behaviour detected at the school or community level in either primary (chapter three) or secondary school-children (chapters four and five). However there were some intervention effects (or trends towards an effect) detected for the communities, schools and students that received the most intensive mix of measures. These were mostly in town 2 where the more resource-intensive intervention was implemented. Here, there was a trend towards significance for an increase in the proportion of primary school boys walking and cycling home from school (chapter three). There was also an absolute increase of 25.8 daily minutes of active travel in one mixed secondary school (chapter four). In town 1, there was an absolute increase of 14% in the proportion of 1st year girls walking and cycling to school in the multi-component intervention study conducted in one all-girls school (chapter five). Taken together, this suggests that low intensity, gender neutral interventions with limited infrastructural provision are unlikely to increase active travel in school-children.

The potential for promoting active travel to school (particularly cycling) appears to be greater in primary schools than in secondary schools. The data in chapters three and four showed that primary school-children are more likely than secondary school-children to indicate a preference for cycling to school (51% versus 22%). Overall, more than 85% of primary school-children indicated a preference for active travel to school compared with 42% of secondary school-children. Furthermore, the majority of secondary school-children live greater than 3km from their school (chapters four and five) and only 7% of this group of students walk or cycle to school (chapter four). Indeed, distance was the strongest correlate of walking to school amongst adolescent girls (chapter five). Consequently, the most intensive intervention efforts should be targeted at primary school-children.

Extensive infrastructural measures targeting specific neighbourhoods, while expensive, are likely to produce the greatest intervention effects on total daily minutes of active travel in adolescents (both sexes). This is based on the intervention effect detected for the students attending the school best served by the new infrastructural measures in town 2. However infrastructural measures alone may not be sufficient. The findings from chapter five have important implications for the design of active travel interventions targeting school-children. The focus of these efforts should be to increase the proportion of pre-adolescent children, particularly girls, who are granted independent mobility to cycle to school. The perceived and actual safety of cycling to school should also be addressed. Given the influence of distance to school on travel mode, the extent of adolescent girls' barriers to active travel and their preference for car travel to school (47% would prefer to travel to school by car), the promotion of cycling to non-school destinations may offer less resistance and greater public health benefits. Considering the positive shift in attitudes noted in chapter five, multi-component programmes in a school setting may play an important role in normalising the use of bicycles for travelling to both school and non-school destinations amongst adolescent girls. Parents are an integral part of the solution to creating a modal shift from passive to active travel in adolescent girls. They are more than gatekeepers of children's mobility; they appear to be agreeable facilitators of passive travel to school.

8.2.3. Moving beyond infrastructural measures

There was no intervention effect detected for active travel behaviour in adults in either intervention town (chapter six). Community-wide changes in active travel and physical activity may be unachievable without significant investment and a high intensity mix of hard (community and infrastructural design) and soft (pricing, programming and policy) measures that target the entire population. Hard measures may be necessary to create the conditions to implement broader active travel programmes. In smaller towns, infrastructural measures, in the absence of a completed community-wide active travel network may not be sufficient to create a modal shift from passive to active commuting across population groups. The effectiveness of a predominant focus on infrastructural measures is questionable and the intervention effects are modest at best. Conversely, increasing awareness of community-wide active travel campaigns can be successfully achieved (chapters three, four and six). Despite the extensive infrastructural investment in intervention town 2 there was no overall intervention effect detected for school-children or adults (chapters three, four and six). The literature presented in chapter two suggests that there may be a greater synergy achieved by introducing a comprehensive suite of soft measures in combination with hard measures to maximise their impact on travel behaviour. Soft measures that merely raise awareness of existing infrastructure for active travel are insufficient. This was identified as a key issue in chapter seven where the project co-ordinators (road engineers) highlighted their lack of experience in utilising soft measures for creating a modal shift. Mechanisms should be developed to bridge this educational gap in local authorities. Soft measures need to be gender-specific and address the mediators of active travel.

8.2.4. Reluctance to use car-restrictive policies

One of the reasons for the limited intervention effects detected in chapters 3-6 may have been the reluctance of the local authorities to adopt car-restrictive policies. Particularly, it may explain why, in chapter six, there was an increase in awareness of changes in town 2 but no commensurate change in intermediate attitudes or in active travel behaviour. The findings from chapter two established that travel behaviours are relatively stable and car use is greatly influenced by trip chaining, habit, car ownership and the availability/cost of car parking. This is consistent with the finding that car was the common mode of transport to school for both primary and secondary school-children (chapters three and four). Chapter five established that 'parents being happy to drive' their child to school was one of the strongest (inverse) correlates of walking to school. Despite these findings, the intervention components described in appendix 2A are almost exclusively pro-cycling and pro-walking policies and therefore only focused on part of the problem. In chapter seven, it was reported that there was a political reluctance to adopt car restrictive policies but they are also undervalued.

The reluctance to use such measures was borne out of intense lobbying of local politicians by retail traders in each town. The local print media may have played a role in shaping public attitudes to car restrictive policies based on the volume of related stories identified in the print media analysis (appendix 7D). The data in chapter seven provides valuable lessons for the implementation of future active travel measures. These lessons include the importance of engaging the local media as project stakeholders from the outset and engaging the wider community by establishing groups that could advocate for active travel measures. The local authority also undervalued car restrictive policies as a result of their (self-confessed) lack of experience in using a full range of pricing, programming and policy measures specific to active travel. This is an educational gap that needs to be addressed in future interventions. Disentangling the contributions of individual policy measures is problematic. Nonetheless the broad spectrum of policies adopted in Dublin can serve as a template for other large Irish towns and cities. Pre-existing conditions such as congestion and a high population density (may facilitate the creation of a business case for car restrictive policies. Building a business case for adopting these measures may be more challenging in smaller towns. Further steps to introduce these measures are presented in chapter seven.

8.2.5. Traders shape active travel policies

It could be argued that a town's urban centre is the fulcrum of a fully completed and integrated infrastructural network for active travel. Neither of the intervention towns significantly increased the accessibility of their urban centres for pedestrians or cyclists during the intervention period from 2011 to 2013. The power of the trader lobby was identified in chapter seven to be largely responsible for this. Consequently, the cohort study of adults described in chapter six effectively only measured the impact of a partially completed network. Adults in town 2 who were employed were almost six times more likely (than those who were unemployed) to be aware of changes to make it easier to walk and cycle in the town. This cohort of adults may have changed their behaviour had the new infrastructural measures been connected to the urban centre and key employment centres. Creating a modal shift to active travel for working adults may have a corresponding effect on active travel to school. This is plausible considering that the qualitative data in chapter five emphasised that parents were happy to drive their children to school as part of their work commute. The literature reviewed as background to chapter seven (appendix 7E) suggests that the influence of traders in shaping active travel policy is underestimated and possibly neglected by intervention studies. The findings in chapter seven support this assertion. Chapter seven highlighted the significant impact traders had on the implementation of policy measures in the urban centres. It is inevitable that the relationship between traders and local authorities will be a recurring issue pending the expansion of the 'Smarter Travel' programme. In the absence of definitive evidence for effective intervention strategies, project teams need to focus on addressing the concerns of traders, implement measures in urban centres in an incremental manner, embrace a culture of community empowerment and strive to implement bolder and more comprehensive measures.

8.2.6. The need to demonstrate clear effectiveness

The 'Smarter Travel Area' and 'Active Travel Town' programmes in Ireland were designed to act as demonstration projects that could be replicated in other Irish towns. The evidence from both the impact studies in this thesis (chapters 3-6) and the process study (chapter seven) suggests that it is premature to consider replicating these programmes nationally. The negative findings need to be interpreted with caution however. It is important to make a distinction between evidence of ineffectiveness and failure to demonstrate effectiveness (Rychetnik, 2002). In relation to the former, it has already been acknowledged that the impact studies reported here measured the effect of an intervention which is still in train, and may take time to become embedded. Nonetheless, initial effects need to be detectable to create leverage for investment in further demonstration projects. The process evaluation in chapter seven described how the project teams did not have the technical expertise to implement a full range of pricing, programming and policy measures specific to active travel. Other implementation issues included the dissonance between the retail traders and the local authority, the lack of community engagement and the lack of resources in town 1. These factors may have combined to moderate any potential intervention effects on active travel behaviour. Conversely, the financial constraints associated with this evaluation may have limited our capacity to detect intervention effects. These limitations have been described in each of the impact chapters.

Several more comprehensive interventions that utilise a broader spectrum of measures are required before accurate conclusions on the effectiveness and generalisability of the programme can be drawn. The extent of funding required to achieve modal shift across an extensive geographical area could be considered prohibitive and impractical to extend countrywide. Further demonstration projects should be implemented in areas with greater population density and should target specific neighbourhoods with low levels of active travel. These projects should aim to deliver a joined-up infrastructural network linking key locations in that community and the urban centre. The introduction of the infrastructural network should be complimented by a comprehensive range of targeted softer measures underpinned by evidence. These measures should aim to both promote active travel and disincentivise car use.

8.3. Original contributions of the research

This research makes several original contributions to theory, knowledge and practice in the field of active travel. This was possible because of the unique nature of the study and its high external validity. This research is one of the few active travel intervention studies that has been rigorously evaluated with a long duration of follow-up and the inclusion of a comparison site (Chillón, Evenson, et al., 2011; Krizek, Forsyth, et al., 2009;

Ogilvie et al., 2007; Pucher, Dill, et al., 2010; Yang et al., 2010). To our knowledge it is also the only one in Ireland. The timing of baseline data collection is a frequent source of measurement error in natural experiments of new active travel measures (Chapman et al., 2014). The administration of the baseline survey six months prior to the opening of the converted railway track in intervention town 2 established a true baseline of active travel. Another unique aspect of the study is that it included a process evaluation to examine the mechanisms that contributed to the heterogeneity that existed between the intervention towns. This was advocated by Goodman, Panter, Sharp, and Ogilvie (2013) who evaluated the impact of similar initiatives in the UK. Detailed recommendations for the design of future demonstration projects are documented at the end of chapters 3-7. There are several overarching original contributions that the research makes to theory, knowledge and practice;

- Existing ecological frameworks applied to active travel (Ogilvie et al., 2011; Panter et al., 2008) underestimate the influence of traders in smaller Irish towns and cities.
- Car restrictive policies are undervalued and unpopular in Ireland.
- Interventions aimed at adolescent girls (and all children) should target parents and prioritise reducing the convenience of car travel. They should also promote cycling to non-school destinations as a social norm and a superior mode of travel.
- Low intensity community-wide interventions are likely to produce limited effects for increasing active travel in adults or school-children. Comprehensive infrastructural measures that join residential locations to other key destinations in a neighbourhood may be effective in increasing the total daily minutes of active travel in adolescents (both sexes) and active travel to school in pre-adolescent boys.

8.4. Opportunities for further research

The limitations of the studies in this thesis have been detailed in each chapter. This section suggests opportunities for further research which may overcome many of these limitations. One of the main conclusions of this thesis is that further quasi-experimental studies in other Irish towns and cities are necessary to establish the generalisability of active travel initiatives in schools and across communities. Interventions should be well-resourced, driven by a dedicated project team and include a balance of hard and soft measures that target the entire population. Considering the traders' support for the 'shared space' concept there should be a full trial comprehensively evaluated in an Irish context. Further intervention studies that target adolescent girls separately from boys are needed. The use of e-books may become more commonplace in Irish schools. The isolated intervention impact of such a measure on active travel should be examined.

Rigorous process evaluations are needed to better understand the conditions that facilitate the success of multi-component programmes. Drawing on the implications for research presented in chapters 3-7, there are several other opportunities for further research. There is a need to develop validated self-report tools to measure destination specific active travel for both school-children and adults. These tools should record walking and cycling separately as continuous measures. In the case of school-children it should discriminate whether the child travelled independently or not and what their preferred mode of travel would be. Variables such as trip-chaining, car convenience and habit strength are understudied but may be important determinants of passive travel in parents of school-children. Cohort studies are expensive and have high attrition rates. Ongoing surveillance of active travel behaviour should be integrated into existing mechanisms such as the Quarterly Household Survey administered by the Central Statistics Office in Ireland. Future studies should be gender specific in terms of design and analysis. There is a paucity of empirical research on the business impact of parking restraint policies, pedestrianisation and active travel infrastructure in Ireland. The impact of these measures should be examined using objective sales data in co-operation with local traders and conducted by an independent research body. Care should be taken to measure the relative impact on various categories of business.

8.5. Conclusion

Recent efforts to attenuate the decline in energy expenditure associated with technological advancements have had limited success (Hallal, Bauman, et al., 2012). Despite the existence of national physical activity guidelines in Ireland, there is still no national physical activity action plan (Harrington et al., 2014), although this will shortly be addressed under Ireland's new public health framework, Healthy Ireland (Department of Health and Children, 2013). The funding of active travel initiatives by Ireland's Department of Transport presents an opportunity to increase population levels of physical activity. However the majority of existing evidence on active travel comes from cross-sectional research (Bauman, Reis, et al., 2012). This research is one of the few empirical studies of active travel interventions. It has made important recommendations for the design and evaluation of further demonstration projects in Ireland and in other car dependent countries. It has also contributed to the limited knowledge base on how to gain trader and political support for the implementation of a broader spectrum of active travel measures.

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APPENDICES

Appendix 1

1A Demographic comparisons of intervention and control towns

Intervention town 1

census 2011 RESULTS

AREA PROFILE FOR TOWN

KILKENNY LEGAL TOWN AND ITS ENVIRONS CO. KILKENNY

AGE/SEX

In April 2011 this area had a population of 24,423, consisting of 11,901 males and 12,522 females.

The population of pre-school age (0-4) was 1,828, of primary school going age (5-12) was 2,379 and of secondary school going age (13-18) was 1,918. There were 2,767 persons aged 65 years and over. The number of persons aged 18 years or over was 18,595.

MARITAL STATUS

Of the 19,553 persons aged 15 years and over, 8,702 were single, 8,439 were married, 751 were separated, 639 were divorced and 1,022 were widowed.

LIVING ARRANGEMENTS

There were 9,271 private households in this area in April 2011, of which 2,444 were single person households. Of the 6,135 families in the area, 1,941 were couples with no children. The average number of children per family was 1.2 compared with 1.4 nationally.

HOUSEHOLDS BY COMPOSITION

	This Area		State
	No. of households	% breakdown	% breakdown
One Person	2,444	26.4	23.7
Couple without children	1,753	18.9	18.9
Couple with children	2,723	29.4	34.9
Lone parent family	1,058	11.4	10.9
Other	1,293	13.9	11.6
Total	9,271	100.0	100.0

MIGRATION AND NATIONALITIES

90.7 per cent of the usually resident population aged over 1 lived at the same address one year before the census. A further 5.8 per cent lived elsewhere in the same county, 2.2 per cent lived elsewhere in the State while 1.3 per cent lived outside the State twelve months before the census on April 10, 2011.

Non-Irish nationals accounted for 15.9 per cent of the population of this area compared with a national average figure of 12.0 per cent. Polish (1,280 persons) were the largest group, followed by UK nationals (532 persons).

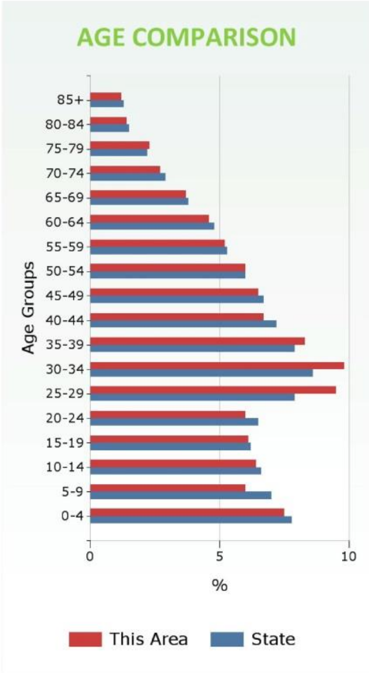
LANGUAGES

9,183 persons could speak the Irish language and of these 3,168 spoke the language daily. 3,765 persons spoke a language other than Irish or English at home and of these 730 could not speak English well or at all. Polish was the most common foreign language spoken at home with 1,234 speakers.

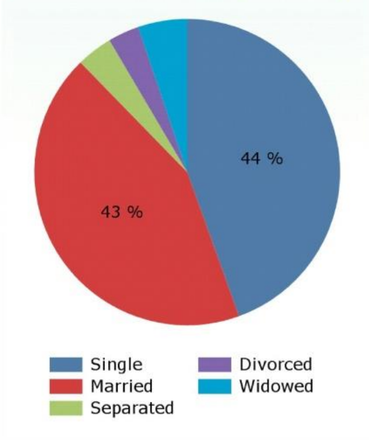
RELIGION

There were 20,327 Roman Catholics in the area at census time. A further 2,441 were adherents of other stated religions (e.g. Church of Ireland, Islam, Presbyterian, Orthodox), while 1,283 persons indicated that they had no religion.

AGE COMPARISON



MARITAL STATUS (AGE 15+)



THIS AREA: KILKENNY LEGAL TOWN AND ITS ENVIRONS

LABOUR FORCE

There were 12,499 persons aged 15 years and over in the labour force and of these, 78.7 per cent (9,838 persons) were at work. The unemployment rate for this area was 21.3 per cent compared with a national average rate of 19.0 per cent.

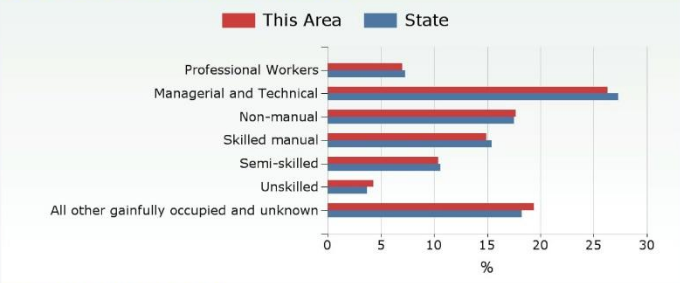
Of the 7,054 persons aged 15 years and over who were outside the labour force, 28.1 per cent were students, 23.0 per cent were looking after the home/family and 36.4 per cent were retired.

Of the 9,838 workers enumerated in this area, 2,767 worked outside the area. The daytime working population (resident and non-resident) of this area was 12,547 with commerce and trade being the largest industry.

EDUCATION

Of those aged 15 years and over whose full-time education had ceased, 13.0 per cent were educated to at most primary level only; a further 53.9 per cent attained second level while 33.1 per cent were educated to third level.

SOCIAL CLASS COMPARISON



TRAVEL TO WORK

The most popular means of travelling to work was by car (driver) with this mode accounting for 60.7 per cent of all journeys. 117 persons commuted using public transport (bus or rail). The average journey time was 21 minutes and 16.0 per cent of workers faced a commuting time in excess of 30 minutes.

DISABILITY AND CARERS

3,323 persons had a disablity in April 2011, of whom 1,084, representing 32.6 per cent of the total, were aged 65 years and over.

892 persons (323 males and 569 females) provided regular unpaid personal help for a friend or family member with a long-term illness, health problem or disability. 21.7 per cent of these provided care for more than 6 hours per day.

HOUSING, INTERNET AND CARS

87.9 per cent of households lived in houses or bungalows while a further 11.9 per cent lived in apartments, flats or bedsits. 5,488 dwellings (59.3 per cent) were owner occupied while 3,668 dwellings (39.6 per cent) were rented. 28.8 per cent of the dwellings in this area were built in the ten years before the census. The average number of persons per household was 2.5 compared with 2.7 nationally.

66.0 per cent of households had broadband connectivity compared with 63.8 per cent nationally. 32.7 per cent of households had two or more cars.

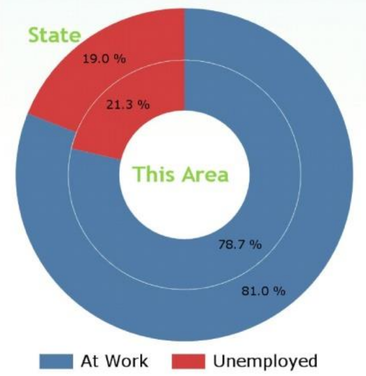
GENERAL HEALTH

In this area 21,550 persons stated they were in very good or good health, representing 88.2 per cent of total persons. This compares to 88.3 per cent of total persons nationally. 360 persons stated they were in bad or very bad health, representing 1.5 per cent of total persons in this area. Again this compares with 1.5 per cent of total persons nationally.

WORKERS BY INDUSTRY

Industry	Daytime Working Population
Agriculture, forestry and fishing	61
Building and construction	231
Manufacturing	569
Commerce and trade	4,092
Transport and communications	328
Public administration	1,535
Professional services	3,745
Other	1,986
Total	12,547

LABOUR FORCE



PERMANENT HOUSING STOCK

Dwelling Type	This Area	State
Occupied or Usually Occupied	9,576	1,705,394
Of which		
House or Bungalow	84.0%	84.7%
Flat, Apartment, Bedsit	11.5%	11.0%
Not Stated	4.5%	4.3%
Vacant	1,220	289,451
Of which		
Holiday Home	3.2%	20.5%
Other	96.8%	79.5%

Source: Central Statistics Office, Census 2011 Area Profiles http://census.cso.ie/areaprofiles/

Intervention town 2

AREA PROFILE FOR TOWN

DUNGARVAN LEGAL TOWN AND ITS ENVIRONS CO. WATERFORD

AGE/SEX

In April 2011 Dungarvan had a population of 9,427, consisting of 4,613 males and 4,814 females.

The population of pre-school age (0-4) was 755, of primary school going age (5-12) was 981 and of secondary school going age (13-18) was 695. There were 1,300 persons aged 65 years and over. The number of persons aged 18 years or over was 7,105.

MARITAL STATUS

Of the 7,447 persons aged 15 years and over, 3,246 were single, 3,143 were married, 321 were separated, 256 were divorced and 481 were widowed.

LIVING ARRANGEMENTS

There were 3,679 private households in Dungarvan in April 2011, of which 1,101 were single person households. Of the 2,404 families in the area, 751 were couples with no children. The average number of children per family was 1.3 compared with 1.4 nationally.

HOUSEHOLDS BY COMPOSITION

	Dungarvan		State
	No. of households	% breakdown	% breakdown
One Person	1,101	29.9	23.7
Couple without children	693	18.8	18.9
Couple with children	1,052	28.6	34.9
Lone parent family	469	12.7	10.9
Other	364	9.9	11.6
Total	3,679	100.0	100.0

MIGRATION AND NATIONALITIES

92.4 per cent of the usually resident population aged over 1 lived at the same address one year before the census. A further 5.5 per cent lived elsewhere in the same county, 1.4 per cent lived elsewhere in the State while 0.8 per cent lived outside the State twelve months before the census on April 10, 2011.

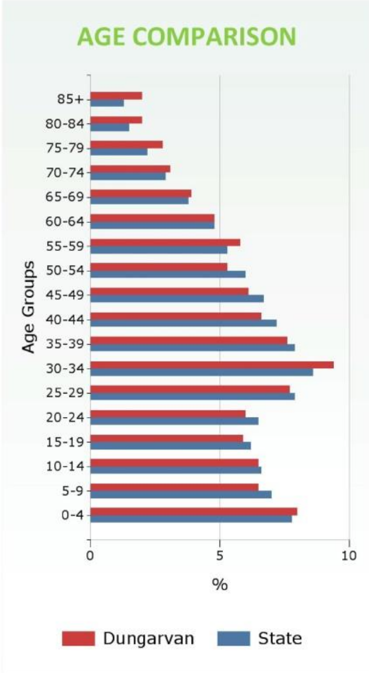
Non-Irish nationals accounted for 13.1 per cent of the population of Dungarvan compared with a national average figure of 12.0 per cent. Polish (498 persons) were the largest group, followed by UK nationals (308 persons).

