

Development and feasibility of an intervention to promote active travel to school

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**Thesis submitted in partial fulfilment for the
qualification of Doctor of Philosophy**

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June 2016



Abstract

Introduction: Active travel to school (ATS) is a source of physical activity for children.

Aim: a) Develop an ATS intervention and b) test its feasibility in Year 5 children.

Methods: a) Intervention development: Review of ATS and other relevant interventions; review of behaviour change theory; public involvement. Intervention: every ATS day equalled one ticket into a £5 voucher draw. b) Feasibility testing: Cluster-randomised pilot trial in two primary schools with process evaluation. Daily outcome measures: parental ATS reports (optionally by SMS); child ATS reports; accelerometry (moderate-to-vigorous physical activity [MVPA] during journey to school).

Results: a) Limited evidence for ATS intervention effectiveness but some evidence for using incentives in health promotion. Twelve theories identified but their utility for ATS intervention development was unclear. Eight families, a head teacher, and a young person's group supported the development of an ATS incentive scheme. b) Four schools agreed to participate in the study (3.3%) and two were selected, 29 child-parent pairs were recruited (33.0%), and 27 retained for the 9 week study (93.1%). Materials returned on time: accelerometers (81.9%), parental ATS reports (82.1%), and child reports (97.9%). Parent-child agreement on school travel mode was moderate ($k=0.53$, CI 95% 0.45; 0.60). MVPA differences (minutes) for parent-reported 'ATS vs non-ATS trips' were significant, during parent-reported times as corresponding to the school journey ($U=390.5$, $p<0.05$; 2.46 (n=99) vs 0.76 (n=13)) and in the pre-classes hour ($U=665.5$, $p<0.05$; 4.99 (n=104) vs 2.55 (n=19)). MVPA differences for child-reported 'ATS vs non-ATS trips' were also significant, both during parent-reported trip times ($U=596.5$, $p<0.05$; 2.40 (n=128) vs 0.81 (n=15)) and the pre-classes hour ($U=955.0$, $p<0.05$; 4.99 (n=146) vs 2.59 (n=20)). In a process evaluation, interviewees reported that procedures were generally appropriate.

Conclusion: An ATS incentive scheme seems feasible. ATS reports showed validity vis-à-vis accelerometry. Further work is required to improve recruitment.

Acknowledgements

This thesis was possible thanks to the contribution and support received from many people. First, I express my gratitude to my supervisors: Professor Elaine McColl, Dr Bronia Arnott, Dr Vera Araujo-Soares and Dr Anil Namdeo. Their support was vital to the success of this project.

Thank you also to the MOVE Project (Durham University) for the loan of 90 accelerometers and accessories, to my PhD funder (Sir James Knott Fellowship), to the Catherine Cookson Foundation for the award of £2100 for my research, and to the NIREs (now IfS) for the provision of 10 brand new accelerometers and accessories (worth £1750) at the very beginning of this project.

Other people were extremely helpful throughout this PhD, including Liane Azevedo, Ash Routen, Shannon Robalino, Alan Barlow, Dorothy Newbury-Birch, Carol O'Brien, Justin Presseau, Margaret Bell, Niina Kolehmainen, Nina Wilkinson, Suzanne McDonald, Falko Sniehotta and Raghu Lingam. I am also very grateful to all the children, parents and school staff who took part in the RIGHT TRACKS study, from its inception to the fieldwork.

To my family, particularly my parents, brother and sister, my 'muito obrigado'.

It is impossible to mention and thank all the friends who helped me one way or another, but here are a few: Angela, Lucy, Sebastian, Rashmi, Majid, Erica, Helio, Dominika, James, Sandra, Mariana, Sofia, Raquel, Cassandra, and all the other Portuguese residents in Newcastle with whom I had so much fun. To the people I lived with, Laura, Maria, and many others.

A special thank you to Yan for accompanying me throughout this journey.

Presentations

Oral presentation:

Ginja, S., Arnott, B., Araujo-Soares, V., & McColl, E. *The RIGHT TRACKS study: feasibility of an incentive scheme to promote active travel to school.* (2014). Third Fuse PA Workshop, Middlesbrough, 8th October 2014.