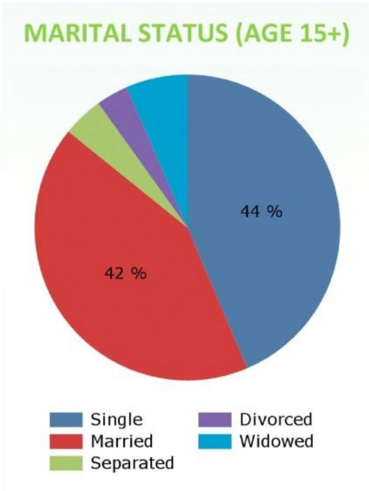
LANGUAGES

4,020 persons could speak the Irish language and of these 1,355 spoke the language daily. 1,014 persons spoke a language other than Irish or English at home and of these 237 could not speak English well or at all. Polish was the most common foreign language spoken at home with 477 speakers.

RELIGION

There were 8,483 Roman Catholics in the area at census time. A further 392 were adherents of other stated religions (e.g. Church of Ireland, Islam, Presbyterian, Orthodox), while 423 persons indicated that they had no religion.





THIS AREA: DUNGARVAN LEGAL TOWN AND ITS ENVIRONS

LABOUR FORCE

There were 4,410 persons aged 15 years and over in the labour force and of these, 76.5 per cent (3,372 persons) were at work. The unemployment rate for this area was 23.5 per cent compared with a national average rate of 19.0 per cent.

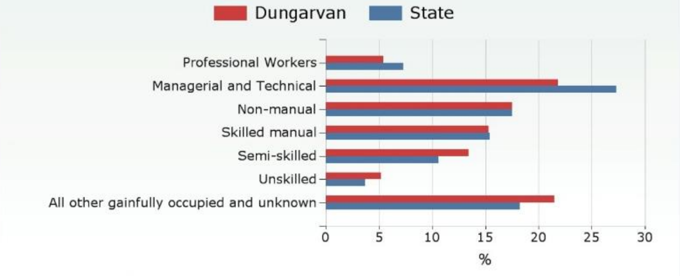
Of the 3,037 persons aged 15 years and over who were outside the labour force, 24.1 per cent were students, 21.7 per cent were looking after the home/family and 38.6 per cent were retired.

Of the 3,372 workers enumerated in Dungarvan, 1,238 worked outside the area. The daytime working population (resident and non-resident) of Dungarvan was 3,443 with commerce and trade being the largest industry.

EDUCATION

Of those aged 15 years and over whose full-time education had ceased, 17.8 per cent were educated to at most primary level only; a further 55.9 per cent attained second level while 26.3 per cent were educated to third level.

SOCIAL CLASS COMPARISON



TRAVEL TO WORK

The most popular means of travelling to work was by car (driver) with this mode accounting for 65.5 per cent of all journeys. 27 persons commuted using public transport (bus or rail). The average journey time was 20 minutes and 20.1 per cent of workers faced a commuting time in excess of 30 minutes.

DISABILITY AND CARERS

1,499 persons had a disablity in April 2011, of whom 605, representing 40.4 per cent of the total, were aged 65 years and over.

335 persons (124 males and 211 females) provided regular unpaid personal help for a friend or family member with a long-term illness, health problem or disability. 15.5 per cent of these provided care for more than 6 hours per day.

HOUSING, INTERNET AND CARS

91.6 per cent of households lived in houses or bungalows while a further 8.3 per cent lived in apartments, flats or bedsits. 2,174 dwellings (59.1 per cent) were owner occupied while 1,452 dwellings (39.5 per cent) were rented. 29.8 per cent of the dwellings in this area were built in the ten years before the census. The average number of persons per household was 2.5 compared with 2.7 nationally.

59.0 per cent of households had broadband connectivity compared with 63.8 per cent nationally. 31.0 per cent of households had two or more cars.

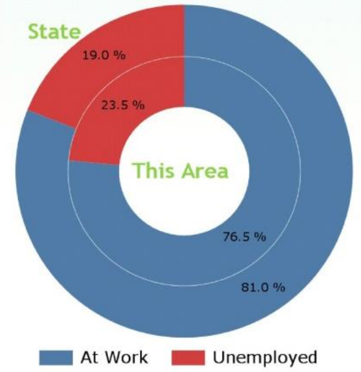
GENERAL HEALTH

In this area 8,136 persons stated they were in very good or good health, representing 86.3 per cent of total persons. This compares to 88.3 per cent of total persons nationally. 170 persons stated they were in bad or very bad health, representing 1.8 per cent of total persons in this area. Again this compares with 1.5 per cent of total persons nationally.

WORKERS BY INDUSTRY

Industry	Daytime Working Population
Agriculture, forestry and fishing	43
Building and construction	57
Manufacturing	286
Commerce and trade	1,184
Transport and communications	103
Public administration	367
Professional services	810
Other	593
Total	3,443

LABOUR FORCE



PERMANENT HOUSING STOCK

Dwelling Type	This Area	State
Occupied or Usually Occupied	3,802	1,705,394
Of which		
House or Bungalow	87.7%	84.7%
Flat, Apartment, Bedsit	8.1%	11.0%
Not Stated	4.2%	4.3%
Vacant	570	289,451
Of which		
Holiday Home	14.9%	20.5%
Other	85.1%	79.5%

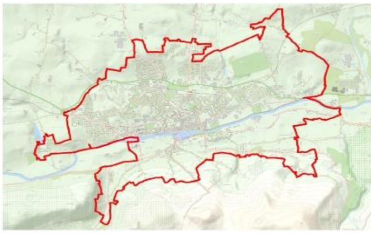
Source: Central Statistics Office, Census 2011 Area Profiles http://census.cso.ie/areaprofiles/

Control town

census 2011 RESULTS

AREA PROFILE FOR TOWN

CLONMEL LEGAL TOWN AND ITS ENVIRONS CO. SOUTH TIPPERARY/WATERFORD



AGE/SEX

In April 2011 Clonmel had a population of 17,908, consisting of 8,761 males and 9,147 females.

The population of pre-school age (0-4) was 1,292, of primary school going age (5-12) was 1,729 and of secondary school going age (13-18) was 1,332. There were 2,333 persons aged 65 years and over. The number of persons aged 18 years or over was 13,727.

MARITAL STATUS

Of the 14,399 persons aged 15 years and over, 6,095 were single, 6,280 were married, 657 were separated, 476 were divorced and 891 were widowed.

LIVING ARRANGEMENTS

There were 6,971 private households in Clonmel in April 2011, of which 1,873 were single person households. Of the 4,760 families in the area, 1,458 were couples with no children. The average number of children per family was 1.3 compared with 1.4 nationally.

HOUSEHOLDS BY COMPOSITION

	Clonmel		State
	No. of households	% breakdown	% breakdown
One Person	1,873	26.9	23.7
Couple without children	1,328	19.1	18.9
Couple with children	2,019	29.0	34.9
Lone parent family	934	13.4	10.9
Other	817	11.7	11.6
Total	6,971	100.0	100.0

MIGRATION AND NATIONALITIES

93.3 per cent of the usually resident population aged over 1 lived at the same address one year before the census. A further 4.4 per cent lived elsewhere in the same county, 1.4 per cent lived elsewhere in the State while 0.9 per cent lived outside the State twelve months before the census on April 10, 2011.

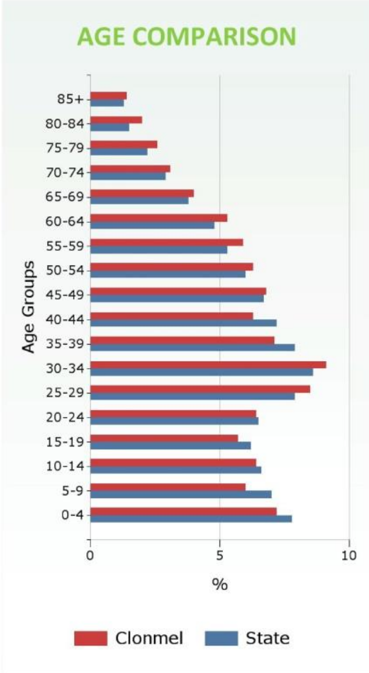
Non-Irish nationals accounted for 13.6 per cent of the population of Clonmel compared with a national average figure of 12.0 per cent. Polish (1,064 persons) were the largest group, followed by UK nationals (340 persons).

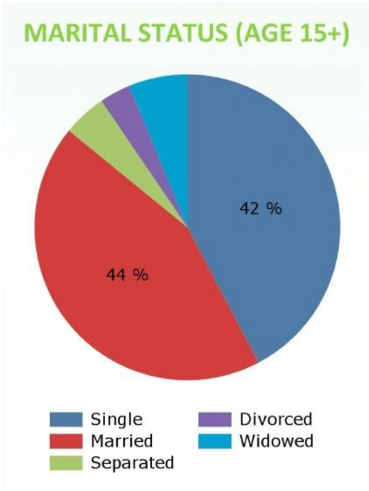
LANGUAGES

7,221 persons could speak the Irish language and of these 2,247 spoke the language daily. 2,390 persons spoke a language other than Irish or English at home and of these 470 could not speak English well or at all. Polish was the most common foreign language spoken at home with 1,034 speakers.

RELIGION

There were 15,927 Roman Catholics in the area at census time. A further 1,064 were adherents of other stated religions (e.g. Church of Ireland, Islam, Presbyterian, Orthodox), while 712 persons indicated that they had no religion.





THIS AREA: CLONMEL LEGAL TOWN AND ITS ENVIRONS

LABOUR FORCE

There were 8,705 persons aged 15 years and over in the labour force and of these, 80.0 per cent (6,961 persons) were at work. The unemployment rate for this area was 20.0 per cent compared with a national average rate of 19.0 per cent.

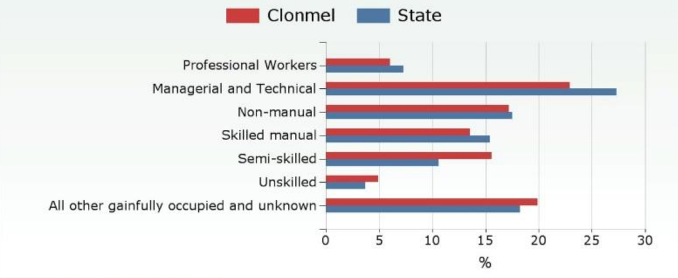
Of the 5,694 persons aged 15 years and over who were outside the labour force, 22.2 per cent were students, 23.9 per cent were looking after the home/family and 36.5 per cent were retired.

Of the 6,961 workers enumerated in Clonmel, 2,358 worked outside the area. The daytime working population (resident and non-resident) of Clonmel was 7,931 with professional services being the largest industry.

EDUCATION

Of those aged 15 years and over whose full-time education had ceased, 16.8 per cent were educated to at most primary level only; a further 57.4 per cent attained second level while 25.8 per cent were educated to third level.

SOCIAL CLASS COMPARISON



TRAVEL TO WORK

The most popular means of travelling to work was by car (driver) with this mode accounting for 67.6 per cent of all journeys. 60 persons commuted using public transport (bus or rail). The average journey time was 18 minutes and 12.3 per cent of workers faced a commuting time in excess of 30 minutes.

DISABILITY AND CARERS

2,930 persons had a disablity in April 2011, of whom 958, representing 32.7 per cent of the total, were aged 65 years and over.

792 persons (267 males and 525 females) provided regular unpaid personal help for a friend or family member with a long-term illness, health problem or disability. 24.6 per cent of these provided care for more than 6 hours per day.

HOUSING, INTERNET AND CARS

92.6 per cent of households lived in houses or bungalows while a further 7.3 per cent lived in apartments, flats or bedsits. 4,514 dwellings (64.9 per cent) were owner occupied while 2,360 dwellings (33.9 per cent) were rented. 18.9 per cent of the dwellings in this area were built in the ten years before the census. The average number of persons per household was 2.5 compared with 2.7 nationally.

61.8 per cent of households had broadband connectivity compared with 63.8 per cent nationally. 34.2 per cent of households had two or more cars.

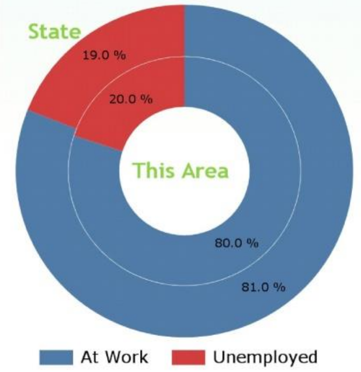
GENERAL HEALTH

In this area 15,478 persons stated they were in very good or good health, representing 86.4 per cent of total persons. This compares to 88.3 per cent of total persons nationally. 345 persons stated they were in bad or very bad health, representing 1.9 per cent of total persons in this area. Again this compares with 1.5 per cent of total persons nationally.

WORKERS BY INDUSTRY

Industry	Daytime Working Population
Agriculture, forestry and fishing	42
Building and construction	242
Manufacturing	756
Commerce and trade	2,440
Transport and communications	314
Public administration	764
Professional services	2,441
Other	932
Total	7,931

LABOUR FORCE



PERMANENT HOUSING STOCK

Dwelling Type	This Area	State
Occupied or Usually Occupied	7,156	1,705,394
Of which		
House or Bungalow	89.0%	84.7%
Flat, Apartment, Bedsit	7.0%	11.0%
Not Stated	4.0%	4.3%
Vacant	728	289,451
Of which		
Holiday Home	3.2%	20.5%
Other	96.8%	79.5%

Source: Central Statistics Office, Census 2011 Area Profiles http://census.cso.ie/areaprofiles/

Population density per square kilometre in intervention and control towns compared with European cities

Town/City	Km²	City	Km²
Ireland[1]		*Europe*[2]	
Intervention town 1	1825	Paris	3800
Intervention town 2	1116	Amsterdam	3200
Control town	1088	Brussels	2600
Dublin	3498	London	5900
		Copenhagen	2800

[1]Central Statistics Office (2015), [2]Demographia (2015)

1B Letters of ethical approval

Waterford Institute of Technology WIT

Institiúid Teicneolaíochta Phort Láirge
Waterford, Ireland.
TEL: +353-51-302000
WEB: www.wit.ie
EMAIL: info@wit.ie

Ref: 11/HSES/03

15th April, 2011.

Dr. Niamh Murphy,
Mr. Barry Lambe,
Department of Health, Sport & Exercise Science,
WIT.

Dear Niamh & Barry,

Thank you for bringing your project *'Evaluation of community interventions to increase active transport behaviour'* to the attention of the WIT Research Ethics Committee.

I am pleased to inform you that we approve WIT's participation in this project and we will convey this to Academic Council.

We wish you well in the work ahead.

Yours sincerely,

Dr. John Wells,
Chairperson,
Research Ethics Committee.

Institiúid Teicneolaíochta Phort Láirge | Waterford Institute *of* Technology

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Ref: 12/HSES/05

8th March, 2012.

Dr. Niamh Murphy,
Mr. Barry Lambe,
Department of Health, Sport & Exercise Science,
WIT.

Dear Niamh & Barry,

Thank you for bringing your project *'Evaluation of community interventions to increase active transport behaviour (studies 2+3)'* to the attention of the WIT Research Ethics Committee.

I am pleased to inform you that we approve WIT's participation in this project and we will convey this to Academic Council.

We would however ask that you submit the following to Suzanne Kiely (skiely@wit.ie) :

(a) A confidentiality agreement signed by all those involved in the research.

Yours sincerely,

Dr. Michael Harrison,
Acting Chairperson,
Research Ethics Committee

cc: Professor Adrian Bauman

Appendix 2

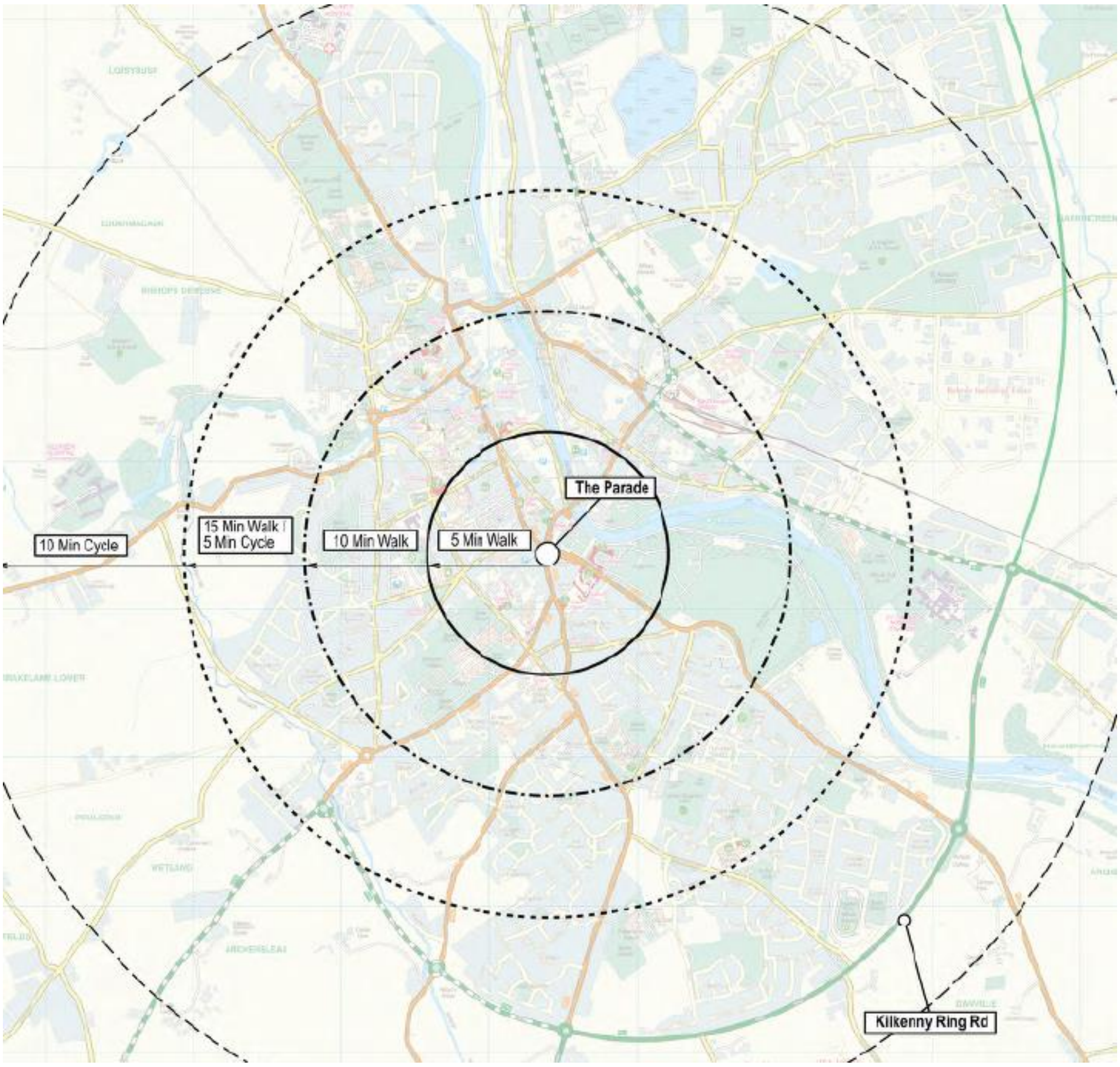
2A Description of community-wide interventions (2011-2013)

Town 1 (Kilkenny)

Inventory of active travel intervention components in town 1 (Kilkenny)

Ecological Level	Intervention Strategy
Policy	None identified
Physical environment	Completion of 12km shared pedestrian / cycleway on the ring road around the city
	Improvement works to 2km of existing cycleways /pedestrian footways on radial routes into the city
	Provision of bicycle stands in 3 city centre sites
	New 1.6km pedestrian boardwalk adjacent to river linking city centre with orbital ring road
	Construction of 4 new cycle tracks in city centre
	5 new pedestrian crossing points and improvements to 2 existing crossing points
	Urban realm improvements, footpath improvements and additional crossing points on main street.
Social environment (Interpersonal)	*Childcare services*
	'Walking to school' promotion at family fun day targeting parents of pre-schoolers.
	Primary schools
	'Sprocket Rocket' cycling skills training delivered to 230 children
	Secondary schools / Post-leaving certificate courses
	'Smarter Travel' themed poster and essay writing competition culminating in 'Smarter Travel' schools walk (500 participants – both primary and secondary)
	Intensive active travel intervention in one all-girls school (see chapter 5)
	Workplaces
	4-week step challenge in 8 workplaces (248 participants)
	Community

	None identified
Individual (Intrapersonal)	‘Smarter Travel’ themed family fun days in June 2011 and June 2012 as part of ‘Bike Week’ (see poster below). The aim of these events was to raise awareness of the ‘Smarter Travel’ programme in the city. The events were held in the city centre on closed streets and included activities such as organised walks and cycles, cycle training, bike servicing, novelty active travel related demonstrations / races and music. The awareness raising was also extended beyond the event day itself. Approximately 10,000 leaflets were delivered to households to both advertise the event but also to promote awareness of travel times by foot or bike around the city and the associated cost savings. 100 posters were displayed throughout the city centre and press releases were printed in the local newspaper and broadcast on local radio. Several hundred primary school-children also committed to walking or cycling to school during bike week in return for free ‘Smarter Travel Kilkenny’ branded t-shirts and sweatshirts. Signage encouraging active travel was displayed around the city centre road network for the week before the event. Approximately 2-3000 people were engaged on the day of each event. ‘Smarter Travel Kilkenny’ information cabin at Christmas Market. Primary aim was to raise awareness of the ‘Smarter Travel’ messages and to promote active travel Several print media stories and radio interviews (approximately 12 of each) covering the activities of the ‘Smarter Travel’ working group.



Walking and cycling times in intervention town 1

Come join the fun

smarter travel »»

changing the way kilkenny moves

By changing our everyday journeys we can get around quicker, save money and add to our health & well-being. The table below provides some information that may be useful to you in your everyday trips around Kilkenny.

FAMILY FUN DAY – Saturday 25th June 2011

FROM	TO	km	WALKING	CYCLING	DRIVING TIME	Avg Cost DRIVING	Avg SAVINGS €
Callan Road Roundabout	Parade	1.4	16min	6min	3min	0.28c	145.60
Bennettsbridge Road Roundabout	Parade	1.6	19min	6min	2min	0.32c	166.40
Kells Road Roundabout	Parade	1.8	22min	7min	4min	0.36c	187.20
Hebron Road Roundabout	Parade	2.3	28min	9min	7min	0.46c	239.20
Johnswell Road Roundabout	Parade	2.6	31min	10min	8min	0.52c	270.40
New Orchard Road Roundabout	Parade	2.9	35min	12min	8min	0.58c	301.60
Castlecomer Road Roundabout	Parade	3.3	39min	13min	6min	0.66c	343.20
Waterford Road roundabout	Parade	1.9	23min	8min	3min	0.38c	197.60
McDonagh Junction	Parade	0.9	10min	4min	2min	0.18c	93.60
Dublin / Carlow Road Roundabout	Parade	2	24min	8min	6min	0.4c	208.00
Watershed	Parade	2.1	25min	8min	4min	0.42c	218.40
Purcellsinch Business Park	Parade	3.1	37min	12min	4min	0.62c	322.40
St Lukes Hospital	Parade	2.2	26min	9min	6min	0.44c	228.80
Full Ring Road							
from Callan Rd to 'Comer Rd roundabout		7.9	94.8min	32min	9min	1.58c	821.60
Linear Park - Riverside Drive to Weir & Back		4.8	57.6min	19min	n/a		
Outer Lap of Castle Park		1.9	23min	8min	n/a		

Walking time in min (avg 1km - 12 minutes)
Cycling time in min (avg spd 15km ph or 4 minutes per km)
Driving time taken between 1 & 3pm on Tue May 31st 2011
Avg cost in cents if driving (av family car ref AA Ireland)
Avg savings based on (10 trips per week) annually

DID YOU KNOW
We have 50km of bicycle lanes and 65 bicycle parking spaces in the city

Bicycle Parking Locations:
Market Yard, Canal Square, The Parade, Friary Street, County Hall, The Library Johns Quay, Kieran Street, Johns Green

This day is organised by the Kilkenny Smarter Travel Office whose aim is to promote and encourage people to get around by walking, cycling, using public transport and other forms of sustainable transport.

trailKilkenny

»» SMARTER TRAVEL - CHANGING THE WAY KILKENNY MOVES

Family fun day poster from intervention town 1

Posters with promotional messages that were displayed in the view of motorists in the lead up to the family fun day

Examples of the promotional messages displayed

You are not stuck in traffic; you are traffic! Get a bike & Break Free!

Average rainfall in Kilkenny is less than Amsterdam where the cycling rate is ten times more than here. Get a bike. Break Free!

The health benefits of cycling outweigh the risks by TWENTY to ONE... 'Smarter Travel'!

49% of primary school-children would like to cycle to school but only 5% actually do. Get a bike. Break Free!

Driving just 30km every week in 2012 will cost you about €440

In a hurry? Cycling is not as slow as you think; sometimes it's faster than driving!

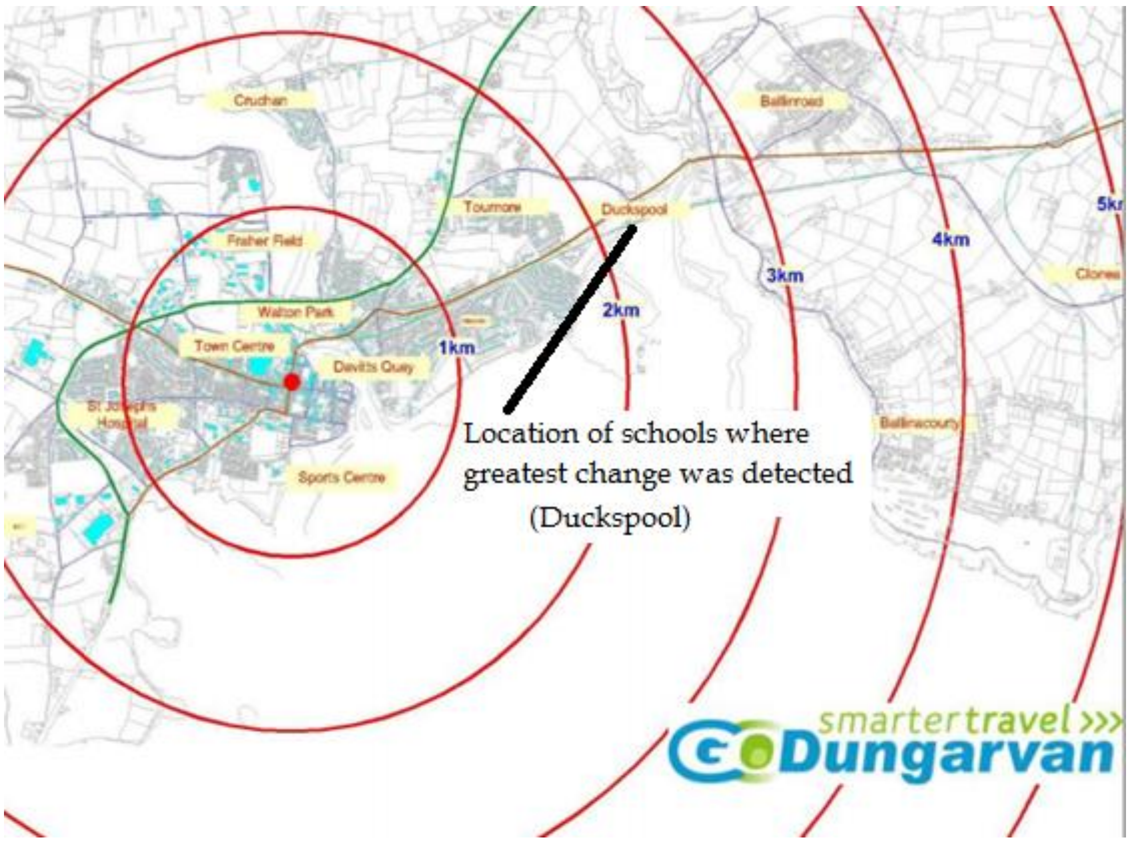
Town 2 (Dungarvan)

Inventory of active travel intervention components in town 2 (Dungarvan)

Ecological Level	Intervention Strategy
Policy	None identified
Physical environment	*May 2011-April 2012*
	3,939m of bidirectional off road cycle and pedestrian routes **(conversion of old railway track linking schools with residential areas and town centre – see photos below)**
	Lighting installed on the entire length of the old railway track
	2,610m of single direction on road cycle lanes
	10 raised pedestrian /cycle zebra crossings
	2 Pelican crossings
	May 2012-April 2013
	New network of pedestrian and cycling facilities connecting the old railway track to several other local areas
	Traffic calming in a residential neighbourhood
	Cycle lanes and traffic calming on the main road into the town
	Bike parking for 32 bikes at local sports centre
	Sheltered and secure bike parking at food festival
	Bicycle recycling project facilitated by local project for ex-offenders. Recycled bikes, repairs and upgrades provided at affordable prices.
Social environment (Interpersonal)	*Childcare services*
	'Smarter Travel' art competition in childminding service providers
	Beep Beep Day – balance bikes and other sports activities for children attending childcare facilities. Children arrived by walking bus to a central venue (n = 60).
	Active travel themed storytelling session for pre-schoolers. Arrived to a central venue by walking school buses
	Road safety awareness session for toddlers
	Balance Bike fun event in park for under 5's
	Primary schools
	Bike Week promotional events 2012 - cycle training for primary school teachers, students and their parents in 2 schools (3-6th class students, n

	= 170). School cycling buses organised on 3 days 195 students from 5 primary schools received the Sprocket Rocket cycling skills training GO School Smart Challenge – 3 week active travel competition. 3 schools, 310 students. Prizes for top class, top performer and most improved performer. Students received rain jackets and gloves. 85% of students walked, cycled or car-shared every day of the 3-week programme. 'Smarter Travel' education and activity day for winning school Peer education in schools as part of road safety awareness week. Safety messages were related to helmet and reflective clothing use. 'Smarter Travel' Seminar for the 9 primary schools in the area. A 'Smarter Travel' co-ordinator was appointed in each school. School principals and the co-ordinators attended the seminar. *Secondary schools / Post-leaving certificate courses* Intensive multi-strategic project with 1st year boys (n=24) – introduction of e-books, provision of bikes, sheltered bike parking, rain gear, high visibility clothing, cycle helmets, cycling training, bicycle maintenance and audits of routes to school Students from 4 secondary schools conducted walkability audits of their primary routes to school 24 PLC (post-secondary school) students trained as tutors to deliver Cycling Irelands 'Sprocket Rocket' cycling skills training *Workplaces* Sponsorship of 'Smarter Travel Green Business Award' Presentation to GSK (large pharmaceutical factory in the area) to develop a workplace travel plan. *Community* GO Dungarvan 4km Santa Cycle (n=<30) Bike smoothie maker at family picnic day in the park GO Dungarvan 1km timed cycle challenge in aid of the Lions Club (held in Dungarvan Shopping Centre). Local athletic club 'Winter League'. Prizes were awarded to competitors that walked, cycles or car-shared to the 16 evenings of the event. 103 signed up. 42% chose smarter travel for 10 or more nights.
Individual (Intrapersonal)	Publication of quarterly newsletter Creation of GO Dungarvan brand, website (including costs savings

	calculator) and Facebook page
	Social media competitions
	GO Dungarvan float in St. Patricks Day Parade (2011 + 2012)
	Competition for the best 3 'Smarter Travel' themed floats in the GO St. Patricks Day Parade (2013). Cash prizes totalling €1000
	Funding of local GP Exercise Referral Scheme
	Sponsorships – local radio daily chat show, local 12km leisure cycle event, large local 10 mile road race (including competitor information on Smarter Travel options for attending the race), local food festival
	Ticket subsidy for those travelling to food festival launch meal by bike (27 of 150 attendees cycled).
	Free coffee and ice-cream vouchers for those using temporary bike parking
	Identification of local 'Smarter Travel' champions who are profiled of social media; Olympic medal winner, parent who transports her children by cargo bike and local celebrity food chef



Distance from town centre in intervention town 2

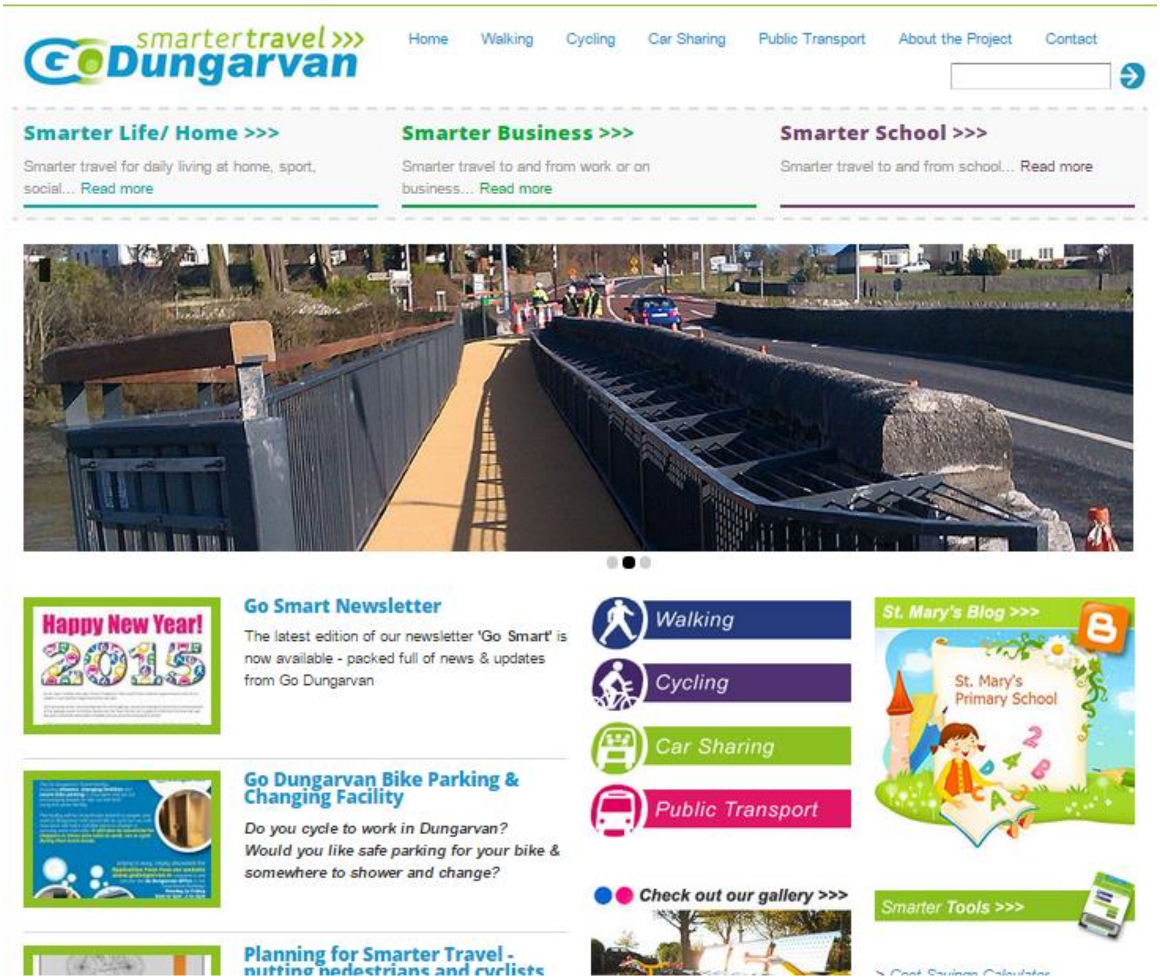
Converted railway line for active travel near town centre in intervention town 2

Converted railway line for active travel near schools in Duckspool area in intervention town 2

Converted railway line for active travel near schools in Duckspool area in intervention town 2

Footpaths and cycle lanes near schools in Duckspool area in intervention town 2

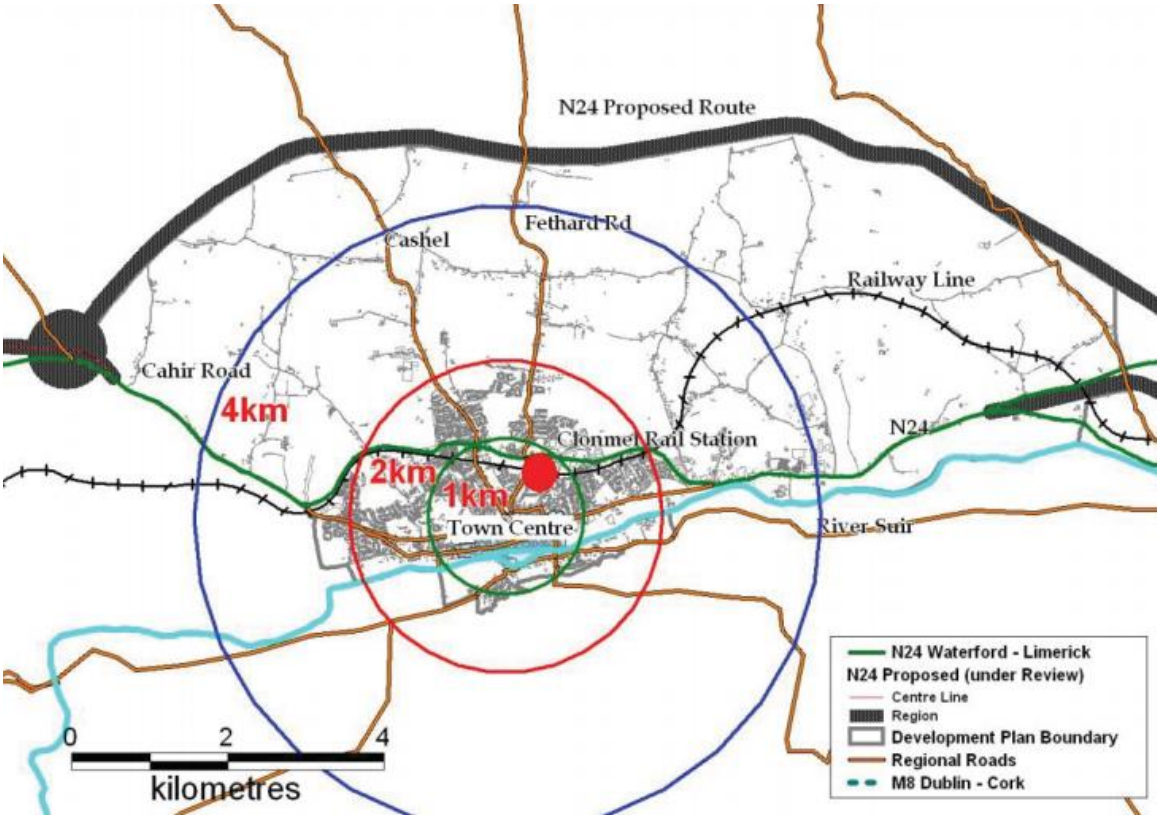
Footpaths and cycle lanes near schools in Duckspool area in intervention town 2



The project website - GODungarvan.ie

The project newsletter

Control town (Clonmel)



Distance from town centre in the control town

2B Cost of on-street car parking*

	< 1 hour	per hour
Intervention town 1	1st 15 minutes = 50c	€1.50 (per 2 hours)
	15-30 minutes = €1.00	
Intervention town 2	1st 30 minutes = free	€1.10
Control town	Not applicable	€1.00

*There are also several free car parks (either for 1 hour or all day) within 500-1000m of each town centre. These are closest to the centre in town 2. Source: www.parkopedia & www.theaa.ie

2C National fuel prices 2010-2013

	Unleaded Petrol (€)	Diesel (€)
2010	1.33	1.24
2011	1.51	1.43
2012	1.63	1.54
2013	1.57	1.48

Source: www.theaa.ie

2D National car ownership rates per 1000 adults 2010-2013

2010	2011	2012	2013	Average annual % growth
521	525	524	533	0.8

Source: SEAI (2014)

Appendix 3

3A Parent information letter and questionnaire

Waterford Institute of Technology

The Councils of the City and County of Kilkenny

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Kilkenny Recreation & Sports Partnership

Information about a student 'Smarter Travel' survey

Dear Parent / Guardian

Your child has been selected to complete a short survey in school on physical activity. This short information letter is to help answer any questions you might have.

What is the study about?
Kilkenny Borough Council is working to increase the number of people who are walking and cycling for transport in the town. In April 2011, we did a survey on their behalf to measure the amount of walking and cycling for transport that both adults and children were doing. We are repeating this survey in April and May of this year to measure any changes that have occurred over the 2 years. As part of this, we are asking a sample of children from all the schools in the town to fill out a short questionnaire about the amount and type of physical activity they do.

What will happen if I allow my child to participate?
If you allow your child to participate they will be asked to complete a short questionnaire during class time. Only researchers involved with this study will have access to your child's information. However your child will not write down their name so they will be anonymous. All the same, all the results will be stored in a secure and locked location, either in a locked filing cabinet or on a laptop. It is important that you understand this information and that you are free to request that your child does not complete the questionnaire.

What do I need to do now?

a) If you are happy for your child to complete the questionnaire then you have nothing to do.
b) If you have further questions about the study e.g. you would like to see the questions, then don't hesitate to contact me (see contact details below).
c) If you would just rather your child DID NOT complete the questionnaire, then please contact me directly (see contact details below).

Thanks for taking the time to read this and please don't hesitate to contact me if you have any further questions.

Barry Lambe
Niamh Richardson
Tel: 051 834097
Email: blambe@wit.ie

Office use only
School code:
Class:

Active Kilkenny Survey

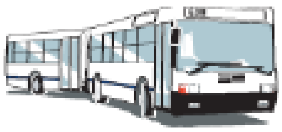
1. Are you a: Boy ❑ or Girl ❑

2. What age are you? ________

3. What class are you in? 5th ❑ or 6th ❑

4. How do you usually travel to school?



Walk ❑ Cycle ❑ Car ❑ Bus ❑

5. How long does your journey to school usually take?

________________ Minutes

6. How would you prefer to travel to school?

Walk ❑ Cycle ❑ Car ❑ Bus ❑

7. How do you usually travel home from school?

Walk ❑ Cycle ❑ Car ❑ Bus ❑

8. How long does your journey home from school usually take?

________________ Minutes

9. How would you prefer to travel home from school?

Walk ❑ Cycle ❑ Car ❑ Bus ❑

10. Do you own a bicycle? Yes ❑ No ❑

The questions on the next page, ask you about exercise. Exercise can be things like running, dancing, basketball, football, hurling, athletics or swimming. Basically any activity that makes your heart rate much faster and you have to breathe deeper and faster than normal. Also, you would probably sweat doing these types of activities.

11. OUTSIDE SCHOOL HOURS: How often do you usually exercise in your free time so much that you get out of breath or sweat?

Every day.................................❑

4 to 6 times a week..............❑

2 to 3 times a week..............❑

Once a week...........................❑

Once a month.........................❑

Less than once a month.......❑

Never......................................❑

12. OUTSIDE SCHOOL HOURS: How many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?

None...❑

About half an hour................❑

About 1 hour...........................❑

About 2 to 3 hours................❑

About 4 to 6 hours................❑

About 7 hours or more.........❑

13. How many times do you have PE per week? *Please tick one box only*

0 ❑ 1 ❑ 2❑ 3 ❑ 4 ❑ 5 times ❑

14. In this question, we want to know about things you have done in the <u>last 7 days</u> that involve sitting down.

For each activity listed, answer these 3 questions

1. Did you do this activity in the past 7 days? Tick NO ☑ or YES ☑
2. **If yes**, on how many days did you do the activity?
3. On average, how long did you do this activity for on the days that you did it

Sitting down activities	Have you done this activity in the last 7 days? NO	YES	Number of Days in the last 7 days	How much time did you spend doing it? None	Half an hour	1 hour	2 hours	More than 3 hours
a. Using the computer	❑	❑	________	❑	❑	❑	❑	❑
b. Homework, studying......................	❑	❑	________	❑	❑	❑	❑	❑
c. Reading (not for school)...............	❑	❑	________	❑	❑	❑	❑	❑
d. Sitting during school breaks.......	❑	❑	________	❑	❑	❑	❑	❑
e. Sitting and talking with................ friends (not on phone), listening to music	❑	❑	________	❑	❑	❑	❑	❑
f. Talking on the phone......................	❑	❑	________	❑	❑	❑	❑	❑
g. Watching TV or DVD's.................	❑	❑	________	❑	❑	❑	❑	❑
h. Other (specify).............................	❑	❑	________	❑	❑	❑	❑	❑

Questions about promoting walking and cycling in Kilkenny

15. Has your school done anything to promote **walking or cycling to school?**

Yes ❑

No ❑ → skip to question 18

I don't know ❑ → skip to question 18

16. **Did it have a name?**

____

17. **What did they do?**

____

____

____

____

18. **Have you noticed any changes in the town to make it easier for people to walk or cycle?**

Yes ❑

No ❑ → you are finished

I don't know ❑ → you are finished

19. What changes have you noticed?

Thank you very much for your help

3B Additional data

Students actual travel mode by town and gender at baseline

	Intervention town 1		Intervention town 2		Control town	
	Male % (n=344)	Female % (n=325)	Male % (n=141)	Female % (n=164)	Male % (n=229)	Female % (n=225)
TO school						
Walk	26.6	32.0	22.9	25.4	19.9	20.7
Cycle	7.5	1.8	6.4	2.9	2.2	0.0
Car	56.5	52.1	61.1	63.0	71.3	71.6
Bus	9.5	14.2	9.6	8.7	6.6	7.8
FROM school						
Walk	33.7	38.2	28.0	37.2	34.8	37.7
Cycle	8.2	1.8	7.6	2.2	2.8	0.0
Car	46.8	46.2	53.5	48.9	51.1	53.2
Bus	11.4	13.9	10.8	11.7	11.2	9.1

Students actual travel mode by town and gender at follow-up

	Intervention town 1		Intervention town 2		Control town	
	Male % (n=402)	Female % (n=338)	Male % (n=181)	Female % (n=232)	Male % (n=157)	Female % (n=138)
TO school						
Walk	26.9	28.7	26.2	23.6	22.2	16.4
Cycle	5.3	1.5	11.3	5.5	2.6	0.4
Car	59.6	62.0	60.3	67.9	71.7	72.4
Bus	8.2	7.7	2.1	3.0	3.5	10.7
FROM school						
Walk	35.2	37.2	33.3	27.4	30.1	28.0
Cycle	4.9	1.5	12.1	4.9	3.1	0.9
Car	50.9	52.0	53.2	63.4	62.4	60.9
Bus	9.0	9.2	1.4	4.3	4.4	10.2

Students preferred travel mode by town and gender at baseline

	Intervention town 1		Intervention town 2		Control town	
	Male % (n = 403)	Female % (n = 336)	Male % (n = 157)	Female % (n = 138)	Male % (n = 183)	Female % (n = 235)
TO school						
Walk	24.1	26.2	15.9	20.3	16.9	28.1
Cycle	49.6	52.7	51.6	60.1	60.1	40.9
Car	22.8	15.8	29.3	15.9	20.8	25.1
Bus	3.5	5.4	3.2	3.6	2.2	6.0
FROM school						
Walk	27.5	26.5	18.6	24.6	25.5	31.5
Cycle	45.3	50.9	52.6	50.7	52.2	34.9
Car	23.0	18.8	26.3	20.3	18.5	27.7
Bus	4.2	3.9	2.6	4.3	3.8	6.0