Poster presentations at international and national conferences:

Ginja, S., Arnott, B., Araujo-Soares, V., Namdeo, A., & McColl, E. 2014. *The Right Tracks Study – Development and Piloting of an Incentive Scheme to Promote Active School Travel in Year 5 Children: Research Protocol.* 28th Conference of the European Health Psychology Society, Innsbruck, 26th to 30th August 2014.

Ginja, S., Arnott, B., Araujo-Soares, V., Namdeo, A., & McColl, E. 2015. *Development of an intervention to promote active school travel.* 11th UKSBM Annual Scientific Meeting, Newcastle, 8th – 9th December 2015.

Ginja, S., Arnott, B., Araujo-Soares, V., Namdeo, A., & McColl, E. 2015. *The RIGHT TRACKS study – feasibility of a lottery-based incentive scheme to promote active travel to school.* 11th UKSBM Annual Scientific Meeting, Newcastle, 8th – 9th December 2015.

Ginja, S., Arnott, B., Araujo-Soares, V., Namdeo, A., & McColl, E. 2015. *Process evaluation of the RIGHT TRACKS study: a feasibility test of an incentive scheme to promote active travel to school.* 11th UKSBM Annual Scientific Meeting, Newcastle, 8th – 9th December 2015.

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Chapter 1 - Introduction

1.1 Thesis overview

My aim in this PhD project was to develop and test the feasibility of an intervention to promote active travel to school (ATS). In Chapter 1, I present a background review of the active school travel (AST)¹ literature. In Chapter 2, I describe the development of an ATS intervention, including a review of the evidence base of previous interventions, relevant theory and a model of processes and outcomes, following existing guidance by the Medical Research Council (MRC). In Chapter 3, I address public involvement in the refinement of the intervention and preparation for the next phase. In Chapter 4, I describe the pilot trial which tested the feasibility of an incentive scheme to promote ATS and of associated trial procedures. In Chapter 5, I focus on the process evaluation which consisted of a qualitative study to further investigate the feasibility and acceptability of the proposed procedures. Finally, in Chapter 6, I summarise the main findings presented in Chapters 4 and 5, followed by an overall discussion and conclusion.

1.2. Background

Behaviour change interventions targeting children have the potential to prevent or lessen unhealthy behaviours or otherwise detrimental lifestyles, which could, if unchecked, persist into adulthood. The study of AST is important for child health for at least two reasons: AST is related to child physical activity (PA) and also to the impact of motorised means of transportation on the environment and health.

1.2.1 Low levels of PA in children

Physical activity has been defined as “any bodily movement produced by skeletal muscles that requires energy expenditure” (WHO, 2016c). Sedentary behaviour involves minimal body movement, such as sitting or lying. According to guidelines applicable to the UK (NHS, 2015; WHO, 2016c), children and adolescents (5-18 years old) should accumulate at least 60 minutes of moderate-to-vigorous intensity

¹ AST will be used when referring to travelling in the school context, to and/or from school, with no particular focus on either of them. Most of this chapter will be about AST in the broad sense of the term. ATS will be preferred when the focus is on the journey to school, as in the pilot study described later in this thesis.

PA (MVPA) daily. The concept of accumulation refers to meeting the goal of 60 minutes per day by adding together the time spent in multiple shorter bouts throughout the day. Examples of activities that require moderate effort for most young people include walking (which may consist of walking for travel purposes), playing in the playground, or riding a bike on level ground. Activities requiring vigorous effort for most young people include running, energetic dancing, playing football, and riding a bike fast or on hilly ground. Guidelines also recommend minimising sedentary behaviour, for example by reducing time spent on the computer, or swapping a long car/bus journey for walking part of the way.