Students preferred travel mode by town and gender at follow-up

	Intervention town 1		Intervention town 2		Control town	
	Male % (n = 345)	Female % (n = 326)	Male % (n = 140)	Female % (n = 167)	Male % (n = 230)	Female % (n = 225)
TO school						
Walk	25.2	26.7	19.3	16.8	25.7	30.2
Cycle	42.9	51.8	52.9	53.9	49.1	32.4
Car	27.5	18.7	27.1	17.4	23.9	29.3
Bus	4.3	2.8	0.7	12.0	1.3	8.0
FROM school						
Walk	26.7	27.1	24.3	22.2	26.1	32.0
Cycle	39.5	47.1	52.1	48.5	42.2	29.3
Car	27.9	20.3	23.6	19.8	30.4	33.3
Bus	5.8	5.5	0.0	9.6	1.3	5.3

The effect of the intervention on the proportion of students that would prefer to walk or cycle to and from school in intervention town 1 vs control

	Intervention town 1				Control town				Absolute change
	Pre % (n)	Post % (n)	% Diff	95 % CI	Pre % (n)	Post % (n)	% Diff	95 % CI	Difference in differences (95 % CI)
TO school									
Male	73.7 (297)	68.1 (235)	-5.6	-12.1, 0.9	77.0 (183)	74.8 (172)	-2.3	-10.4, 6.1	-3.31 (-13.9, 7.2)
Female	78.9 (265)	78.5 (256)	-0.3	-6.6, 5.9	68.9 (162)	62.7 (141)	-6.3	-14.8, 2.4	5.93 (-4.7, 16.6)
Total	76.0 (562)	73.2 (491)	-2.9	-7.4, 1.7	72.5 (303)	68.8 (313)	-3.7	-9.7, 2.4	0.82 (-6.7, 8.4)
FROM school									
Male	72.8 (294)	66.3 (228)	-6.5	-13.1, 0.1	77.7 (143)	68.3 (157)	-9.5	-17.7, 0.8	2.96 (-7.8, 13.7)
Female	77.4 (260)	74.2 (241)	-3.2	-9.7, 3.3	66.4 (156)	61.3 (138)	-5.1	-13.7, 3.7	1.82 (-9.1, 12.8)
Total	74.9 (554)	70.1 (469)	**-4.8**	**-9.4, -0.1**	71.4 (299)	64.8 (295)	**-6.5**	**-12.6, -0.3**	1.76 (-5.9, 9.5)

(n) denotes the number of participants that equates to the given percentage; All % differences in this table are absolute differences

Percentage of students that report participating in vigorous exercise 4 or more times per week in intervention town 1 vs control

	Intervention town 1				Control town				Absolute change
	Pre % (n)	Post % (n)	% Diff	95 % CI	Pre % (n)	Post %(n)	% Diff	95 % CI	Difference in differences (95 % CI)
Male	84.7 (343)	79.9 (275)	-4.8	-10.3, 0.7	83.7 (154)	74.3 (171)	**-9.4**	**-16.9, -1.4**	4.6 (-4.9, 14.1)
Female	80.5 (272)	77.1 (253)	-3.3	-9.5, 2.9	66.0 (155)	56.9 (128)	**-9.1**	**-17.8, -0.2**	5.73 (-5.1, 16.6)
Total	82.8 (615)	78.6 (528)	-4.2	-8.3, -0.1	73.7 (309)	65.7 (299)	**-8.0**	**-14.0, -1.9**	3.83 (-3.5, 11.2)

(n) denotes the number of participants that equates to the given percentage; All % differences in this table are absolute differences

Percentage of students that report participating in vigorous exercise 4 or more times per week in intervention town 2 vs control

	Intervention town 2				Control town				Absolute change
	Pre % (n)[1]	Post % (n)	% Diff	95 % CI	Pre % (n)	Post % (n)	% Diff	95 % CI	Difference in differences (95 % CI)
Male	80.8 (126)	80.0 (112)	-0.8	-9.9, 8.2	83.7 (154)	74.3 (171)	**-9.4**	**-16.9, -1.4**	8.58 (-3.4, 20.5)
Female	73.9 (102)	77.2 (129)	3.3	-6.2, 13.1	66.0 (155)	56.9 (128)	**-9.1**	**-17.8, -0.2**	12.4 (-0.7, 25.5)
Total	77.6 (228)	78.5 (241)	0.9	-5.7, 7.6	73.7 (309)	65.7 (299)	**-8.0**	**-14.0, -1.9**	8.98 (0.0, 17.9)

(n) denotes the number of participants that equates to the given percentage; All % differences in this table are absolute differences

Appendix 4

4A Parent information letter and questionnaire

Waterford Institute of Technology | The Councils of the City and County of Kilkenny | Feidhmeannacht na Seirbhíse Sláinte Health Service Executive | Kilkenny Recreation & Sports Partnership

Information about a student 'Smarter Travel' survey

Dear Parent / Guardian

Your child has been selected to complete a short survey in school on physical activity. This short information letter is to help answer any questions you might have.

What is the study about?
Kilkenny Borough Council is working to increase the number of people who are walking and cycling for transport in the town. In April 2011, we did a survey on their behalf to measure the amount of walking and cycling for transport that both adults and children were doing. We are repeating this survey in April and May of this year to measure any changes that have occurred over the 2 years. As part of this, we are asking a sample of children from all the schools in the town to fill out a short questionnaire about the amount and type of physical activity they do.

What will happen if I allow my child to participate?
If you allow your child to participate they will be asked to complete a short questionnaire during class time. Only researchers involved with this study will have access to your child's information. However your child will not write down their name so they will be anonymous. All the same, all the results will be stored in a secure and locked location, either in a locked filing cabinet or on a laptop. It is important that you understand this information and that you are free to request that your child does not complete the questionnaire.

What do I need to do now?

a) If you are happy for your child to complete the questionnaire then you have nothing to do.
b) If you have further questions about the study e.g. you would like to see the questions, then don't hesitate to contact me (see contact details below).
c) If you would just rather your child DID NOT complete the questionnaire, then please contact me directly (see contact details below).

Thanks for taking the time to read this and please don't hesitate to contact me if you have any further questions.

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Waterford Institute of Technology

The Councils of the City and County of Kilkenny

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Kilkenny Recreation & Sports Partnership

Office use only
School code:
Class:

Active Kilkenny Adolescent Survey

Questions about you

1. **What year are you in?** 1st ❑ 2nd ❑ 5th ❑

2. **Are you** Male ❑ Female❑

3. **What age are you?** _______ (years)

Questions about how active you are

The following questions are about all the **walking, vigorous and moderate physical activities** that you did **for at least 10 uninterrupted minutes in the last 7 days**.

Please do not include those activities that took less than 10 minutes per occasion. By the last 7 days we mean 5 school days and 2 weekend days.

The questions are divided into four groups and ask questions about

- physical activities you did during school time,
- physical activities you did in and around your home like housework and gardening
- physical activities you did to get to and from places,
- physical activities you did during leisure time (physical activities during play, sports, dancing, exercise and competition).

Physical Activity in School

This part is about the physical activities you did over the last 7 days during school hours (during class and during break-time). Transportation to and from school are NOT included.

A. During PE classes

4. How many classes (in school hours) of PE did you have during the last seven days?

❍ none	❍ 1	❍ 2	❍ 3	❍ 4	❍ Other ______

How much time did you spend in TOTAL during these PE classes on **physical activities** such as sport, running, playing or dancing? Give the total for the whole week, but count only the occasions that you were active for at least 10 uninterrupted minutes.

_____**hours** _____**minutes physical activity during the last 7 days**

B. During breaks

5. During the last 7 days, on how many days did you do the following, during **breaks** at school, **for at least 10 uninterrupted minutes?** Don't include activities that took less than 10 uninterrupted minutes.

WALK?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days **walking**?

_____**hours** _____**minutes per day**

VIGOROUS physical activity, that takes hard physical effort and makes you breathe much harder than normal, like running?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days doing **vigorous physical activities**?

_____**hours** _____**minutes per day**

MODERATE physical activity, that takes moderate physical effort and makes you breathe somewhat harder than normal, like dancing?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days doing **moderate physical activities?**

___**hours** ___**minutes per day**

Housework and Gardening

This part is about physical activity that you might have been done during the last 7 days in and around the house.

6. **During the last 7 days, on how many days did you do, for at least 10 uninterrupted minutes, physical activities in the garden or at home that took at least moderate physical effort and made you breathe somewhat or much harder than normal like carrying heavy loads, scrubbing floors or sweeping.** Don't include activities that took less than 10 uninterrupted minutes.

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍ 7 days

How much time did you usually spend on those activities in the home and yard on such a day?

___**hours** ___**minutes per day**

Transport Physical Activity

These questions are about how you travelled from place to place during the last 7 days. It includes places like school, the shops, the cinema, and so on.

7. During the **last 7 days**, on how many days did you **travel for at least 10 uninterrupted minutes ...** Don't include activities that took less than 10 uninterrupted minutes.

... **IN A MOTOR VEHICLE** like a train, bus or car?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend on one of those days **travelling by motor vehicles?**

___**hours** ___**minutes per day**

... **WITH A BICYCLE ?**

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍ 7 days

How much time did you usually spend on one of those days **cycling** from place to place?

___**hours** ___**minutes per day**

... **BY FOOT?**

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend walking from place to place on one of those days

___**hours** ___**minutes per day**

Recreation, Sport and Leisure-time Physical Activity

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned!!!

8. During the last 7 days on how many days did you do one of the following **for at least 10 uninterrupted minutes in your leisure time**? Don't include activities that took less than 10 uninterrupted minutes!

WALK?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend on one of those days **walking** in your leisure time?

_____**hours** _____**minutes per day**

MODERATE physical activity, that takes moderate physical effort and makes you breathe somewhat harder than normal, like dancing?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend on one of those days doing **moderate physical activity** in your leisure time?

_____**hours** _____**minutes per day**

VIGOROUS physical activity, that takes hard physical effort and makes you breathe much harder than normal, like running?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend on one of those days doing **vigorous physical activity** in your leisure time?

_____**hours** _____**minutes per day**

Questions about promoting walking and cycling in Kilkenny

9. Have you ever heard of a campaign to promote walking or cycling in Kilkenny?

Yes ❑

No ❑ → skip to question 12

I don't know ❑ → skip to question 12

10. What was it called?

____

11. What were the main messages or events surrounding this campaign?

____

____

____

12. Have you noticed any changes in the town to make it easier to walk or cycle for transport?

Yes ☐

No ☐ → ***skip to question 14***

I don't know ☐ → ***skip to question 14***

13. What changes have you noticed?

____

____

____

Questions about how you travel to school

14. How do you usually travel **TO** school? i.e. think about the longest part of your journey

Walk ❍   Cycle ❍   Car ❍   Bus❍

15. How would you **prefer** to travel **TO** school?

Walk ❍   Cycle ❍   Car ❍   Bus❍

16. How long does your journey take from your home to the school gate?

______ Minutes

17. Can you estimate the distance from your home to the school gate?

______ Kilometres

If you only know the distance in miles you can give your answer here _____

18. Do you own or have access to a bicycle that is in working order?   Yes ❍   No ❍

Thank you very much for your help

4B Additional data

Log10 transformed data for average daily minutes per day (mean, SD) of domain specific, total and MVPA physical activity pre and post in intervention towns 1+2 (pooled data) vs control

	Intervention town 1+2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA	0.95	0.94	-0.01	-0.09, 0.07	0.99	0.91	-0.08	-0.17, 0.01	0.44
(n, SD)	(1287, 1.03)	(1180, 1.06)	(2.08)		(881, 0.99)	(853, 1.02)	(2.01)		
Secondary[1]									
School PA	1.43	1.44	0.01	-0.04, 0.06	1.48	1.51	0.03	-0.02, 0.08	0.70
(n, SD)	(1331, 0.65)	(1240, 0.74)	(1.37)		(925, 0.53)	(889, 0.47)	(1.00)		
Home PA	0.78	0.99	0.21	-0.4, 0.82	0.82	0.94	**0.12**	**0.03, 0.21**	0.32
(n, SD)	(1264, 1.03)	(1121, 1.01)	(2.03)		(865, 0.98)	(840, 0.97)	**(1.95)**		
Leisure PA	1.63	1.51	-0.12	-0.19, -0.05	1.64	1.60	-0.04	-0.12, 0.04	0.29
(n, SD)	(1301, 0.83)	(1135, 0.95)	(1.74)		(878, 0.77)	(857, 0.84)	(1.60)		
Total PA	2.06	2.00	**-0.06**	**-0.1, -0.02**	2.02	2.04	0.02	-0.02, 0.06	0.04
(n, SD)	(1332, 0.38)	(1249, 0.58)	**(0.90)**		(927, 0.44)	(890, 0.41)	(0.85)		
MVPA	1.82	1.80	-0.02	-0.07, 0.03	1.77	1.83	**0.06**	**0.02, 0.1**	0.07
(n, SD)	(1332, 0.54)	(1248, 0.63)	(1.15)		(927, 0.47)	(890, 0.45)	**(0.92)**		

[1]Bonferroni correction applied to secondary variables

Log10 transformed data for domain specific, total and MVPA physical activity (average minutes per day) pre and post-intervention in intervention town 1 vs control

	Intervention town 1				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	1.01 (704, 1.03)	0.97 (573, 1.04)	-0.04 (2.03)	-0.15, 0.07	0.99 (881, 0.99)	0.91 (853, 1.02)	-0.08 (2.01)	-0.17, 0.01	0.71
Secondary[1]									
School PA (n, SD)	1.41 (719, 0.70)	1.47 (591, 0.66)	0.06 (1.35)	-0.01, 0.13	1.48 (925, 0.53)	1.51 (889, 0.47)	0.03 (1.00)	-0.02, 0.08	0.64
Home PA (n, SD)	0.80 (677, 1.03)	0.94 (532, 1.02)	**0.14 (2.01)**	**0.02, 0.26**	0.82 (865, 0.98)	0.94 (840, 0.97)	**0.12 (1.95)**	**0.03, 0.21**	0.86
Leisure PA (n, SD)	1.65 (699, 0.81)	1.49 (538, 0.94)	**-0.16 (1.65)**	**-0.26, -0.06**	1.64 (878, 0.77)	1.60 (857, 0.84)	-0.04 (1.60)	-0.12, 0.04	0.18
Total PA (n, SD)	2.07 (720, 0.37)	2.00 (599, 0.63)	**-0.07 (0.89)**	**-0.12, -0.02**	2.02 (927, 0.44)	2.04 (890, 0.41)	0.02 (0.85)	-0.02, 0.06	0.04
MVPA (n, SD)	1.83 (720, 0.54)	1.80 (598, 0.65)	-0.03 (1.14)	-0.09, 0.03	1.77 (927, 0.47)	1.83 (890, 0.45)	**0.06 (0.92)**	**0.02, 0.1**	0.11

[1]Bonferroni correction applied to secondary variables

Log10 transformed data for domain specific, total and MVPA physical activity (average minutes per day) pre and post-intervention in intervention town 2 vs control

	Intervention town 2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	0.88 (583, 1.03)	0.91 (607, 1.08)	0.03 (2.11)	-0.09, 0.15	0.99 (881, 0.99)	0.91 (853, 1.02)	-0.08 (2.01)	-0.17, 0.01	0.32
Secondary[1]									
School PA (n, SD)	1.47 (612, 0.59)	1.41 (649, 0.80)	-0.06 (1.36)	-0.14, 0.02	1.48 (925, 0.53)	1.51 (889, 0.47)	0.03 (1.00)	-0.02, 0.08	0.16
Home PA (n, SD)	0.75 (587, 1.04)	1.03 (589, 1.01)	**0.28 (2.05)**	**0.16, 0.4**	0.82 (865, 0.98)	0.94 (840, 0.97)	**0.12 (1.95)**	**0.03, 0.21**	0.14
Leisure PA (n, SD)	1.61 (602, 0.84)	1.54 (597, 0.95)	-0.07 (1.78)	-0.17, 0.03	1.64 (878, 0.77)	1.60 (857, 0.84)	-0.04 (1.60)	-0.12, 0.04	0.74
Total PA (n, SD)	2.04 (612, 0.40)	2.02 (650, 0.52)	-0.02 (0.91)	-0.05, 0.01	2.02 (927, 0.44)	2.04 (890, 0.41)	0.02 (0.85)	-0.02, 0.06	0.39
MVPA (n, SD)	1.80 (612, 0.54)	1.80 (650, 0.61)	0 (1.15)	-0.06, 0.06	1.77 (927, 0.47)	1.83 (890, 0.45)	**0.06 (0.92)**	**0.02, 0.1**	0.28

[1]Bonferroni correction applied to secondary variables

Average daily minutes (mean, SD) of domain specific, total and MVPA physical activity in intervention towns (pooled data) versus control

	Intervention towns 1+2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA	36.8	38.0	1.2	-2.71, 5.11	37.0	33.4	-3.6	-8.1, 0.90	0.27
(n, SD)	(1287, 49.1)	(1180, 50.0)	(98.7)		(881, 49.6)	(853, 45.7)	(95.2)		
Secondary[1]									
School PA	48.0	54.5	**6.5**	**2.83, 10.17**	47.3	47.7	0.4	-3.39, 4.19	0.11
(n, SD)	(1331, 41.7)	(1240, 52.8)	**(91.5)**		(925, 42.0)	(889, 40.3)	(82.3)		
Home PA	27.0	36.6	**9.6**	**6.27, 12.93**	26.2	30.5	**4.3**	**0.73, 7.87**	0.13
(n, SD)	(1264, 38.5)	(1121, 44.4)	**(80.9)**		(865, 37.2)	(840, 37.9)	**(74.4)**		
Leisure PA	93.2	86.3	**-6.9**	**-13.59, -0.21**	89.4	89.3	-0.1	-7.76, 7.56	0.36
(n, SD)	(1301, 84.6)	(1135, 83.3)	**(166.9)**		(878, 81.3)	(857, 81.3)	(162.5)		
Total PA	151.9	157.7	**5.8**	**0.09, 11.51**	146.9	150.3	3.4	-5.95, 12.75	0.79
(n, SD)	(1332, 102.4)	(1249, 101.4)	**(203.5)**		(927, 102.5)	(890, 100.6)	(203.0)		
MVPA	100.6	107.2	**6.6**	**0.44, 12.76**	88.6	97.6	**9.0**	**2.34, 15.66**	0.72
(n, SD)	(1332, 74.9)	(1248, 84.6)	**(157.4)**		(927, 71.7)	(890, 73.1)	**(144.5)**		

[1]Bonferroni correction applied to secondary variables

Average daily minutes (mean, SD) of domain specific, total and MVPA physical activity in intervention town 1 versus control

	Intervention town 1				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	40.3 (704, 51.7)	38.3 (573, 49.5)	-2.0 (100.1)	-6.07, 2.07	37.0 (881, 49.6)	33.4 (853, 45.7)	-3.6 (95.2)	-8.1, 0.90	0.76
Secondary[1]									
School PA (n, SD)	48.8 (719, 42.4)	53.4 (591, 51.4)	4.6 (89.2)	-0.48, 9.68	47.3 (925, 42.0)	47.7 (889, 40.3)	0.4 (82.3)	-3.39, 4.19	0.36
Home PA (n, SD)	27.3 (677, 37.6)	33.5 (532, 40.7)	**6.2 (75.5)**	**1.77, 10.63**	26.2 (865, 37.2)	30.5 (840, 37.9)	**4.3 (74.4)**	**0.73, 7.87**	0.65
Leisure PA (n, SD)	95.4 (699, 86.6)	80.3 (538, 77.7)	**-15.1 (162.7)**	**-24.42, -5.78**	89.4 (878, 81.3)	89.3 (857, 81.3)	-0.1 (162.5)	-7.76, 7.56	0.09
Total PA (n, SD)	156.5 (720, 103.8)	157.9 (599, 109.7)	1.4 (209.0)	-10.16, 12.96	146.9 (927, 102.5)	150.3 (890, 100.6)	3.4 (203.0)	-5.95, 12.75	0.85
MVPA (n, SD)	103.7 (720, 75.6)	107.2 (598, 83.0)	3.5 (154.2)	-5.08, 12.08	88.6 (927, 71.7)	97.6 (890, 73.1)	**9.0 (144.5)**	**2.34, 15.66**	0.49

[1]Bonferroni correction applied to secondary variables

Average daily minutes (mean, SD) of domain specific, total and MVPA physical activity in intervention town 2 versus control

	Intervention town 2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	32.6 (583, 45.5)	37.7 (607, 50.5)	5.1 (95.8)	-0.37, 10.57	37.0 (881, 49.6)	33.4 (853, 45.7)	-3.6 (95.2)	-8.1, 0.90	0.09
Secondary[1]									
School PA (n, SD)	47.1 (612, 40.9)	55.4 (649, 54.0)	8.3 (93.3)	-23.49, 40.09	47.3 (925, 42.0)	47.7 (889, 40.3)	0.4 (82.3)	-3.39, 4.19	0.09
Home PA (n, SD)	26.7 (587, 39.6)	39.4 (589, 47.3)	**12.7 (85.9)**	**7.71, 17.69**	26.2 (865, 37.2)	30.5 (840, 37.9)	**4.3 (74.4)**	**0.73, 7.87**	0.06
Leisure PA (n, SD)	90.6 (602, 82.3)	91.8 (597, 87.8)	1.2 (169.6)	-8.44, 10.84	89.4 (878, 81.3)	89.3 (857, 81.3)	-0.1 (162.5)	-7.76, 7.56	0.88
Total PA (n, SD)	146.5 (612, 100.5)	157.5 (650, 113.1)	11.0 (213.2)	-0.84, 22.84	146.9 (927, 102.5)	150.3 (890, 100.6)	3.4 (203.0)	-5.95, 12.75	0.49
MVPA (n, SD)	97.0 (612, 74.1)	107.2 (650, 86.1)	**10.2 (159.6)**	**1.3, 19.1**	88.6 (927, 71.7)	97.6 (890, 73.1)	**9.0 (144.5)**	**2.34, 15.66**	0.88

[1]Bonferroni correction applied to secondary variables

Log10 transformed data (mean, SD) for domain specific, total and MVPA physical activity in adolescent males in intervention town 2 versus control

	Intervention town 2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	0.98 (285, 1.05)	0.98 (311, 1.11)	0 (2.16)	-0.17, 0.17	1.15 (360, 0.97)	1.01 (408, 1.00)	-0.14 (1.96)	-0.28, 0.00	0.39
Secondary[1]									
School PA (n, SD)	1.56 (303, 0.52)	1.51 (342, 0.78)	-0.05 (1.26)	-0.15, 0.05	1.58 (389, 0.43)	1.57 (426, 0.50)	-0.01 (0.93)	-0.07, 0.05	0.64
Home PA (n, SD)	0.80 (291, 1.10)	1.05 (303, 1.03)	**0.25 (2.12)**	**0.08, 0.42**	0.84 (348, 1.06)	0.96 (404, 0.95)	0.12 (1.96)	-0.92, 1.16	0.42
Leisure PA (n, SD)	1.69 (296, 0.85)	1.57 (308, 1.00)	-0.12 (1.84)	-0.27, 0.03	1.75 (356, 0.81)	1.67 (407, 0.82)	-0.08 (1.62)	-0.20, 0.04	0.77
Total PA (n, SD)	2.10 (303, 0.39)	2.05 (343, 0.56)	-0.05 (1.85)	-0.13, 0.03	2.10 (390, 0.46)	2.11 (427, 0.39)	0.01 (0.83)	-0.05, 0.07	0.59
MVPA (n, SD)	1.94 (303, 0.44)	1.87 (343, 0.60)	-0.07 (1.03)	-0.14, 0.00	1.86 (390, 0.49)	1.90 (427, 0.45)	0.04 (0.93)	-0.02, 0.1	0.14