The Health Survey for England (HSE) is an official source of nationwide health-related data, including PA in children (Fat, 2015). The latest survey addressing PA indicated that, in children aged 5-15 years, 21% and 16% of boys and girls respectively were classified as meeting current guidelines (Scholes and Mindell, 2013). Among both sexes, the proportion meeting guidelines was lower in older children. The proportion of boys meeting guidelines decreased from 24% in those aged 5-7 to 14% aged 13-15. Among girls, the corresponding decrease was from 23% to 8% (Scholes and Mindell, 2013).

The 2008 HSE was the last one to include objective measures of PA, namely accelerometry (Craig R *et al.*, 2009). At that time, based on self-reported data, 31% of boys and 22% of girls aged 4-15 met PA recommendations². Overall, these estimates were close to the proportions meeting recommendations according to accelerometry, 33% and 21% respectively. However, there were some discrepancies between the two classifications, based on those children with both measurements. Accelerometry indicated a much larger contrast between younger and older children than was apparent with self-reported data. Furthermore, self-report may underestimate MVPA in younger children, and over-estimate among older children.

Overall, the above figures suggest that the vast majority of English children are insufficiently active and that girls are less active than boys. It also indicates that the number of those reporting sufficient levels of PA has fallen over the years, but accelerometry data supporting these trends is not yet available in nationally representative samples.

² These figures include 4 year olds for whom PA recommendations are different and are not covered here.

There is compelling evidence relating lack of PA to higher mortality rates and to a range of health risks including higher BMI (Eisenmann *et al.*, 2002), obesity (Janssen *et al.*, 2005), lower cardiovascular (aerobic) fitness (Strong *et al.*, 2005), lower muscular fitness (Martínez-Gómez *et al.*, 2011), metabolic syndrome (Ford *et al.*, 2005) and other medical conditions (Garcia-Aymerich *et al.*, 2006). Obesity and overweight (excessive body fat) are of particular interest because of their impact on a number of other conditions and due to their pervasiveness throughout an individual's lifetime. The body mass index (BMI) is a common way of assessing a person's weight status, by dividing a person's weight (kg) by the height (m²) (NHS, 2014). In children, however, the BMI is a less accurate measure of adipose tissue because of the physiological changes their bodies undergo during growth, and an alternative use of BMI for children consists of centile curves averaged to provide age and sex specific cut off points for children from 2-18 years (James *et al.*, 2012).

It is estimated that 170 million children under the age of 18 are overweight worldwide (WHO, 2016b). Data from Public Health England 2016 includes data from the HSE and the National Child Measurement Programme (NCMP) (PHE, 2016). According to the HSE 2014, 17% of English children aged 2-15 were obese in 2014 and an additional 14% were overweight; proportions were similar for boys and girls (obesity data on a more specific age groups were not provided) (Fat, 2015). Data from the NCMP are consistent with these figures: in 2014/2015, 19% of Year 6 children (age 10-11) were classified as obese, and 33.2% as obese or overweight which is lower than in 2013/14 (33.5%) but higher than in 2006/07 (31.6%) (NCMP, 2015).

Obese or overweight children and adolescents are at increased risk of developing a number of morbidities including impaired glucose tolerance, type 2 diabetes, early signs of insulin resistance syndrome, cardiovascular risk (Goran *et al.*, 2003), asthma (Gilliland *et al.*, 2003) menstrual abnormalities, sleep-disordered breathing and psychological problems (Must and Anderson, 2003). Obesity in childhood, particularly in adolescence, is a key predictor for obesity in adulthood (Deckelbaum and Williams, 2012). In the long-term, childhood obesity is associated with premature mortality, cardiometabolic disease (diabetes, hypertension, ischemic heart disease and stroke), asthma, polycystic ovary syndrome symptoms and later reliance on disability pension during adult life (Reilly and Kelly, 2010). Economically, the obesity epidemic has placed a burden on healthcare systems and losses on productivity,

through increased health expenditure and restricted activity (Withrow and Alter, 2010).