[1]Bonferroni correction applied to secondary variables

Average daily minutes (mean, SD) of domain specific, total and MVPA physical activity in adolescent males in intervention town 2 versus control

	Intervention town 2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	38.7 (285, 48.2)	45.8 (311, 57.4)	7.1 (105.1)	-1.47, 15.67	48.1 (360, 56.6)	38.7 (408, 48.4)	**-9.4 (102.0)**	**-16.84, -1.96**	**0.045***
Secondary[1]									
School PA (n, SD)	53.9 (303, 43.9)	66.1 (342, 58.9)	**12.2 (101.6)**	**1.04, 23.36**	54.4 (389, 45.2)	54.4 (426, 42.2)	0 (86.5)	-6.01, 6.01	0.10
Home PA (n, SD)	31.8 (291, 42.3)	42.5 (303, 49.7)	**10.7 (91.4)**	**3.25, 18.15**	32.3 (348, 43.5)	30.7 (404, 38.8)	-1.6 (80.2)	-7.49, 4.29	0.07
Leisure PA (n, SD)	104.7 (296, 89.0)	103.4 (308, 93.4)	-1.3 (182.1)	-15.89, 13.29	112.8 (356, 89.9)	99.0 (407, 84.0)	**-13.8 (171.1)**	**-26.17, -1.43**	0.37
Total PA (n, SD)	168.5 (303, 106.7)	174.9 (343, 117.5)	6.4 (223.8)	-11.03, 23.83	176.1 (390, 110.5)	166.3 (427, 101.5)	-9.8 (209.4)	-24.36, 4.76	0.33
MVPA (n, SD)	119.7 (303, 79.5)	120.4 (343, 90.1)	0.7 (169.3)	-12.5, 13.9	108.2 (390, 80.0)	110.8 (427, 76.7)	2.6 (155.5)	-8.16, 13.36	0.88

[1]Bonferroni correction applied to secondary variables, *p<0.05

Log10 transformed data (mean, SD) for domain specific, total and MVPA physical activity in adolescent females in intervention town 2 versus control

	Intervention town 2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA	0.78	0.84	0.06	-0.06, 0.18	0.87	0.81	-0.06	-0.19, 0.07	0.28
(n, SD)	(298, 0.01)	(295, 1.04)	(1.04)		(520, 0.99)	(445, 1.02)	(1.98)		
Secondary[1]									
School PA	1.38	1.28	-0.1	-0.22, 0.02	1.40	1.45	0.05	-0.01, 0.11	0.10
(n, SD)	(309, 0.64)	(306, 0.81)	(1.42)		(535, 0.58)	(463, 0.44	(1.01)		
Home PA	0.70	1.00	**0.3**	**0.14, 0.46**	0.81	0.92	0.11	-0.01, 0.23	0.19
(n, SD)	(296, 0.97)	(285, 0.98)	**(1.94)**		(517, 0.92)	(436, 0.98)	(1.86)		
Leisure PA	1.53	1.50	-0.03	-0.17, 0.11	1.56	1.54	-0.02	-0.12, 0.08	0.93
(n, SD)	(306, 0.83)	(288, 0.90)	(1.71)		(521, 0.74)	(450, 0.85)	(1.54)		
Total PA	1.97	1.97	0	-0.07, 0.07	1.96	1.99	0.03	-0.02, 0.08	0.62
(n, SD)	(309, 0.39)	(306, 0.47)	(0.85)		(536, 0.42)	(463, 0.43)	(0.84)		
MVPA	1.67	1.72	0.05	-0.05, 0.15	1.71	1.77	0.06	0.00, 0.12	0.90
(n, SD)	(309, 0.58)	(306, 0.62)	(1.2)		(536, 0.45)	(463, 0.45)	(0.89)		

[1]Bonferroni correction applied to secondary variables

Average daily minutes (mean, SD) of domain specific, total and MVPA physical activity in adolescent females in intervention town 2 versus control

	Intervention town 2				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	26.9 (298, 41.9)	29.2 (295, 40.4)	2.3 (82.1)	-4.34, 8.94	29.4 (520, 42.6)	28.5 (445, 42.4)	-0.9 (84.0)	-6.29, 4.49	0.60
Secondary[1]									
School PA (n, SD)	40.5 (309, 36.5)	43.0 (306, 44.4)	2.5 (79.6)	-3.93, 8.93	42.0 (535, 38.8)	41.5 (463, 37.4)	-0.5 (75.8)	-5.25, 4.25	0.60
Home PA (n, SD)	21.6 (296, 36.0)	35.7 (285, 43.8)	**14.1 (78.1)**	**7.58, 20.62**	22.2 (517, 31.8)	30.3 (436, 37.2)	**8.1 (66.5)**	**3.71, 12.49**	0.28
Leisure PA (n, SD)	77.0 (306, 72.9)	78.6 (288, 78.5)	1.6 (150.1)	-10.6, 13.8	73.5 (521, 70.7)	80.4 (450, 77.8)	6.9 (145.3)	-2.46, 16.26	0.63
Total PA (n, SD)	125.0 (309, 89.2)	137.5 (306, 104.1)	12.5 (191.1)	-2.85, 27.85	125.8 (536, 90.8)	135.5 (463, 97.7)	9.7 (185.1)	-2.01, 21.41	0.84
MVPA (n, SD)	74.7 (309, 60.7)	91.9 (306, 78.4)	**17.2 (135.6)**	**6.10, 28.3**	74.4 (536, 61.5)	85.4 (463, 67.4)	**11.0 (126.2)**	**2.99, 19.01**	0.52

[1]Bonferroni correction applied to secondary variables

Log10 transformed data (mean, SD) for domain specific, total and MVPA physical activity in adolescent females in intervention town 1 versus control

	Intervention town 1				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA	0.85	0.86	0.01	-0.14, 0.15	0.87	0.81	-0.06	-0.19, 0.07	0.68
(n, SD)	(378, 1.05)	(431, 1.08)	(2.12)		(520, 0.99)	(445, 1.02)	(1.98)		
Secondary[1]									
School PA	1.18	1.42	**0.24**	**0.14, 0.34**	1.40	1.45	0.05	-0.01, 0.11	0.03
(n, SD)	(383, 0.79)	(443, 0.70)	**(1.45)**		(535, 0.58)	(463, 0.44)	(1.01)		
Home PA	0.73	0.97	**0.24**	**0.1, 0.38**	0.81	0.92	0.11	-0.01, 0.23	0.35
(n, SD)	(360, 1.03)	(393, 0.98)	**(1.99)**		(517, 0.92)	(436, 0.98)	(1.86)		
Leisure PA	1.56	1.43	**-0.13**	**-0.25, -0.01**	1.56	1.54	-0.02	-0.12, 0.08	0.34
(n, SD)	(375, 0.80)	(402, 0.96)	**(1.75)**		(521, 0.74)	(450, 0.85)	(1.54)		
Total PA	1.99	1.96	-0.03	-1.0, 0.04	1.96	1.99	0.03	-0.02, 0.08	0.34
(n, SD)	(384, 0.37)	(449, 0.66)	(0.98)		(536, 0.42)	(463, 0.43)	(0.84)		
MVPA	1.76	1.78	0.02	-0.07, 0.12	1.71	1.77	0.06	0.00, 0.12	0.60
(n, SD)	(384, 0.60)	(448, 0.68)	(1.28)		(536, 0.45)	(463, 0.45)	(0.89)		

[1]Bonferroni correction applied to secondary variables

Average daily minutes (mean, SD) of domain specific, total and MVPA physical activity in adolescent females in intervention town 1 versus control

	Intervention town 1				Control town				Change in int vs change in control
Outcome variables	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
Primary									
Transport PA (n, SD)	33.3 (378, 47.0)	33.3 (432, 45.3)	0 (91.2)	-6.37, 6.37	29.4 (520, 42.6)	28.5 (445, 42.4)	-0.9 (84.0)	-6.29, 4.49	0.88
Secondary[1]									
School PA (n, SD)	33.9 (383, 34.3)	49.8 (443, 49.7)	**15.9 (82.5)**	**10.14, 21.66**	42.0 (535, 38.8)	41.5 (463, 37.4)	-0.5 (75.8)	-5.25, 4.25	**0.003***
Home PA (n, SD)	24.7 (360, 35.3)	32.6 (393, 38.2)	**7.9 (73.4)**	**2.65, 12.15**	22.2 (517, 31.8)	30.3 (436, 37.2)	**8.1 (66.5)**	**3.71, 12.49**	0.97
Leisure PA (n, SD)	79.2 (375, 76.9)	72.9 (403, 70.0)	-6.3 (145.2)	-16.66, 4.06	73.5 (521, 70.7)	80.4 (450, 77.8)	6.9 (145.3)	-2.46, 16.26	0.19
Total PA (n, SD)	131.1 (384, 96.6)	150.4 (450, 108.6)	**19.3 (204.8)**	**5.37, 33.23**	125.8 (536, 90.8)	135.5 (463, 97.7)	9.7 (185.1)	-2.01, 21.41	0.48
MVPA (n, SD)	95.2 (384, 76.3)	104.8 (449, 83.2)	9.6 (159.0)	-1.24, 20.44	74.4 (536, 61.5)	85.4 (463, 67.4)	**11.0 (126.2)**	**2.99, 19.01**	0.89

[1]Bonferroni correction applied to secondary variables, *$p<0.05$

Students actual travel mode by town and gender at follow-up.

	Intervention town 1		Intervention town 2		Control town	
	Male (n = 140)	Female (n = 450)	Male (n = 336)	Female (n = 306)	Male (n = 421)	Female (n = 460)
Walk	29.3	14.4	17.6	15.0	14.7	8.5
Cycle	7.9	0.4	6.5	1.3	2.6	0.2
Car	47.9	55.8	57.4	68.0	64.6	68.0
Bus	15.0	29.3	18.5	15.7	18.1	23.3

Students preferred travel mode by town and gender at follow-up.

	Intervention town 1		Intervention town 2		Control town	
	Male (n = 145)	Female (n = 449)	Male (n = 327)	Female (n = 304)	Male (n = 418)	Female (n = 454)
Walk	27.6	22.0	17.4	24.7	16.5	19.2
Cycle	32.4	19.2	30.9	20.1	26.1	13.4
Car	31.7	45.2	41.6	46.7	48.1	54.4
Bus	8.3	13.6	10.1	8.6	9.3	13.0

Appendix 5

5A Parent information letters, participant questionnaire, topic guide

Information about the school 'Smarter Travel' study

Dear Parent / Guardian

In April of last year, we did a survey for Kilkenny Borough Council to measure the amount of walking and cycling for transport that adults and children in Kilkenny are doing. Our next step is to try and encourage more teenage girls to walk or cycle to school. Before we can do that, we would like to find out a little more about their physical activity and travel behaviours. We hope to do this by giving a questionnaire to every student in the school (in April 2012 and April 2013) and by having discussion groups with smaller groups of students.

Here's some more information to help you understand the study:

What is the research for?

1. To measure how much physical activity (particularly walking or cycling for transport) teenage girls in Kilkenny do.
2. To find out what things influence how they travel to school e.g. weather, time, safety etc.
3. To measure whether promoting active travel in school can increase the number of students that walk or cycle for transport

What will happen if I allow my child to participate?

If you allow your child to participate they will be asked to complete a short questionnaire during class time. They may also be selected to join a small group discussion (with me and their teacher) about the things that influence how they travel to school. Only researchers involved with the study will have access to your child's information. Your child will not need to give us their name. All the same, the results will be stored in a secure location, either in a locked filing cabinet or on a laptop. It is important that you understand this information and that you are free to request that your child does not participate in the study.

What do I need to do now?

a) If you are happy for your child to participate then you have nothing to do.
b) If you have further questions about the study e.g. you would like to see the questions, then don't hesitate to contact me (see contact details below).
c) If you would just rather your child DID NOT participate, then please contact me directly. Once I have your child's name and class I will ensure your child doesn't participate in the study.

Thanks for taking the time to read this and please don't hesitate to contact me if you have any further questions.

Barry Lambe
Niamh Richardson
Tel: 051 834097
Email: blambe@wit.ie

Waterford Institute of Technology

The Councils of the City and County of Kilkenny

Kilkenny Recreation & Sports Partnership

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'Leg it to Loreto' Survey

Questions about you

1. What year are you in?

   1st ❍ 2nd ❍ 3rd ❍ TY ❍ 5th ❍ 6th ❍

2. What age are you? _______ (years)

3. How well off do you think your family is?

   Very well off ❍
   Quite well off ❍
   Average ❍
   Not very well off ❍
   Not at all well off ❍

4. What is your home address? *Don't forget the house number if it has one!*

   ____

   ____

   ____

Questions about how you travel TO school

5. How do you usually travel **TO** school? i.e. think about the longest part of your journey

   Walk ❍ Cycle ❍ Car ❍ Bus❍

6. How would you **prefer** to travel **TO** school?

   Walk ❍ Cycle ❍ Car ❍ Bus❍

7. How long does your journey take from your home to the school gate?

   ______ Minutes

8. Can you estimate the distance from your home to the school gate?

   ______ Kilometres

   If you only know the distance in miles you can give your answer here _____

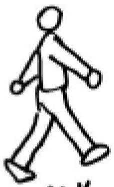
9. Do you own or have access to a bicycle? Yes ❍ No ❍

Questions about your thoughts on active travel

10. To what extent do you agree with the following statements about CYCLING to school?

	Agree strongly	Agree	Neither	Disagree	Disagree strongly
Cycling to school would be too tiring	❍	❍	❍	❍	❍
Cycling to school is not safe	❍	❍	❍	❍	❍
I am confident in my cycling ability	❍	❍	❍	❍	❍
I hate wearing a cycle helmet	❍	❍	❍	❍	❍
I don't like to cycle when the weather is bad	❍	❍	❍	❍	❍
I have lots of stuff to carry to school	❍	❍	❍	❍	❍
I couldn't be bothered cycling to school	❍	❍	❍	❍	❍
Cycling to school would take too long	❍	❍	❍	❍	❍
My friends would think I looked stupid if I cycled to school	❍	❍	❍	❍	❍
The clothes I wear make it hard to cycle	❍	❍	❍	❍	❍
Other students would think I looked stupid if I cycled to school	❍	❍	❍	❍	❍
My friends cycle to school	❍	❍	❍	❍	❍
Driving is the easiest way to get to school	❍	❍	❍	❍	❍
My parents/guardians encourage me to cycle to places	❍	❍	❍	❍	❍
Cycling to school would ruin my hair	❍	❍	❍	❍	❍
My parents/guardians are happy to drive me to school	❍	❍	❍	❍	❍
Cycling to school would ruin my make-up	❍	❍	❍	❍	❍
I worry about my bicycle being stolen in school	❍	❍	❍	❍	❍
There is a safe cycling route from my house to school	❍	❍	❍	❍	❍
There is a direct cycling route from my house to school	❍	❍	❍	❍	❍
I live too far away from school to cycle	❍	❍	❍	❍	❍

11. To what extent do you agree with the following statements about WALKING to school?



	Agree strongly	Agree	Neither	Disagree	Disagree strongly
Walking to school would be too tiring	❍	❍	❍	❍	❍
I don't like to walk when the weather is bad	❍	❍	❍	❍	❍
I have lots of stuff to carry to school	❍	❍	❍	❍	❍
I couldn't be bothered walking to school	❍	❍	❍	❍	❍
Walking to school would take too long	❍	❍	❍	❍	❍
My friends would think I looked stupid if I walked to school	❍	❍	❍	❍	❍
Other students would think I looked stupid if I walked to school	❍	❍	❍	❍	❍
My friends walk to school	❍	❍	❍	❍	❍
Driving is the coolest way to get to school	❍	❍	❍	❍	❍
My parents/guardians encourage me to walk to places	❍	❍	❍	❍	❍
Walking to school would ruin my hair	❍	❍	❍	❍	❍
My parents/guardians are happy to drive me to school	❍	❍	❍	❍	❍
Walking to school would ruin my make-up	❍	❍	❍	❍	❍
There is a safe walking route from my house to school	❍	❍	❍	❍	❍
There is a direct walking route from my house to school	❍	❍	❍	❍	❍
I live too far away from school to walk	❍	❍	❍	❍	❍

Questions about how active you are

The following questions are about all the **walking, vigorous and moderate physical activities** that you did **for at least 10 uninterrupted minutes in the last 7 days**.

Please do not include those activities that took less than 10 minutes per occasion. By the last 7 days we mean 5 school days and 2 weekend days.

The questions are divided into four groups and ask questions about

- physical activities you did during school time,
- physical activities you did in and around your home like housework and gardening
- physical activities you did to get to and from places,
- physical activities you did during leisure time (physical activities during play, sports, dancing, exercise and competition).

Physical Activity in School

This part is about the physical activities you did over the last 7 days during school hours (during class and during break-time). Transportation to and from school are **NOT** included.

A. During PE classes

12. How many **classes** (in school hours) of PE did you have during the last seven days?

❍ none ❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ Other ______

How much time did you spend in TOTAL during these PE classes on **physical activities** such as sport, running, playing or dancing? Give the total for the whole week, but count only the occasions that you were active for at least 10 uninterrupted minutes.

_____hours _____minutes physical activity during the last 7 days

5

B. During breaks

13. During the last 7 days, on how many days did you do the following, during **breaks** at school, **for at least 10 uninterrupted minutes?** Don't include activities that took less than 10 uninterrupted minutes.

WALK?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days **walking?**

_____**hours** _____**minutes per day**

VIGOROUS physical activity, that takes hard physical effort and makes you breathe much harder than normal, like running?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days doing **vigorous physical activities?**

_____**hours** _____**minutes per day**

MODERATE physical activity, that takes moderate physical effort and makes you breathe somewhat harder than normal, like dancing?

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days doing **moderate physical activities?**

___**hours** ___**minutes per day**

Housework and Gardening

This part is about physical activity that you might have been done during the last 7 days in and around the house.

14. During the last 7 days, on how many days did you do, for at least 10 uninterrupted minutes, physical activities in the garden or at home that took at least moderate physical effort and made you breathe somewhat or much harder than normal like carrying heavy loads, scrubbing floors or sweeping. Don't include activities that took less than 10 uninterrupted minutes.

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍ 7 days

How much time did you usually spend on those activities in the home and yard on such a day?

___hours ___minutes per day

Transport Physical Activity

These questions are about how you travelled from place to place during the last 7 days. It includes places like school, the shops, the cinema, and so on.

15. During the **last 7 days**, on how many days did you **travel for at least 10 uninterrupted minutes ...** Don't include activities that took less than 10 uninterrupted minutes.

... IN A MOTOR VEHICLE like a train, bus or car?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend on one of those days **travelling by motor vehicles?**

___hours ___minutes per day

... WITH A BICYCLE ?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍ 7 days

How much time did you usually spend on one of those days **cycling** from place to place?

___hours ___minutes per day

... BY FOOT?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend walking from place to place on one of those days

___**hours** ___**minutes per day**

Recreation, Sport and Leisure-time Physical Activity

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned!!!

16. During the last 7 days on how many days did you do one of the following **for at least 10 uninterrupted minutes in your leisure time?** Don't include activities that took less than 10 uninterrupted minutes!

WALK?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend on one of those days **walking** in your leisure time?

_____**hours** _____**minutes per day**

MODERATE physical activity, that takes moderate physical effort and makes you breathe somewhat harder than normal, like dancing?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend on one of those days doing **moderate physical activity** in your leisure time?

_____**hours** _____**minutes per day**

VIGOROUS physical activity, that takes hard physical effort and makes you breathe much harder than normal, like running?

❍none	❍1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days	❍ 6 days	❍7 days

How much time did you usually spend on one of those days doing **vigorous physical activity** in your leisure time?

_____**hours** _____**minutes per day**

Questions about promoting walking and cycling in Kilkenny and in your School

17. Has your school done anything to promote **walking or cycling to school?**

Yes ❑

No ❑ → skip to question 20

I don't know ❑ → skip to question 20

18. What was it called? ______________________________

19. What did they do?

____

____

____

20. Have you ever heard of a campaign to promote walking or cycling in Kilkenny?

Yes ❑

No ❑ → You're finished

I don't know ❑ → You're finished

21. What was it called? ____

22. What were the main messages or events surrounding this campaign?

____

____

____

Thanks for your help

Schools (pre) Intervention Focus Group Topic Guide

What's involved?

This is a chat about the things that influence the way you travel to school; one conversation at a time, everyone can give their opinion; recorded and typed up after but names and places will be taken out; not compulsory

Why?

To help design an active travel project in the school i.e. encourage more students to walk or cycle to school. Discussion groups will help us understand the things that influence the choices teenage girls make about how they travel to school. – walking, cycling, car, bus etc.

Who?

Centre for Health Behaviour Research in Waterford Institute of Technology

Topics:

Tell me about your usual / typical journey to school

What was it like when you last walked / cycled to school?

What things would make you want to get a lift instead of walking / cycling?

What would be good about walking / cycling to school?

What would make it easier?

Prompts:

Walking versus cycling; time, distance, clothes, hair and make-up, safety, access to bike, type of bike, cycle lanes, what others would think, parents, sweat, effort, bike security, bags, weather, lazy

Schools (mid) Intervention Focus Group Topic Guide

What's involved?

This is a chat about the things that influence the way you travel to school and what you thought of the bike training and the incentive scheme; one conversation at a time; everyone can give their opinion; recorded and typed up after but names and places will be taken out; not compulsory

Why?

To help design an active travel project in the school i.e. encourage more students to walk or cycle to school. Discussion groups will help us understand the things that influence the choices teenage girls make about how they travel to school. – walking, cycling, car, bus etc.

Who?

Centre for Health Behaviour Research in Waterford Institute of Technology

Topics:

Tell me about your usual/typical journey to school

What was it like when you last walked / cycled to school?

What things would make you want to get a lift instead of walking / cycling?

What would be good about walking / cycling to school? / What would make it easier?

What did you think of the bike training? What do you remember about it? Cycling through town in traffic? Confidence to cycle before/after?

What do you think of the 'Leg it to Loreto' challenge? What other incentives would work? How easy has it been to walk/cycle to do the challenge?

How have the Samsung tablets worked out for you? Changed the way you travel? Made life any easier/harder for you? 2nd years – compared to last year, have the tablets changed anything about your typical day?