1.2.2 Impact of motor vehicle use

Cars are amongst the most commonly used engine-powered vehicles, having acquired a prominent role in the daily life and the economy of many countries. However, dependence on cars and other motor vehicles has contributed to major environmental and social problems. Outdoor air pollution, the contamination of the outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (WHO, 2016a), is a serious consequence of motorized transport use. It has been estimated that air pollution caused 3.7 million premature deaths worldwide in 2012, predominantly in low and middle-income countries (WHO, 2014). In the UK, each year, around 40,000 deaths are attributable to exposure to outdoor air pollution and the costs of health problems linked to air pollution are estimated to be around £20 billion (Holgate *et al.*, 2016).

In 2013, the WHO concluded that there is sufficient evidence that exposure to outdoor air pollution causes lung cancer, with particulate matter (one of the pollutants emitted by motorised vehicles) having been classified as carcinogenic to humans (IARC, 2013). Although the composition of air pollution and levels of exposure can vary dramatically between locations, these conclusions apply to all world regions.

Common vehicle combustion engines burn fossil fuels to convert heat into useful mechanical motion, releasing greenhouse gases, mainly carbon dioxide (CO₂). Motor vehicles account for a significant portion of the greenhouse effect, over 25% of all global greenhouse gases production (Wilkinson D., 2013). The average global concentration of CO₂ is currently around 406 parts per million (ppm) (CO2.earth, 2016) well beyond the 350ppm limit recommended (Hansen *et al.*, 2008). In the UK, total greenhouse gas emissions in 2014 were 514.4 million tonnes carbon dioxide equivalent (7.7% lower than in 2013), of which 23% were emitted by the transport sector, mainly petrol and diesel in road transport (DECC, 2016).

Nitrous oxides (NO_x), such as nitrogen dioxide (NO₂), are another major greenhouse gas and transport-derived air pollutant, being the single leading ozone-depleting emission (Ravishankara *et al.*, 2009). The ozone layer absorbs nearly all medium-frequency ultraviolet (UV) light, which potentially damages exposed life forms on

Earth. In response to ozone depletion, UV radiation has increased in large geographical regions contributing to higher incidence of skin cancer in particular (Henriksen *et al.*, 1990).

In parallel with the accumulation of greenhouse gases, more of the infrared energy emitted by the surface ended up being absorbed by the atmosphere (Rosenzweig, 2007). This has contributed to global warming, an unusually rapid increase in Earth's average temperature over the past century, and climate change, characterized by modifications on physical and biological systems. Despite notable international reverting efforts, the problem is intensified by the durability of changes in the climate, largely irreversible for 1000 years after cessation of CO₂ emissions (Solomon *et al.*, 2009). Climate change effects on human health are evidenced by altered distribution of infectious diseases and increased heat-wave related deaths (Confalonieri *et al.*, 2007).

Motorized transport is over 95% dependent on oil and accounts for almost half of world use of oil (Fulton, 2004), thus sharing responsibility for depletion of natural resources and oil reserves in particular. Members of the Organization of Petroleum Exporting Countries (OPEC) have warned about approaching shortages on the grounds of geological depletion, rather than sole geopolitical events (Hamilton, 2012).

Traffic is also the dominant source of noise pollution (Dora and Racioppi, 2003) with detrimental effects on health and wellbeing, including cardiovascular risk (Babisch *et al.*, 2005) interference in complex task performance, social behaviour, psychological symptoms, raised catecholamine secretion (Stansfeld and Matheson, 2003), impaired sleep and concentration, and effects on communication and recreation (Goines and Hagler, 2007). At least one million healthy life years are lost every year from traffic related noise in the western part of Europe (WHO, 2011). Sleep disturbance and annoyance, mostly related to road traffic noise, comprise the main burden of environmental noise (WHO, 2011).

Higher volumes of traffic result in more road accidents and consequent injuries, deaths and disability. Worldwide, 1.18 million people died from road accidents in 2002, accounting for 2.1% of all global deaths; in addition, an estimated 20 to 50 million are injured in road accidents each year (Peden *et al.*, 2004). Motorcyclists and pedestrians comprise the majority of road-traffic victims globally (Ameratunga *et al.*, 2006). Traffic accidents are the largest cause of death among young people (10-24

years), accounting for 14% of male and 5% of female deaths (Patton, 2009). In the UK, in the year ending June 2015, a total of 1700 people were killed on the road and 22,830 were killed or seriously injured, down by 2% and 7% from the previous year respectively (DfT, 2015c).