Prompts: *Walking versus cycling; time, distance, clothes, hair and make-up, safety, access to bike, type of bike, cycle lanes, what others would think, parents, sweat, effort, bike security, bags, weather, lazy*

Intervention: *type of incentives, confident about cycling before/after*

5B Additional data

Percentage of participants travelling to school by mode type

	Intervention School								Control School							
	Pre % (n)				Post % (n)				Pre % (n)				Post % (n)			
	Walk	Cycle	Car	Bus	Walk	Cycle	Car	Bus	Walk	Cycle	Car	Bus	Walk	Cycle	Car	Bus
Total	13.6 (85)	0.3 (2)	57.4 (359)	28.6 (179)	14.6 (91)	1.0 (6)	56.5 (353)	28.0 (175)	19.1 (85)	0.2 (1)	55.6 (247)	25.0 (111)	17.0 (75)	0.2 (1)	58.9 (259)	23.9 (105)
1st year	11.3 (14)	0 (0)	50.0 (62)	38.7 (48)	21.4 (30)	1.4 (2)	52.9 (74)	24.3 (34)	20.7 (17)	0 (0)	50.0 (41)	29.3 (24)	17.0 (15)	0 (0)	55.7 (49)	27.3 (24)
2nd year	12.1 (16)	0 (0)	61.4 (81)	26.5 (35)	12.2 (17)	0.7 (1)	48.2 (67)	38.8 (54)	18.2 (10)	0 (0)	58.2 (32)	23.6 (13)	11.4 (5)	0 (0)	61.4 (27)	27.3 (12)
3rd year	19.0 (24)	0 (0)	57.1 (72)	23.8 (30)	13.7 (14)	1.0 (1)	58.8 (60)	26.5 (27)	12.4 (12)	0 (0)	61.9 (60)	25.8 (25)	17.5 (17)	0 (0)	63.9 (62)	18.6 (18)
4th year	12.6 (11)	2.3 (2)	57.5 (50)	27.6 (24)	16.7 (10)	3.3 (2)	56.7 (34)	23.3 (14)	23.9 (17)	1.4 (1)	54.9 (39)	19.7 (14)	22.7 (10)	0 (0)	47.7 (21)	29.5 (13)
5th year	12.1 (11)	0 (0)	61.5 (56)	26.4 (24)	9.2 (8)	0 (0)	62.1 (54)	28.7 (25)	22.9 (22)	0 (0)	55.2 (53)	21.9 (21)	16.3 (16)	0 (0)	57.1 (56)	25.5 (25)
6th year	13.8 (9)	0 (0)	58.5 (38)	27.7 (18)	12.4 (12)	0 (0)	66.0 (64)	21.6 (21)	16.3 (7)	0 (0)	51.2 (22)	32.6 (14)	17.4 (12)	0 (0)	63.8 (44)	18.8 (13)

(n) denotes the number of participants that equates to the given percentage

Percentage of participants travelling to school by mode type preference

	Intervention School								Control School							
	Pre % (n)				Post % (n)				Pre % (n)				Post % (n)			
	Walk	Cycle	Car	Bus	Walk	Cycle	Car	Bus	Walk	Cycle	Car	Bus	Walk	Cycle	Car	Bus
Total	19.6 (123)	15.3 (96)	49.4 (311)	15.7 (99)	20.8 (136)	18.7 (122)	45.9 (300)	14.5 (95)	20.5 (90)	8.7 (38)	58.7 (257)	12.1 (53)	24.5 (135)	11.4 (63)	51.0 (281)	13.1 (72)
1st year	19.7 (24)	28.7 (35)	24.6 (30)	27.0 (33)	20.0 (28)	26.4 (37)	34.3 (48)	19.3 (27)	21.5 (17)	17.7 (14)	45.6 (36)	15.2 (12)	24.4 (22)	15.6 (14)	41.1 (37)	18.9 (17)
2nd year	25.8 (34)	6.8 (9)	45.5 (60)	22.0 (29)	23.0 (31)	21.5 (29)	37.8 (51)	17.8 (24)	11.1 (6)	7.4 (4)	68.5 (37)	13.0 (7)	20.5 (9)	27.3 (12)	47.7 (21)	4.5 (2)
3rd year	22.7 (29)	11.7 (15)	56.3 (72)	9.4 (12)	22.5 (23)	10.8 (11)	52.9 (54)	13.7 (14)	22.7 (22)	9.3 (9)	52.6 (51)	15.5 (15)	23.5 (23)	4.1 (4)	60.2 (59)	12.2 (12)
4th year	20.0 (17)	29.4 (25)	36.5 (31)	14.1 (12)	20.3 (12)	23.7 (14)	45.8 (27)	10.2 (6)	19.1 (13)	7.4 (5)	66.2 (45)	7.4 (5)	34.1 (15)	11.4 (5)	38.6 (17)	15.9 (7)
5th year	12.5 (12)	7.3 (7)	77.1 (74)	3.1 (3)	13.8 (12)	23.0 (20)	52.9 (46)	10.3 (9)	26.0 (25)	4.2 (4)	59.4 (57)	10.4 (10)	26.3 (26)	13.1 (13)	44.4 (44)	16.2 (16)
6th year	10.6 (7)	7.6 (5)	66.7 (44)	15.2 (10)	17.5 (17)	8.2 (8)	67.0 (65)	7.2 (7)	15.9 (7)	4.5 (2)	70.5 (31)	9.1 (4)	23.2 (16)	5.8 (4)	63.8 (44)	7.2 (5)

(n) denotes the number of participants that equates to the given percentage

Weekly minutes (mean, SD) of domain specific, total and MVPA physical activity pre and post-intervention

	Intervention school				Control school				Change in int vs change in control
	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
School PA	226.9	241.2	14.3	-13.4, 42.0	207.5	223.1	15.6	-16.5, 47.7	0.97
	(621, 247.8)	(613, 247.6)	(495)		(449, 234.9)	(442, 253.0)	(486)		
Home PA	192.4	190.1	2.3	-28.2, 32.8	177.0	204.0	27.0	-7.7, 61.7	0.46
	(543, 276.1)	(526, 229.4)	(501)		(388, 246.1)	(408, 252.0)	(497)		
Leisure PA	454.1	448.2	5.9	-48.3, 60.1	429.1	470.7	41.6	-22.9, 106.1	0.56
	(566, 469.0)	(546, 452.0)	(920)		(404, 473.0)	(419, 469.4)	(941)		
Total PA	931.9	933.1	1.2	-82.2, 84.6	897.3	991.5	94.2	-0.6, 189.0	0.32
	(628, 764.1)	(654, 757.6)	(1519)		(452, 763.7)	(557, 762.8)	(1501)		
MVPA	603.5	612.8	9.3	-51.6, 70.2	526.1	624.0	**97.9**	**32.1, 163.7**	0.18
	(628, 548.5)	(652, 560.7)	(1108)		(451, 508.6)	(556, 544.8)	**(1045)**		

Log10 transformed data for minutes (mean, SD) of domain specific, total and MVPA physical activity pre and post-intervention

	Intervention school				Control school				Change in int vs change in control
	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	Pre (n, SD)	Post (n, SD)	Mean diff (SD)	95 % CI	P value
School PA	1.97	2.01	0.03	-0.06, 0.12	1.90	2.04	**0.14**	**0.04, 0.23**	0.25
	(621, 0.80)	(645, 0.82)	(1.62)		(449, 0.84)	(552, 0.71)	**(1.45)**		
Home PA	1.66	1.72	0.07	-0.05, 0.18	1.61	1.73	0.12	-0.01, 0.25	0.68
	(543, 0.98)	(554, 0.98)	(1.96)		(388, 1.0)	(509, 0.97)	(1.90)		
Leisure PA	2.14	2.17	0.03	-0.09, 0.15	2.05	2.24	**0.19**	**0.06, 0.32**	0.20
	(566, 1.01)	(575, 0.98)	(1.99)		(404, 1.06)	(514, 0.92)	**(1.89)**		
Total PA	2.68	2.69	0.01	-0.07, 0.09	2.65	2.78	**0.13**	**0.05, 0.22**	0.16
	(628, 0.75)	(656, 0.74)	(1.49)		(452, 0.77)	(558, 0.61)	**(1.30)**		
MVPA	2.44	2.46	0.02	-0.07, 0.11	2.35	2.52	**0.17**	**0.08, 0.27**	0.10
	(628, 0.81)	(654, 0.79)	(1.60)		(451, 0.82)	(557, 0.67)	**(1.41)**		

The effect of the intervention on the proportion of 1st year students that agreed with attitudinal statements related to cycling for transport

	Intervention school			Control school			Absolute change
	Pre % (n = 126)	Post % (n = 172)	% Diff (95%CI)	Pre % (n = 84)	Post % (n = 94)	% Diff (95%CI)	Difference in differences % (95%CI)
Cycling to school too tiring	34.1	22.8	**-11.3 (-21.7, -0.9)**	33.7	38.7	5.0 (-9.2, 18.7)	-16.3 (-33.9, 1.3)
Cycling to school not safe	30.2	22.9	-7.2 (-17.4, 2.8)	41.0	39.8	-1.2 (-15.4, 13.0)	-6.0 (-23.8, 11.7)
Confident in cycling ability	91.0	84.6	-6.4 (-13.7, 1.6)	84.1	87.2	3.1 (-7.7, 14.0)	-9.4 (-22.4, 3.5)
I hate wearing a helmet	71.8	80.8	9.1 (-7.1, 19.0)	75.0	70.3	-4.7 (-17.5, 8.6)	13.7 (-2.8, 30.2)
Don't cycle bad weather	82.9	83.1	0.2 (-8.2, 9.3)	90.5	80.9	-9.6 (-19.8, 0.9)	9.8 (-3.5, 23.2)
Stuff to carry to school	94.2	70.3	**-23.9 (-31.7, -15.4)**	92.9	88.2	-4.7 (-13.7, 4.4)	**-19.2 (-30.9, -7.5)**
I couldn't be bothered	23.2	21.1	-2.2 (-11.9, 7.2)	39.8	25.5	**-14.2 (-27.5, -0.4)**	12.1 (-4.7, 28.8)
Take too long	62.4	49.7	**-12.7 (-23.6, -1.2)**	66.7	56.5	-10.1 (-23.8, 4.2)	-2.6 (-20.8, 15.7)
Looking stupid (friends)	18.4	12.9	-5.5 (-14.3, 2.8)	39.3	33.3	-6.0 (-19.8, 8.1)	0.5 (-16.0, 17.0)
Clothes - hard to cycle	73.0	69.0	-4.0 (-14.1, 6.5)	88.0	77.4	-10.5 (-21.4, 0.9)	6.5 (-8.6, 21.7)
Looking stupid (students)	19.7	11.0	**-8.6 (-17.5, -0.4)**	41.7	41.3	-0.4 (-14.7, 13.9)	-8.3 (-25.1, 8.6)
Friends cycle to school	6.7	30.6	**23.9 (15.2, 31.9)**	7.1	1.1	-6.0 (-13.7, 0.2)	**30.0 (19.8, 40.1)**
Driving is the easiest way	65.0	69.2	4.2 (-6.6, 15.1)	81.0	68.8	-12.1 (-24.3, 0.8)	16.3 (-0.4, 33.0)
Parental support to cycle	36.1	41.1	5.0 (-6.4, 16.0)	31.3	38.0	6.7 (-7.4, 20.3)	-1.7 (-19.8, 16.3)
Cycling ruin my hair	44.3	30.6	**-13.7 (-24.6, -2.5)**	40.2	32.3	-7.9 (-21.8, 6.2)	-5.7 (-23.8, 12.4)
Parents happy to drive	65.3	64.1	-1.3 (-12.1, 9.9)	68.3	80.6	12.4 (-0.5, 25.0)	-13.6 (-30.6, 3.4)
Cycling ruin make-up	9.8	8.3	-1.4 (-8.7, 5.2)	18.5	14.0	-4.5 (-15.9, 6.4)	3.1 (-9.8, 16.0)
Worry bicycle being stolen	52.0	34.7	**-17.3 (-28.2, -5.8)**	63.9	45.2	**-18.7 (-32.3, -3.9)**	1.4 (-16.9, 19.8)
Safe cycling route	18.5	30.4	**11.8 (1.7, 21.2)**	21.7	23.7	2.0 (-10.5, 14.1)	9.8 (-5.9, 25.6)
Direct cycling route	19.2	24.6	-5.4 (-14.6, 4.4)	15.5	18.5	3.0 (-8.3, 14.0)	2.4 (-12.3, 16.9)
Too far away	61.1	48.8	**-12.3 (-23.2, -0.8)**	67.9	55.3	-12.5 (-26.1, 1.8)	0.3 (-17.9, 18.4)

All % differences in this table are absolute differences

The effect of the intervention on the proportion of 1st year students that agreed with attitudinal statements related to walking for transport

	Intervention school			Control school			Absolute change
	Pre % (n = 126)	Post % (n = 172)	% Diff (95%CI)	Pre % (n = 84)	Post % (n = 94)	% Diff (95%CI)	Difference in differences % (95%CI)
Walking too tiring	40.2	38.1	-2.1 (-13.6, 9.4)	49.4	50.6	1.2 (-13.7, 16.0)	-3.2 (-22.4, 15.9)
Don't walk bad weather	80.7	73.5	-7.2 (-16.7, 2.9)	87.8	76.7	-11.1 (-22.3, 0.5)	3.9 (-11.0, 18.9)
Lots of stuff to carry	89.3	67.3	**-22.1 (-30.7, -12.6)**	90.4	82.6	-7.8 (-17.9, 2.7)	**-14.3 (-27.8, -0.9)**
I couldn't be bothered	20.2	15.4	-4.8 (-14.0, 3.9)	34.9	22.3	-12.6 (-25.5, 0.7)	7.8 (-8.2, 23.8)
Walking take too long	71.4	57.4	**-14.0 (-24.4, -2.9)**	71.1	69.1	-1.9 (-15.1, 11.5)	-12.1 (-29.4, 5.2)
Looking stupid (friends)	4.1	4.1	0 (-5.5, 4.8)	8.3	2.1	-6.2 (-14.2, 0.6)	6.3 (-1.8, 14.3)
Looking stupid (students)	3.3	3.0	-0.3 (-5.4, 4.0)	10.7	1.1	**-9.7 (-18.1, -2.8)**	**9.4 (1.3, 17.4)**
My friends walk to school	45.5	64.5	**19.0 (7.4, 29.9)**	60.7	59.6	-1.1 (-15.2, 13.1)	**20.1 (1.8, 38.5)**
Driving is the coolest way	12.8	13.7	0.9 (-7.4, 8.6)	28.9	15.2	**-13.7 (-25.8, -1.4)**	**14.6 (0.1, 29.1)**
Parental support to walk	68.5	68.0	-0.5 (-11.0, 10.3)	71.4	64.2	-7.2 (-20.4, 6.5)	6.7 (-10.7, 24.1)
Walking ruin hair	20.8	20.7	-0.1 (-9.7, 9.1)	20.5	17.9	-2.6 (-14.4, 8.9)	2.5 (-12.4, 17.4)
Parents happy to drive	68.0	67.1	-0.9 (-11.7, 10.1)	69.9	75.8	5.9 (-7.1, 18.9)	-6.9 (-24.0, 10.2)
Walking ruin make-up	12.1	8.3	-3.8 (-11.5, 3.1)	16.7	7.5	-9.1 (-19.3, 0.5)	5.3 (-6.6, 17.3)
Safe walking route	29.3	40.8	**11.6 (0.4, 22.1)**	32.5	38.3	5.8 (-8.3, 19.4)	5.8 (-12.0, 23.6)
Direct walking route	25.2	34.9	9.7 (-1.0, 19.8)	26.2	35.8	9.6 (-4.0, 22.6)	0.1 (-17.0, 17.2)
Live too far away	64.2	54.8	-9.5 (-20.4, 2.0)	65.1	53.7	-11.4 (-25.1, 3.1)	1.9 (-16.4, 20.2)

All % differences in this table are absolute differences

5C Photos of intervention

Active travel curricular projects

Students participating in the incentivised challenge

'Leg it to Loreto' day

School bike rack on 'Leg it Loreto' day

Cycle skills training

Samsung e-books

Social media promotion (student-led)

Hoodies for incentivised active travel challenge being presented on social media

Appendix 6

6A Information letter and survey

Active Kilkenny Adult Survey

All returned surveys will be entered into a draw for a €100 restaurant voucher

Why did I receive this?
You filled out this very same questionnaire for us 2 years ago and kindly said you wouldn't mind if we contacted you again.

Just to remind you, Kilkenny Borough Council has been working to increase the number of people who walk and cycle for transport in the city. This questionnaire is to help us measure how effective this work has been.

It won't take long and I've tried to answer some of your questions here.

Some Information before you get started
All the information we collect will be kept in the strictest confidence, and used for research purposes only. It will not be possible to identify any particular individual or address in the results.

What do I do when I finish it?
We have provided a return envelope and there's no need for a stamp. Try and send it back before May 24th to be in with a chance to win the voucher. Remember to include your contact details at the end of the questionnaire.

Thank you, in advance, for your contribution to promoting physical activity in Kilkenny!

If you want any further information on the questionnaire or the research study, please contact us at the Centre for Health Behaviour Research in Waterford IT (contact details below).

Barry Lambe
Niamh Richardson

Email: blambe@wit.ie
Tel: 051 834097

Office use only

Respondent code:

Section A: Activity at work

These questions are about the time you spend doing physical activity **at work in a typical week**. Please answer these questions even if you do not consider yourself to be a physically active person. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, seeking employment. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

1. **Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like carrying or lifting heavy loads, digging or construction work for at least 10 minutes continuously?**

   Yes ☐

   No ☐ → *skip to question 4*

2. **In a typical week, on how many days do you do vigorous intensity activities as part of your work?**

   Number of days ________

3. **How much time do you spend doing vigorous-intensity activities at work on a typical day?**

   Hours __________

   Minutes ________

4. **Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking** *[or carrying light loads]* **for at least 10 minutes continuously?**

   Yes ☐

   No ☐ → *skip to question 7*

5. **In a typical week, on how many days do you do moderate intensity activities as part of your work?**

   Number of days ________

6. **How much time do you spend doing moderate-intensity activities at work on a typical day?**

   Hours __________

   Minutes ________

Section B: Travel to and from places

The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, to the shops, to visit friends or to the church.

7. **Do you walk or use a bicycle for at least 10 minutes continuously to get to and from places?**

   Yes ☐

   No ☐ → *skip to question 10*

8. **In a typical week, on how many days do you walk or cycle for at least 10 minutes continuously to get to and from places?**

   Number of days _______

9. **How much time do you spend walking or cycling for travel on a typical day?**

   Hours _________

   Minutes _______

Section C: Recreational activities

The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness or recreational activities.

10. **Do you do any vigorous-intensity sports, fitness or recreational activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?**

    Yes ☐

    No ☐ → *skip to question 13*

11. **In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational activities?**

    Number of days _______

12. **How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?**

    Hours _________

    Minutes _______

13. **Do you do any moderate-intensity sports, fitness or recreational activities that causes a small increase in breathing or heart rate such as brisk walking, cycling or swimming, for at least 10 minutes continuously?**

Yes ☐

No ☐ → *skip to question 16*

14. **In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational activities?**

Number of days _______

15. **How much time do you spend doing moderate-intensity sports, fitness or recreational activities on a typical day?**

Hours _________

Minutes _________

16. **How many bicycles, if any, does your household have that are used by adults**

Number of bicycles _____ *If there are none → skip to question 18*

17. **How often do you use a bicycle?**

3 or more times a week.......................... ☐

Once or twice a week.............................. ☐

Once a month.. ☐

Occasionally, a few times per year.......... ☐

Rarely or never.. ☐

Section D: Sedentary behaviour

The following question is about sitting or reclining when at work, at home, getting to and from places, or with friends. This includes time spent sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television, **but do not include time spent sleeping**.

18. **How much time do you usually spend sitting or reclining on a typical day?**

Hours _________

Minutes _______

Section E: Active Travel Awareness

19. Have you ever heard of a campaign to promote walking or cycling in Kilkenny?

Yes ☐

No ☐ → *skip to question 23*

I don't know ☐ → *skip to question 23*

20. What was it called? ____

21. What were the main messages or events surrounding this campaign?

____

____

____

22. For each of the following statements about the campaign, do you agree strongly, tend to agree, neither agree nor disagree, tend to disagree or disagree strongly? *Circle the relevant number*

	Agree strongly	Tend to agree	Neither	Tend to disagree	Disagree strongly
The campaign made me think about cycling and walking............	1	2	3	4	5
The campaign didn't tell me anything new....................................	1	2	3	4	5
The campaign made me want to cycle more.................................	1	2	3	4	5
The campaign made me want to walk more..................................	1	2	3	4	5
I didn't take much notice of the campaign....................................	1	2	3	4	5
The campaign made me give cycling a try......................................	1	2	3	4	5
The local authority should not be spending money on cycling......	1	2	3	4	5
The campaign helped me see cyclists' point of view, rather than drivers' point of view..	1	2	3	4	5

23. Have you noticed any changes in the town to make it easier to walk or cycle for transport?

Yes ☐

No ☐ → *skip to question 25*

I don't know ☐ → *skip to question 25*

24. **What changes have you noticed?**

____

____

____

Section F: Some questions about you

25. **What is the highest level of education you have completed to date?**

Some Primary but didn't finish................................ ☐

Finished Primary School.. ☐

Intermediate, Group or Junior Certificate.............. ☐

Leaving Certificate.. ☐

Diploma or Certificate.. ☐

Primary degree.. ☐

Postgraduate or Higher degree............................. ☐

26. **Which of these descriptions BEST describes your usual situation in regard to work?** *Tick one only*

Not employed, retired or have a long-term disability....... ☐

Employed full-time... ☐

Employed part-time.. ☐

27. **What is your sex?**

Male ☐

Female ☐

28. **What age are you?** _____ years

5

Thank you for your time in completing this questionnaire. Please complete the details below if you would like to be entered into the prize draw

....

Name   Date

Address...

Contact number...

And finally, please return this questionnaire in the envelope provided by May 24th

6B Screenline Count Form and Instructions

Counter Name:________________________

Junction: _____________________________ **Exact count spot**:______________________

Street A name: ________________________ Street B name: _______________________

Date: ________________________________ **Time Period:** 8.15-9.30 □ 3-6pm □

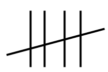
Weather Conditions: ___________________ (complete at end of period)

Preparation for Count Day:

1. You will need the following
    a. Count forms
    b. Location map
    c. High-viz jacket
    d. Clipboard
    e. Pen and spares

Count Instructions:

1. Record the exact location that you are standing for the count use shop, building name or landmark
2. Count all cyclists and walkers that cross your screenline under the appropriate headings (male, female)
3. If a cyclist is wearing a helmet, record them in the appropriate box with an X
4. If there is more than one person on a bike (i.e. parent and child) count them as two
5. Walkers include people in wheelchairs (including motorised) and children in buggies
6. People on skateboards or rollerblades should be recorded as 'others'
7. Record each cyclist/pedestrian using method shown below i.e. 5 in total, then start another 5. If the cyclist is wearing a helmet just place an 'X' in the lower portion of the appropriate box.



8. Bicycle parking should be recorded during the period from 9.30am-10am. Count the number of bikes parked in the formal bicycle parking and record on the bicycle parking form. Describe the type of bike parking. Count and record any bikes parked informally in the vicinity.

Some final points:

9. You will need to record the name of the streets being monitored on the document. The streets are all labelled 'A' and 'B'.
10. If you are aware of any new bike parking racks in addition to that listed in this document, please include them in the count.
11. You will need to print enough record sheets for the day
12. You need to stick strictly to the data collection times
13. The count sheets should be retained by co-ordinator for the counts in the town
14. Remember to count everyone that passes through the imaginary screenline(s)

	Cyclists		**Pedestrians**		**Other**
	Male	**Female**	**Male**	**Female**	
A					
B					

6C Additional data

Univariate comparison of demographic characteristics of those who agreed and declined to be followed-up

	Intervention town 1			Intervention town 2			Control town		
	Agreed (n=428)	Declined (n = 391)	P	Agreed (n=201)	Declined (n=151)	P	Agreed (n=325)	Declined (n=214)	P
Age (yrs ± SD)	44.8 (6.6)	44.9 (6.7)	0.71	45.2 (6.9)	45.4 (6.3)	0.79	44.1 (7.5)	43.4 (6.8)	0.30
Sex (%)									
Male	48.6	51.4	0.60	57.0	43.0	0.89	55.4	44.6	**0.04***
Female	55.1	44.9		57.7	42.3		63.9	36.1	
Education (%)									
< Tertiary	41.0	59.0	**0.00****	52.6	47.4	0.14	58.0	42.0	0.36
Tertiary	59.4	40.6		60.4	39.6		61.9	38.1	
Employment (%)									
Unemployed	50.4	49.6	0.64	51.6	48.4	0.32	58.3	41.7	0.66
Employed	52.6	47.4		58.4	41.6		60.8	39.2	

*p<0.05, **p<0.01

Univariate comparison of the log10 transformed average domain-specific minutes of physical activity per day of those who agreed and declined to be followed-up

	Agreed	Declined	Mean diff	95% CI's	P
	Mean (±SD)	Mean (±SD)			
Intervention town 1	(n=436)	(n=404)			
Total physical activity	1.80 (0.69)	1.70 (0.85)	**-0.11**	**-0.21, -0.00**	**0.04***
Work	0.86 (1.07)	0.89 (1.10)	0.03	-0.12, 0.17	0.75
Travel	0.72 (0.82)	0.65 (0.82)	-0.07	-0.18, 0.05	0.26
Recreation	1.22 (0.74)	1.06 (0.83)	**-0.16**	**-0.37, -0.06**	**0.00****
Intervention town 2					
Total physical activity	1.83 (0.70)	1.72 (0.85)	-0.11	-0.28, 0.05	0.16
Work	0.90 (1.06)	0.94 (1.11)	0.04	-0.19, 0.27	0.74
Travel	0.80 (0.86)	0.60 (0.84)	**-0.20**	**-0.38, -0.01**	**0.03***
Recreation	1.24 (0.76)	1.06 (0.81)	**-0.18**	**-0.35, -0.02**	**0.03***
Control town					
Total physical activity	1.77 (0.73)	1.75 (0.90)	-0.02	-0.16, 0.11	0.75
Work	0.85 (1.07)	1.02 (1.15)	0.17	-0.02, 0.36	0.07
Travel	0.72 (0.81)	0.58 (0.85)	-0.14	-0.29, 0.00	0.05
Recreation	1.26 (0.73)	1.01 (0.84)	**-0.25**	**-0.38, -0.12**	**0.00****

*p<0.05; **p<0.01; All values are average log10 transformed minutes per day.

Multivariate odds ratios of agreeing to be followed-up

		Intervention town 1[a]			Intervention town 2[a]			Control town[a]		
Variable		OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Sex	Female	1.0	Ref		1.0	Ref		1.0	Ref	
	Male	0.91	0.66, 1.24	0.53	1.06	0.66, 1.71	0.80	0.78	0.53, 1.20	0.21
Age (years)	<45	1.0	Ref		1.0	Ref		1.0	Ref	
	>45	1.09	0.80, 1.45	0.59	0.84	0.52, 1.35	0.47	1.39	0.95, 2.04	0.09
Tertiary education	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	**2.20**	**1.60, 3.04**	**0.00****	1.37	0.85, 2.20	0.19	1.05	0.70, 1.57	0.82
Employed	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	0.87	0.56, 1.34	0.52	1.26	0.66, 2.41	0.49	1.05	0.63, 1.76	0.85
Sufficiently active	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	1.09	0.73, 1.63	0.68	1.09	0.58, 2.05	0.78	0.65	0.39, 1.08	0.10
Any work PA	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	1.16	0.83, 1.63	0.39	1.04	0.62, 1.76	0.88	0.88	0.57, 1.37	0.58
Any active travel	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	1.03	0.74, 1.41	0.88	**1.75**	**1.06, 2.89**	**0.03***	**1.85**	**1.22, 2.80**	**0.00****
Any recreational PA	No	1.0	Ref		1.0	Ref		1.0	Ref	
	Yes	**1.56**	**1.07, 2.27**	**0.02***	1.49	0.86, 2.60	0.16	**2.70**	**1.68, 4.35**	**0.00****

	Total Sample[b]		
Intervention vs control			
Control town	1.0	Ref	
Intervention town 1	**0.74**	**0.58, 0.94**	**0.01***
Intervention town 2	0.91	0.68, 1.22	0.55

*p<0.05, **p<0.01; [a] adjusted for all other variables in table (except intervention vs control); [b] adjusted for all other variables in table

Univariate comparison of demographic characteristics of respondents and non-respondents at follow-up

	Intervention town 1			Intervention town 2			Control town		
	Respondent (n=213)	Non-respondent (n=606)	P	Respondent (n=115)	Non-respondent (n=237)	P	Respondent (n=173)	Non-respondent (n=366)	P
Age (yrs ± SD)	45.0 (5.9)	44.8 (6.9)	0.72	45.6 (7.1)	45.2 (6.4)	0.57	45.0 (7.5)	43.2 (7.0)	0.00**
Sex (%)									
Male	21.9	78.1	0.02*	27.8	72.2	0.11	26.1	73.9	0.01*
Female	29.0	71.0		36.3	63.7		36.1	63.9	
Education (%)									
< Tertiary	18.0	82.0	0.00**	29.2	70.8	0.31	27.3	72.7	0.06
Tertiary	30.9	69.1		34.8	65.2		34.9	65.1	
Employment (%)									
Unemployed	21.4	78.6	0.23	32.8	67.2	1.00	28.1	71.9	0.47
Employed	26.6	73.4		32.8	67.2		32.5	67.5	

*p<0.05, **p<0.01

Univariate comparison of the log10 transformed average domain-specific minutes of physical activity per day of respondents and non-respondents at follow-up

	Respondent	Non-respondent	Mean difference	95% CI's	P
	Mean (±SD)	Mean (±SD)			
Intervention town 1	(n=216)	(n=624)			
Total PA	1.80 (0.65)	1.74 (0.81)	-0.06	-0.18, 0.06	0.30
Work	0.85 (1.05)	0.89 (1.10)	0.04	-0.13, 0.21	0.68
Travel	0.72 (0.82)	0.67 (0.82)	-0.05	-0.18, 0.08	0.45
Recreation	1.28 (0.67)	1.09 (0.82)	**-0.20**	**-0.31, -0.7**	**0.00****
Intervention town 2	(n=116)	(n=244)			
Total PA	1.82 (0.69)	1.76 (0.80)	-0.06	-0.23, 0.11	0.50
Work	0.97 (1.08)	0.90 (1.08)	-0.07	-0.31, 0.18	0.59
Travel	0.72 (0.83)	0.71 (0.87)	-0.01	-0.21, 0.19	0.92
Recreation	1.24 (0.73)	1.13 (0.81)	-0.11	-0.28, 0.07	0.23
Control town	(n=173)	(n=378)			
Total PA	1.80 (0.65)	1.74 (0.86)	-0.05	-0.20. 0.09	0.46
Work	0.79 (1.02)	0.98 (1.14)	0.19	-0.01, 0.39	0.06
Travel	0.75 (0.80)	0.62 (0.85)	-0.13	0.28, 0.02	0.91
Recreation	1.33 (0.70)	1.08 (0.81)	-0.23	-0.40, -0.12	0.00**

*p<0.05, **p<0.01; All values are average log10 transformed minutes per day

Change in mean daily minutes (log10 transformed) of physical activity in intervention towns versus control from baseline to follow-up

	Intervention town 1 (n=216)			Intervention vs control
	Baseline	Follow-up	Difference (95% CI)	P value
Total PA (±SD)	1.80 (0.64)	1.88 (0.58)	0.07 (-0.03, 0.16)	0.84
Work (±SD)	0.85 (1.04)	0.89 (1.02)	0.05 (-0.11, 0.20)	0.57
Recreation (±SD)	1.29 (0.66)	1.31 (0.69)	0.02 (-0.07, 0.11)	0.21
	Intervention town 2 (n=116)			
Total PA (±SD)	1.85 (0.66)	1.91 (0.65)	0.06 (-0.08, 0.19)	0.73
Work (±SD)	1.00 (1.08)	0.87 (1.06)	-0.13 (-0.31, 0.06)	0.73
Recreation (±SD)	1.26 (0.72)	1.34 (0.74)	0.08 (-0.07, 0.23)	0.63
	Control town (n=172)			
Total PA (±SD)	1.81 (0.64)	1.86 (0.66)	0.06 (-0.05, 0.17)	
Work (±SD)	0.80 (1.02)	0.81 (1.06)	0.02 (-0.15, 0.18)	
Recreation (±SD)	1.35 (0.70)	1.42 (0.67)	0.74 (-0.03, 0.18)	

Change in mean daily minutes of physical activity in intervention towns versus control from baseline to follow-up

	Intervention town 1 (n=216)			Intervention vs control
	Baseline	Follow-up	Difference (95% CI)	P value
Total PA	145.7 (193.1)	152.0 (220.4)	6.3 (-25.4, 38.0)	0.70
Work	74.4 (149.9)	73.5 (144.4)	-0.83 (-22.3, 20.6)	0.43
Recreation	40.5 (42.9)	53.5 (132.4)	13.0 (-3.5, 29.4)	0.77
	Intervention town 2 (n=116)			
Total PA	159.0 (216.2)	169.6 (200.0)	10.6 (-25.8, 47.0)	0.84
Work	89.6 (154.9)	77.0 (137.1)	-12.5 (-35.9, 10.8)	0.37
Recreation	49.3 (97.1)	52.4 (62.2)	3.1 (-16.5, 22.6)	0.92
	Control town (n=172)			
Total PA	135.9 (184.0)	155.3 (189.6)	19.5 (-13.7, 52.7)	
Work	62.6 (125.6)	79.2 (167.6)	16.6 (-10.1, 43.2)	
Recreation	55.1 (91.0)	55.7 (68.9)	0.62 (-14.0, 15.2)	

Appendix 7

7A Participant consent form

Participant Consent Form

Who is doing the research?

Mr Barry Lambe from the Centre for Health Behaviour Research in Waterford Institute of Technology

Why?

To understand the mechanisms that facilitate and inhibit the process of promoting walking and cycling for transport in a community

What is involved?

This component of the research is a qualitative study which means that the research data will be from interviews. You will be asked questions on a number of active travel related topics. These will include your views on the importance and benefits of active travel and what factors you consider to have the greatest influence on active travel. The interview will be recorded and will subsequently be transcribed verbatim. Any text that may identify you or another person will be removed. Pseudonyms will be used to ensure anonymity. You will also be given an opportunity to review the final transcript and how the information is used in the final manuscript before publication.

Questions for you to consider:

1. I confirm that I have had the purpose and nature of the above study clearly explained to me

2. I understand that my participation is voluntary and I am free to withdraw at any time without giving a reason.

4. If interviewed, I agree to written notes being taken by the interviewer.

5. If interviewed, I agree to the interview being audio-recorded.

6. I agree to the use of anonymous quotes in the research report.

Signature of participant: ______________________ Date: ________________

Signature of researcher: ______________________ Date: ________________

7B Interview schedules and topic guides 2011 and 2013

Local authority interview schedule 2011

Explain that the interview relates to the development and implementation of the Smarter Travel related programmes/activities

1. Introduction
    a. description of their position (background to working in/with the local Council)
    b. their role/involvement in - active travel promotion (current and past)
    c. history of active travel promotion in locality

2. Why was it decided to develop a policy/programme on active travel?
    a. Because of national policy/funding; advocacy; champion, local need?
    b. What are/were the main goals of the programme?
    c. How are activities currently prioritised and planned?

3. How successful have efforts to promote smarter travel been to date? In the future? Why?
   Prompt how the following determinants have/may influence efforts

    a. Personnel, organisational capacity, organisational cooperation, funding
    b. Support from other sectors, political climate
    c. Involvement & support of the public, media's support

4. Recommendations for others to interview

Community advocate interview schedule 2011

I have been doing some research on the work done by the Borough Council to promote more sustainable travel in Kilkenny. Part of my work has involved establishing baseline level of active travel and physical levels in the population. My interest in this is largely from a physical activity perspective and I want to know **if** community based active travel programmes can actually impact on population physical activity levels in Irish towns and **how**. While there are examples of how cities in other countries have established a culture of active travel we don't have many, if any, examples here in Ireland. Hopefully that is something that will change but in order to learn how to do so successfully I want to document what happened in Kilkenny, what worked, what didn't work and why. Most importantly though, I want to hear about your perspective on what has happened and what should happen.

1. Introduction
   a. Tell me about your interest in active travel travel
   b. When did Kilkenny start to take an interest in promoting active travel? Why?
   c. What do you know about efforts in this area to date?

2. Why is a policy/programme on active travel necessary in Kilkenny / Dungarvan?
   a. What should the main goals of the programme be?
   b. What would the main benefits of the programme be?
   c. What would be the most effective way to increase active travel
   d. Who should be targeted?

3. How successful have efforts to promote active travel been to date? In the future? Why?
   Prompt how the following determinants have/may influence efforts

   a. Borough Council well equipped in terms of personnel, organisational capacity, organisational cooperation, funding
   b. Support from other sectors, political climate
   c. Involvement & support of the public, media's support

4. Recommendations for others to interview

Trader interview schedule 2011

Explain that the interview relates to the development and implementation of the Smarter Travel related programmes/activities in the locality

1. Describe your experience of active travel promotion in the locality
    a. In what way have the activities affect you? Others? *Probe*
    b. Why did they/it not work? *probe*

2. (Ethos/Actions) What do you think of 'Smarter Travel' as a concept?
    a. What is it trying to achieve?
    b. What actions/activities should a ST programme focus more on?

3. (How they're implemented) How could 'Smarter Travel' related activities be organised better in Kilkenny/Dungarvan?
    a. Collaboration, consultation, location, evidence

4. Recommendations for others to interview

Dungarvan local authority topic guide 2013

Background

2 years ago I interviewed several people in both Kilkenny and Dungarvan to talk about the implementation and development of 'Smarter Travel' Policy. The idea was to help explain the obstacles to 'Smarter Travel' or the factors that are accelerating its implementation in Kilkenny. I interviewed people from the local authority, community advocates of 'Smarter Travel' and also people who were resistant to current 'Smarter Travel' policy. So now I'm going back to these people again and doing a sort of a review of progress 2 years on. That interview I did with you was in November 2011.

So I'll start by asking you what **progress** has been made since then?

- How successful have you been?
- What has contributed to this?
- What factors have slowed the progress?

The rest of my questions are related to issues that were the dominant themes that emerged from the interviews in 2011

- Main **purpose** of 'Smarter Travel'? Is it mainly for children? (definitions)
- **Hard measures before soft measures** - How complete does it have to be?
- Incremental actions towards what? Grattan square / shared space – compromise or ideal scenario?
- Traders equate car accessibility to retail trade – justified?
- Evidence – there seems to be lack of evidence on both sides
- Why is their lobby so strong?
- The silent majority – how do you engage them?

Kilkenny local authority topic guide 2013

Background

2 years ago I interviewed several people in both Kilkenny and Dungarvan to talk about the implementation and development of 'Smarter Travel' policy. The idea was to help explain the obstacles to 'Smarter Travel' or the factors that are accelerating its implementation in Kilkenny. I interviewed people from the local authority, community advocates of 'Smarter Travel' and also people who were resistant to current 'Smarter Travel' policy. So now I'm going back to these people again and doing a sort of a review of progress 2 years on. That interview I did with you was in November 2011.

So I'll start by asking you what **progress** has been made since then?

- How successful have you been?
- What has contributed to this?
- What factors have slowed the progress?

The rest of my questions are related to issues that were the dominant themes that emerged from the interviews in 2011

- Current shared space scheme - compromise or ideal scenario?
- Criteria for pedestrianisation? Why pedestrianisation? Short and long-term impact?
- Traders want cars to travel through the centre of town. They acknowledge that moving cars don't equate to retail trade. Why is that?
- Why is their lobby so strong? How could you establish a better working relationship with them?
- The silent majority – how do you engage them?
- Hard measures before soft measures - How complete does it have to be?

Dungarvan-Kilkenny community advocate topic guide 2013

Background

2 years ago I interviewed several people in both Kilkenny and Dungarvan to talk about the implementation and development of Smarter Travel policy. The idea was to help explain the obstacles to 'Smarter Travel' or the factors that are accelerating its implementation in Kilkenny/Dungarvan. I interviewed people from the local authority, community advocates of 'Smarter Travel' and also people who were resistant to current 'Smarter Travel' policy. So now I'm going back to these people again and doing a sort of a review of progress 2 years on.

So I'll start by asking you what **progress** has been made since then?

- How successful have you been?
- What has contributed to this?
- What factors have slowed the progress?

The rest of my questions are related to issues that were the dominant themes that emerged from the interviews in 2011

- Hard measures before soft measures - How complete does it have to be?
- Hard measures seem essential – what is the purpose of behaviour change? Is visibility enough?
- Incremental actions towards what? Grattan square / shared space – compromise or ideal scenario.
- Traders equate car accessibility to retail trade – justified?
- Evidence – there seems to be lack of evidence on both sides
- Why is their lobby so strong? How do you engage them?
- The silent majority – how do you engage them?

Dungarvan trader topic guide 2013

Background

2 years ago I interviewed several people in both Kilkenny and Dungarvan to talk about the implementation and development of 'Smarter Travel' policy. The idea was to help explain the obstacles to 'Smarter Travel' or the factors that are accelerating its implementation in Kilkenny/Dungarvan. I interviewed people from the local authority, community advocates of 'Smarter Travel' and also people who were resistant to current 'Smarter Travel' policy. So now I'm going back to these people again and doing a sort of a review of progress 2 years on.

So I'll start by asking you:

- Prior to hearing about the plans for Grattan Square, what was your experience of 'Smarter Travel'? How successful have they been?
- Main purpose of 'Smarter Travel'? Is it mainly for children? (definitions) Is it to create a vibrant town centre? Is it needed?

The rest of my questions are related to issues that were the dominant themes that emerged from the interviews in 2011

- Hard measures before soft measures – What should their priority be?
- What role is there for 'Smarter Travel' in the town centre?
- What has been your experience of their plans to redesign Grattan Square?
    - What are their motives?
    - Consultation?
    - Does car accessibility equate to retail trade?
    - Any suitable compromise?

Kilkenny trader topic guide 2013:

Background

2 years ago I interviewed several people in both Kilkenny and Dungarvan to talk about the implementation and development of 'Smarter Travel' policy. The idea was to help explain the obstacles to 'Smarter Travel' or the factors that are accelerating its implementation in Kilkenny/Dungarvan. I interviewed people from the local authority, community advocates of 'Smarter Travel' and also people who were resistant to current 'Smarter Travel' policy. So now I'm going back to these people again and doing a sort of a review of progress 2 years on.

So I'll start by asking you what progress has been made since then?

- How successful have they been?
- What has contributed to this?
- What factors have slowed the progress?

The rest of my questions are related to issues that were the dominant themes that emerged from the interviews in 2011

- Impact of potential pedestrianisation on traders?
- Hard measures before soft measures – what should their priority be?
- What role is there for 'Smarter Travel' in the town centre?
- What has been your experience of the 'shared space' scheme?
- What are their motives?
- Consultation?
- Does car accessibility equate to retail trade? How?
- Any suitable compromise?

7C Code book

Code Name	Code description
1. Adopting a nanny state approach	Includes accusations of the council being too directive from non-council interviewees and directive type language from council interviewees.
2. Moving beyond infrastructure	Priority being given to infrastructure first and then the recognition of the need to introduce softer measures. Only include information relating to priorities/order of events. Don't include discussion of softer measures.
3. Inadequacy of statutory consultation	How to define success. Don't include examples of better practice but more the general sentiment that statutory consultation doesn't work and why.
4. Valuing the roles of the project team	How to engage and utilise the steering committee members. The benefits of having them etc.
5. Diverging definitions of 'Smarter Travel'	This relates to the several definitions of 'Smarter Travel' given by the local authority, traders and community advocates. Includes the geographical focus, travel or recreation, strategy type. Is it for tourism, health, reducing congestion etc? Why it was started etc.
6. Engaging key stakeholders	Include how to negotiate with them effectively and any evidence of actions or commentary that suggests the traders are partners in the process and not merely people to be consulted with. Also content related to addressing the fears of other stakeholders and how to address it.
7. Economic importance of accessibility for cars	Trader fears of reduced retail sales due to reducing urban accessibility for cars – either through reduced parking or pedestrianisation or traffic calming. Only include data relating to unsupported commentary but all information relating to reducing car accessibility. Include any statements to the contrary i.e. reducing car dependency increases economic activity
8. Meeting the requirements for pedestrianisation	What are the criteria or conditions required for pedestrianisation before its introduction?
9. Understanding what shoppers want	Evidence to support the contrasting opinions of traders and shoppers in relation to their preferences for their town centre.
10. Using subjective or contested evidence	Examples of evidence being used to support own beliefs or evidence being misused or not being sought at all.
11. The power of the trader lobby	Include only examples of language indicating the weight of their influence
12. Making ST visible	This is about creating as culture of 'Smarter Travel' where

	people accept it as a cultural norm. Seeing people walk and cycle for transport encourages others to do likewise. Show people the benefits as a means of changing the cultural norm
13. Breaking with conventional design	This includes evidence that the project team is either engaging new design ideas or sticking with traditional/conventional designs. It also includes suggestions made from non-local authority interviewees. Don't include contested research data. Include data related to calls for better quality project management.
14. Implementing incremental actions	The best way to introduce ST initiatives is by implementing them slowly and with sufficient communication. No big bang approach i.e. don't just implement pedestrianisation straight away. Example of implementing the new one-way system.
15. Mistrust of local authority	Mistrust may be due to 'Smarter Travel' motivations, previous relationship, poor planning previously or purely anti-government sentiment -
16. 'Smarter Travel' advocates	The support received from the local authority management but predominantly the personal motivations and commitment of project leaders. Don't stray into definitions of 'Smarter Travel'
17. The silent majority	Include anecdotal evidence of the project working and commentary relating to a small number of people making a lot of noise
18. Signposting new infrastructure	This includes the contrasting views on the purpose of softer measures i.e. to inform people of the presence of new infrastructure or to address correlates of change
19. Prioritising schools	This is about the reasons the local authority have for specifically targeting schools
20. Engaging traders	Information from all stakeholders about how traders can be engaged more successfully. Avoid focusing on the problems – explore solutions
21. Engaging wider community	This is about harnessing the support of the silent majority – how can it be done successfully

7D Local print media analysis

The volume and type of local print media stories[1] about walking and cycling for transport in the intervention towns from May 2010 to May 2013[2]

	Town 1 (n)	Dominant themes	Town 2 (n)	Dominant themes
Positive				
2010-11[3]	6	schools, new traffic flow measures	12	new pedestrian infrastructure, schools
2011-12	12	schools, new infrastructure	25	funding awards
2012-13	13	Schools, new infrastructure	30	GO Dungarvan activities (new hard & soft measures)
Total	31		67	
Negative				
2010-11[3]	3	failure of one-way system	9	quality or lack of pedestrian infrastructure
2011-12	4	political resistance to 'Smarter Travel'	17	quality or lack of pedestrian infrastructure
2012-13[4]	1	design of cycle lanes	8	noise and inconvenience of speed ramps
Total	8		34	

[1] *The newspapers were the Kilkenny People and the Dungarvan Leader.*

[2]*The three time periods were May 2010 – April 2011 (baseline), May 2011 – April 2012 (intervention year 1) and May 2012 – April 2013 (intervention year 2).*

[3] *In April 2010 (immediately before the inclusion period) there were 10 articles published in relation to the implementation of a one-way traffic system in Kilkenny (7 negative, 3 positive).*

[4] *From September 2013 to date there were several prominent articles published in relation to the redesign of Grattan Square in Dungarvan. There number of positive and negative stories was approximately equal.*

7E Literature review pertaining to issues examined in chapter 7

Reducing car accessibility in urban centres

The value of cars to retail trade

Restricting the accessibility of urban centres for cars is a contentious issue in traffic management. In particular there is a belief that car drivers are more valuable to retail trade than pedestrians and cyclists (Marsden, 2006; Rowe, 2013). The available literature, though limited and mostly restricted to larger cities, would suggest otherwise. This over-estimation of the importance of the car to retail trade is grounded in two misconceptions about car drivers.

Firstly, traders over-estimate the percentage of their customers that arrive by car compared with other modes. In the UK, traders in Bristol perceived twice as many shoppers arrived by car than was actually the case (see figure 7a; Sustrans, 2006). The same extent of over-estimation has also been shown in Rotterdam (van den Bulk, 2011) and Dublin (O'Connor, Nix, & Bradshaw, 2011). In each of these studies, walking was the most commonly used mode of transport for shoppers. Irrespective of how shoppers arrive in retail areas, evidence of their spending habits is of greater importance to this debate. This is the second misconception.

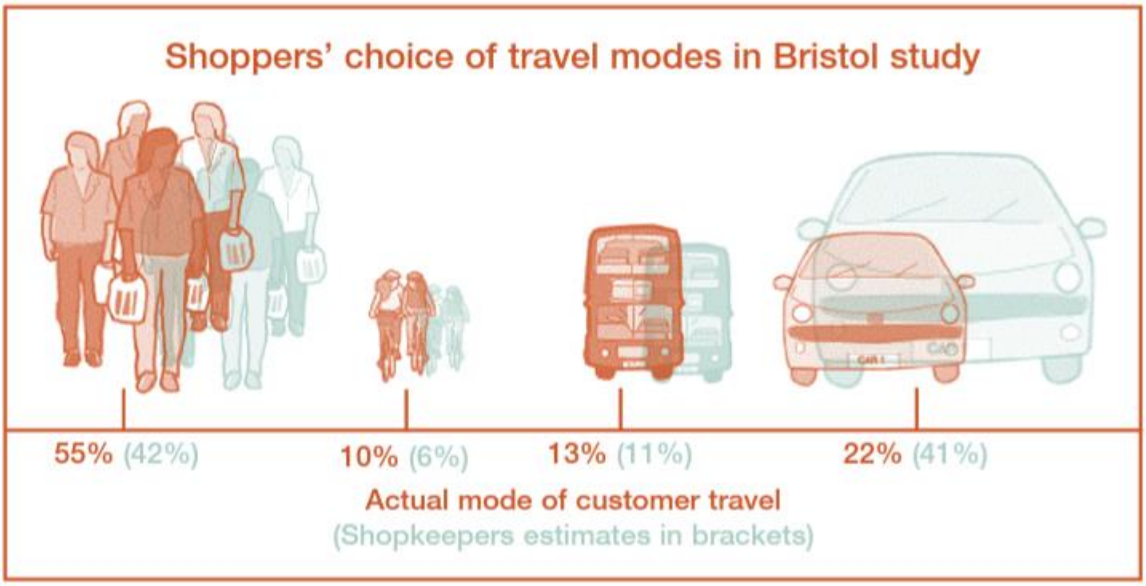


Figure 7a *Shoppers actual mode of travel compared with traders estimates (Sustrans, 2006)*

Largely without exception, car drivers typically spend more per trip than either cyclists or pedestrians. This was highlighted by Fleming, Turner, and Tarjomi's (2013) study of shoppers (n = 1744) in nine retail areas across New Zealand. Car drivers typically spend NZ$12 more per trip than those arriving in the city centre by sustainable modes. The authors do concede that the frequency of trips and the social class of shoppers were not measured. A more accurate way of determining the relative importance of the car is by measuring monthly or yearly spending by modal share. In Copenhagen, where cycling is the principal mode of travel for the majority of the population, walkers and cyclists account for 55% of traders yearly revenue compared with 32% by car drivers (Kåstrup, 2013). This trend is also evident in cities without a tradition of active travel. Clifton et al., (2013) compared the spending habits of drivers, pedestrians and cyclists in convenience stores, restaurants and bars in Portland, Oregon. The results of consumer intercept surveys (n = 1884) across 78 businesses indicated that walkers and cyclists typically had a lower spend per trip than car drivers. However the active travel users reported more frequent trips and consequently had significantly greater monthly spends. Lee and March, (2010) reported similar trends in that shoppers arriving to a suburban retail district in Melbourne by car spent more than those arriving by bike. In an Irish context, it has been shown that shoppers with the greatest monthly spend on Grafton Street and Henry Street (Dublin City Centre) arrive by bus (38%). Furthermore, walkers were more lucrative to traders than car drivers, accounting for 17% and 15% of monthly spend, respectively (O'Connor et al., 2011).

Parking restraint policies

Modal shift or change in destination?

Parking restraint policies include the reduction in supply of parking or increasing the price of parking. The use of such policies by local authorities can potentially serve three main purposes; the generation of revenue, reduced traffic congestion and improved vitality and vibrancy of an urban centre. Traders often express fears that parking restraint in urban centres forces shoppers to larger retail centres on the fringes of town. This has been borne out in many cases (Banister, 2009.; Marsden, 2006). Burd-Eden and Shiftan, (2001) provide further evidence for such an effect in Haifa, Israel. This study examined the likely actions taken by workers and non-workers if parking supply was reduced or became more expensive thereby increasing their search time for a space. Non-workers were more sensitive to parking restraint than workers with more than half indicating that they would cancel their trip and choose a different destination. The results of this study suggest that traders may have genuine reason for concern. It should also be noted however that such evidence has a geographically specific context when a viable alternative exists (i.e. peripheral retail areas). It may also depend on the extent and quality of the public transport infrastructure in a given area. Marsden (2006) points out that this only becomes a concern when parking restraint policies are applied inconsistently throughout a wider urban region. Moreover, the majority of the available evidence suggests that these policies are not a deterrent for travelling to a town centre.

The potential consequences of increasing the cost of paid parking have been examined in several studies. Hensher and King (2001) conducted a stated preference study with car drivers in Sydney. They were asked to choose their most likely travel behaviour response to several potential parking restraint measures (cost and time restrictions). Virtually no one indicated that they would cancel their trip. Switching to public transport and parking further away were the most likely outcome. This trend has been observed in other studies in Belgrade (Simićević et al., 2013) and Edinburgh (Ryley, 2008). Only 2% of those travelling into Belgrade centre indicated that they would cancel their trip in response to the increased cost of parking. In contrast to Burd-Eden and Shiftans' (2001) findings, workers were more sensitive to paid parking than other visitors. Interestingly, there is evidence that where the urban environment is compact and conducive to walking as is the case in Edinburgh, car parking restraint policies can create a modal shift to walking (Ryley, 2008). This study surveyed 977 Edinburgh residents to examine the relative influence of increased travel time, parking charges and fuel costs on their decision to walk instead of drive. Only 16% of the sample stated that they would choose to walk in response to a 25% increase in fuel prices. The increased cost of parking was the most influential factor overall but more pronounced for women and low-income groups. This suggests that these policies will be less effective if implemented in isolation. Such hypothetical scenarios may also be insufficient to satisfy traders' concerns about the impact on trade.

Impact on retail trade

Two Dutch studies have measured the business impact of parking restraint measures and reported no negative relationship between such measures and retail trade. Mingardo and van Meerkerks' (2012, p. 195) study challenges the 'widespread belief that parking plays a fundamental role in the performance of shopping areas'. They assessed parking supply and retail turnover (i.e. number of shoppers) over a one year period in 80 retail areas (both urban centre retail strips and regional shopping areas) across the Netherlands. They sought to answer one principal research question; whether parking supply was related to retail turnover. Contrary to traders' beliefs, logistic regression analyses revealed a positive relationship between higher parking charges and turnover. There was also a positive relationship between parking supply and turnover but only in regional shopping areas. These results were supported by Koetse and Rietveld (2008) who found limited negative consequences for the retail sector arising from increased parking prices across Dutch cities. The authors caution against relying on pricing policies alone due to the impact parked cars have on the attractiveness of historical centres. Indeed studies have shown that replacing a car space with bike parking will not only make the space more attractive but generate up to five times more revenue than the car space did (Kåstrup, 2013; Lee & March, 2010)

Such counterintuitive findings are not limited to countries with pedestrian and cycling cultures. Leitman (2013) examined the impact of introducing free parking in the central business district of Eugene, Oregon on retail trade. The two hour free parking initiative was introduced in 2010 to stimulate retail trade in the area. Both traders and the public alike were supportive of the initiative. Eighty percent of the public perceived the initiative to be good for business yet the traders (n = 62) did not report any significant change in retail trade. Furthermore, the majority of traders were concerned about the number of employees using the free spaces themselves.

Although they have been shown to create a modal shift to active travel, car parking restraint measures have been cited as, politically, the least feasible of all measures to promote active travel (Simićević et al., 2013). Riley (2008) points out that such 'stick' approaches are best introduced alongside 'carrot' approaches such as improving the public realm, pedestrianisation and improving accessibility for cyclists.

Car-free urban centres

The evidence that pedestrianisation benefits retail trade is unequivocal. Although not without its shortcomings, empirical evidence from around the world suggests that traders can expect footfall, profits and the value of their retail space (measured by retail rent) to increase after the introduction of pedestrianisation schemes in urban centres. There are several potential mechanisms to explain these trends. Creating a modal shift away from motorised transport may result in a households fuel and vehicle spending being transferred to other areas of the local retail economy (Litman, 2015). Parkhurst (2008) provides more likely scenarios;

> *First, many cars may simply be 'in transit'. Second, suitable travel alternatives such as P&R [park and ride] sites outside the urban area may be acceptable. Whilst motorists may insist on the benefits of car use from their points of departure, given a suitable travel alternative they may be prepared to trade car use right up to the destination with wider benefits, such as freedom to wander. Third, traditional centres have other strengths, such as 'character,' which are hard to recreate in new centres. Hence, traditional centres can offer a diversified product, which appeals to particular market niches, both in terms of suppliers and consumers.* (p. 19)

The pedestrianisation of the main shopping street in Copenhagen in 1962 was one of the earliest examples of its introduction (Lemberg, 1990). The city's shopkeepers, police and principal engineer were all vehemently against the scheme. Their fears proved unnecessary however as traders saw an increase in turnover and profits. The expected dispersion of congestion to the adjacent streets never materialised with only approximately 72% of the traffic being displaced. Coupled with the increased footfall in the shops, this suggests that the scheme prompted a shift to sustainable modes of transport into Copenhagen. The traders consequently became powerful supporters of plans to pedestrianise other areas in the city.

The pedestrianisation of urban centres became mainstream in Central Europe throughout the 1970's. The work of Hass-klau (1993) provided early evidence for the success of these schemes across several cities in Germany. In each of the cities studied there was an increase in pedestrian flow ranging from 18-69% in the years following pedestrianisation. This translated into higher market rents and a significant increase in trade for the retail and restaurant sectors. The most extensive schemes experienced the most pronounced gains and there was some evidence of a short-term (1-2 years) downturn in trade during the implementation phase. This long-term benefit to the retail sector was also found in Sandahl and Lindh's (1995) study of the economic impact of pedestrianisation and town centre management in six Swedish towns. Of all the measures introduced, including improved public transport, pedestrianisation had the greatest impact on retail turnover and the perceived attractiveness of the area by visitors.

The UK has been slower to embrace pedestrianisation because it was traditionally only justified based on accident prevention and speed reduction related to the implementation costs. Nonetheless, the impact of pedestrianisation in the historic English cities of Oxford (Parkhurst, 2008) and York (Banister, 2009) provided early evidence of its effectiveness. Thirty nine of York's city streets were pedestrianised in 1987 without the support of the business community. One year later, after experiencing the benefits of the scheme, the majority of the traders (75%) supported its continuation. The only notable negative impact of the scheme was that, unlike Copenhagen, the city centre traffic was displaced into the residential areas on the periphery of the city. This put the local authority under financial pressure to implement more wide-ranging traffic management measures.

The impact of the scheme in Oxford in 1999 mirrored those described by Hass-klau (1993) in German cities. There were an increased number of visitors to the city and they travelled more by bus and walking. The scheme was controversial due its impact on traders. Two afters after the introduction of the scheme, the retail rental market and turnover had improved but many traders had experienced up to a 20% reduction in sales during the 1-2 year implementation phase. Parkhurst (2008) notes that the local authority did not invest in enhancing the streetscape to the extent they would have liked and that this may have contributed to the short-term decline in trade. He also highlights the legal requirement for traders in Germany and Denmark to contribute financially to their adjacent streetscape. The short-term downturn in trade is not the only side-effect of pedestrianisation.

The increase in the price of renting retail space in pedestrianised streets is an indicator of its retail trade value. Ultimately this leads to more premium chain stores locating in the area. While this is economically important for the wider retail area, it may also serve to squeeze out the smaller independent traders and reduce land use mix (Topp & Pharoah, 1994). Not all sectors are likely to benefit from it equally. Hass-klau (1993) cited the retail and restaurant sectors as being most likely to see an increase in trade but hotels reported no improvements. It is also likely that traders selling heavy or larger goods would see downturns in trade (Wallar, n.d.).

Improving the cycling and pedestrian infrastructure

Improving cycling infrastructure

There are a relatively small number of studies that have assessed the impact of improving cycling infrastructure on retail trade. Those that have been done are specific to North America, are focused on the introduction of cycle lanes and tend to be predominantly grey literature.

The earliest of these studies was a retrospective study of traders in San Francisco four years after the introduction of a cycle lane outside their premises (Drennen, 2003). Of the 27 traders who were interviewed, 65% stated that it had a positive impact on their business and that they supported further measures to promote cycling. These findings are supported by research conducted with traders in Toronto, Canada (Clean Air Partnership, 2009, 2010). Traders at opposite ends of a cross-city retail strip were asked to estimate the potential impact on their business of removing half of the car parking and introducing a cycle lane in its place adjacent to their business. More than half of the traders believed that the measure would increase or have no impact on their sales.

Other studies have attempted to conduct more objective economic assessments of the impact on business. The City of Vancouver trialled two separated two-way cycle lanes in June and December 2010. Several traders expressed concern over a downturn in trade subsequent to the introduction of the first cycle lane. This prompted the project stakeholders to employ an independent consultancy firm to measure the actual impact of the second cycle lane on retail sales (Stantec Consulting Limited, 2011). They reported a 10% and 4% reduction in retail sales in the two streets with cycle lanes. This represents $2.4 million in lost sales annually. The authors do acknowledge several limitations of the study; there were several other possible confounding factors evident during or just prior to 2010; the sales data were self-reported and may have resulted in response bias; the response rate was only 32% and the research only measured the short-term effects (two months).

> *As with any major infrastructure change in a city there is normally an adjustment period, so it may take years for the business impacts to become clear and definitive. Impacts may continue to be felt in the coming months but will likely decline as the City takes steps to mitigate the blocks where the impacts are greatest. (* p.2)

Rowe (2013) attempted to address many of these limitations in research conducted on the introduction of a cycle lane and the removal of 12 parking spaces to facilitate a cycling climbing lane in a downtown retail district in Seattle. Rowe's (2013) research design was more robust due to the actual taxable retail sales being sourced from the Department of Revenue and the data being collected for one year prior to the cycle lanes being introduced and two years post. There was no negative impact on retail trade adjacent to the cycle lane and there was a 400% increase in retail sales in the businesses adjacent to the climbing. Rowe (2013) acknowledges that this is unlikely to be attributable to the new lane but it at least provides evidence that retail sales are not negatively impacted.

Improving pedestrian infrastructure

The evidence supporting the positive economic impact of pedestrianisation is established and has been discussed in the previous section. There is also evidence, to a lesser extent, to suggest that improving the infrastructure for pedestrians alongside introducing some element of traffic calming increases retail sales in that area (Lawlor, 2013). This has prompted trader support for the 'shared space' concept (Hamilton-Baillie, 2008) whereby the infrastructure segregating cars and pedestrians is removed and speed limits are lowered. The economic impacts of 'shared space' schemes are not well understood. Although there is some positive economic evidence emerging from shared space schemes it is likely that the catalyst has been reduced vehicular speeds or increased pedestrian friendliness, not necessarily due to shared space (Moody & Melia, 2013).

One of the most extensive studies examining the impact of pedestrian infrastructure is provided by the Commission for Architecture and the Built Environment in the UK (Commission for Architecture and the Built Environment, 2007). This study measured the relationship between the quality of street design and retail rents using the Pedestrian Environment Review System (PERS). The PERS assesses several variables associated with a street such as the quality of the environment, personal security, permeability, user conflict, surface quality etc. A PERS score (on a seven point scale) was calculated for 10 high streets in London along with related data on retail rents. They found that for every one point increase on the PERS scale there was a corresponding £25 per metre squared increase (4.9%) in retail rent. One of the potential mechanisms for this may be that the area becomes more attractive for the shopper. This is highlighted by Litman (2013);

> *Pedestrian environments serve many functions and are a critical part of the public realm (public spaces where people naturally interact). On sidewalks and paths people stand, wait, socialize, play, eat, work and window-shop, and these facilities are an important part of the landscape. Improving pedestrian environments can improve the utility and enjoyment of these activities, and create more attractive communities.* (p. 17)

Shoppers preferences for urban centres

Accessibility ('ease to reach activities or locations') and attractiveness ('quality and quantity of the options available in order to spend time usefully') of a town centre tend to be the most frequently cited factors influencing shoppers choice of shopping destinations (Thull & Mersch, 2005, p. 4068). As shown in 7.3.1 above, traders overestimate the percentage of their customers that travel by car. Such misconceptions are also evident when comparisons are made between traders and shoppers perceptions of the factors considered most important about the retail environment. Traders perceive the accessibility of the area (e.g. provision of car parking) to be more important than it actually is (Fleming et al., 2013).

Teller and Reutterer (2008) conducted a survey of 2000 Viennese shoppers in a peripheral mall and an inner city retail strip to identify the relative importance of accessibility and attractiveness in their decision of where to shop. They concluded that the tenant mix, fun and atmosphere in the retail area are more important than accessibility and parking specifically. This is supported by Fleming et al., (2013) who found that shoppers in Wellington, New Zealand (n=65) prioritised the attractiveness of the retail area, it's safety (pedestrian crossing points), good urban design and a good mix of quality shops. Of these, the latter appeared to be the most important to shoppers. Notably, shoppers indicated that they would be willing to walk further to parking to reach such a retail environment. Also in New Zealand, shoppers in Christchurch (n=340) (where the car is given greater priority than in Wellington) indicated a preference for more greenery and car free streets to improve the attractiveness of the city. One-way streets were less attractive than two-way because of the increased speed of traffic on the former (Thull & Mersch, 2005). The authors suggest that both accessibility and attractiveness are highly correlated and one can influence the other. For example, poor internal accessibility for pedestrians and cyclists is likely to impact on retail attractiveness.

Engaging the engineers, planners and politicians

Stakeholder consultation is a legislative requirement in Ireland and is something that has been recognised to improve the quality of sustainable transport projects across Europe. Conducting a stakeholder analysis is one of the most important early tasks in good consultation practice. This was just one of the findings reported in the Civitas (2011) review of the consultation process undertaken in over 60 European demonstration cities for sustainable transport development. Traders and the end users (wider community) are two key stakeholders in the context of this study.

Traders

Moutou and Mulley (2012) examined the potential for the business community to shape the provision of sustainable transport in central business districts in Sydney. They provided evidence from several case studies that highlight displays of power from the business community to either protect or advance their self-interests. This has resulted in both the abandonment and acceleration of the projects implementation depending on the relationship between stakeholders. This has also been seen in an Irish context whereby traders are currently lobbying for the pedestrianisation of Dublin 2 but lobbied for the reversal of schemes in Dun Laoghaire and Sligo (Ginty, 2012). Although Moutou and Mulley (2012) provide no concrete strategies for creating a synergistic dynamic between the local authority and traders, they emphasise the importance of recognising the power of the business lobby.

Wallar (n.d.) provides some practical guidance for local authorities on how to achieve a more synergistic dynamic with traders before introducing pedestrianisation. Firstly, a campaign should be developed to educate traders on case studies from other areas. The Clean Air Partnership (2009) also suggests measuring the business communities' perceptions of the potential retail impact of the measure being introduced. This gives the local authority a more representative view of trader support. Taken together, these tasks foster a good working relationship with traders from the outset. In the event of this not working the Civitas review (2011) states that when two groups have polarised views of how to achieve certain objectives they should be focused on separately. This serves to identify the specific points of conflict but also areas of agreement between both parties.

In the event of the two parties not reconciling, ongoing communication from the local authority is essential. Waller (n.d.) then recommends an intensive period of objective data collection before any pedestrianisation. The data should include numbers of window shoppers and actual customers. This is followed by an experimental closure during periods of expected good weather or before Christmas. Further data is then collected during the experimental closure before any decision is made to extend the permanency of the scheme. If this decision is taken, then a public awareness campaign and improvements to the public realm of that area are critical.

The wider community

The media and local champions are two of the most important and most overlooked stakeholders in urban active travel projects. They both have a significant impact on public acceptance of the project and generate political support for it. The media also serve to raise awareness of the project objectives in the community e.g. the public may not be aware of the mobility barriers experienced by parents with young children, older people and those with disabilities. The consultation process is likely to be more effective when there is widespread public acceptance for the philosophy and business case for the project (Civitas, 2011). This is evident not only in European projects but also across America.

The Living Streets (Sagaris, 2009) and Ciclovías (Sarmiento et al., 2010) projects in Santiago, Chile and Bogota, Colombia, respectively, have demonstrated how effective community engagement is an essential ingredient for project success. Community ownership and control was a key feature of the Living Streets initiative where the community was mobilised by opposing the construction of a highway. The knowledge they gained about the health impact of transport and their experience of influencing policymakers prompted them to continue to promote active travel. Their organisation provided a crucial link between ordinary people and policymakers. Indeed many of the Ciclovías (events where city streets are closed for traffic usually on a Sunday) that have been organised across Latin America were set up as a result of community advocacy groups. Where political support for Ciclovías declined, again community advocates pressurised government into maintaining them. The Ciclovías concept and philosophy has been replicated in many cities in North America. Zieff, Hipp, Eyler, and Kim (2013) describe the factors that contributed to the success of Ciclovías in California and

Missouri. Although these events were more top-down, getting community buy in was essential. The awareness raising activities included monthly meetings with key stakeholders, focused marketing, utilising Twitter and Facebook and creating partnerships with local newspaper and radio stations. The organisations with limited financial or human resources were less successful.

The Ciclovías concept is akin to repeated trialling of car-free days in urban centres. The trialling of sustainable transport policies is something which is advocated by Waller (n.d.) as described above. Winslott-Hiselius, Brundell-Freij, Vagland, and Byström (2009) provide further support for this approach. Their study of the trial congestion charging in Stockholm showed that the trial period had a greater impact on changing public attitudes than awareness-raising. The trial allowed the public to better understand the measure and experience its benefits. Such action, whether on a trial or permanent basis, requires policy makers to make bold decisions using the best evidence available "but in a whirl of lobbying, conflicting advice, commercial marketing masquerading as science, and media simplifications, how can they tell which evidence to trust?" (Insall, 2009, p. S21). This is compounded by traffic engineers' inexperience in the areas of active travel and the public's affinity with the car (Cole et al., 2010). In the absence of innovative and exciting multi-level active travel policies, cities are unlikely to reduce car travel. This is the case in several Swedish cities which have been unsuccessfully trying to increase modal share for cycling since the 1990's (Robertson & Aretun, 2013).

Summary

Traders overestimate the importance of the car to their retail trade and have the power to shape the direction of sustainable transport measures in urban centres. The best available evidence suggests that these fears are unfounded. On the contrary, there is an argument that areas with high levels of car accessibility (to the detriment of the walking and cycling environment) are harmful to retail trade. Parking restraint policies, improvements to the cycling and pedestrian infrastructure and full pedestrianisation have all been shown to have no negative impact on retail trade. Several studies prove that cyclists have a higher yearly retail spend than car drivers. There is also strong evidence to suggest that pedestrianisation and improved walkability will have a positive impact on retail turnover and rents. The most likely mechanism to explain this is the greater importance shoppers place on the attractiveness of a retail strip than its accessibility. The negative aspects of pedestrianisation include the potential for a short-term downturn in retail trade and the displacement of traffic to adjacent streets. The characteristics of the most successful active travel projects include; implementing a suite of complementary measures; making bold decisions; fostering community empowerment; getting a representative view of traders opinions; developing targeted campaigns for the public and traders; identifying a community champion; partnering with local media and trialling new measures at times when retail footfall is expected to be high. The projects with limited financial or human resources are typically less successful.