Children who shift to walking or cycling may also experience higher inhalation of air pollutants, noise and traffic hazards, but there is indication that the health benefits substantially outweigh the risks (Tainio *et al.*, 2016). Before discussing some of these benefits, I will address issues around the measurement of AST.

1.3 Active school travel

1.3.1 Definition

*Active travel*³, *active transportation* or *active commuting* denote an approach to making journeys by means of PA, such as walking or cycling, as opposed to motorised and carbon-dependent forms of transport. *Active school travel* (AST) makes this specific to the school context, focusing on the transport modes of students from home to school and back again. A journey may include more than one travel mode, as it is generally the case of the walks preceding and following public transport usage, to and from the vehicle stopping point.

Behavioural properties of AST include frequency, duration and intensity (Caspersen *et al.*, 1985), but also travel mode and distance travelled (Krizek *et al.*, 2009). This multi-dimensional approach has, however, led to a wide range of definitions of *active travel*, *active traveller*, *non-active* or *passive traveller*, and a standardised definition is lacking (Herrador-Colmenero *et al.*, 2014). For example, studies often assess “*usual mode of travel to and from school*” or use different cut-off points when measuring “*walking or cycling to school on at least N days per week*” (Faulkner *et al.*, 2009). Others have referred to the use of public transport as active travel (Wen *et al.*, 2008), perhaps because it usually includes a walking element and has less environmental impact than cars. Grouping different forms of non-motorised travel can be useful due to common potential health and environmental benefits, and if the goal is to assess overall active travel behaviour. However, factors spurring different travel modes such

³ For clarity, the term ‘active travel’ will be preferred.

as walking or cycling vary, and separating them may be required, especially when planning interventions with a focus on a particular mode (Krizek *et al.*, 2009).

1.3.2 Measures of AST

An accurate assessment of AST is crucial to identify its prevalence and estimate the effect size of interventions. Because it is part of a child's overall levels of PA, AST is often assessed with similar methods contextualised in the time and space of the journey to and from school. Ideally, an assessment method should measure all the dimensions of AST behaviour and account for day-to-day variation (Warren *et al.*, 2010). However, some measures are impracticable in a number of situations and the choice of a method is ultimately dictated by the balance between accuracy and feasibility, and the dimension(s) of interest. As in PA research (Troiano, 2005), measurement methods in AST fall mainly into three categories: self-report, direct observation and portable monitors.

1.3.2.1 Self-reports in AST

Self-reports measuring active school travel include questionnaires (surveys), diaries, logs, recalls (including "hand counts") and interviews. In the case of AST, this can include asking proxies, such as parents or teachers, about children's travel modes. This applies particularly with children of a very young age who may have difficulty recalling such information (Sirard and Pate, 2001). Self-report instruments are widely used to assess AST, as they are an inexpensive and easy way to collect data from a large number of people in short time. Unlike some objective measures, self-report instruments can inform the context of PA (Warren *et al.*, 2010) and thus be complementary to other measurements (Lubans *et al.*, 2011b).

Self-reports present, however, a number of limitations such as difficulties in determining frequency, modality, duration and intensity of AST, and are particularly subject to social desirability and recall bias (Warren *et al.*, 2010). Self-reports can be relatively accurate at the group level but imprecise at the level of the individual participants (Warren *et al.*, 2010). Usually, questionnaires which assess school travel modes have a broader focus such as overall PA, and often include other domains such as leisure and household related PA. A systematic review (Chinapaw *et al.*,

2010) on PA questionnaires found no instruments (out of 61) showing both acceptable reliability and validity, whereas another recent review (Helmerhorst *et al.*, 2012) identified only four questionnaires (out of 130) showing acceptable to good results for both reliability and validity. Across the two reviews, twenty studies overlapped including three out of the four identified as valid/reliable by the second review, indicating a lack of consensus on criteria for validity and reliability. Of these four, only two questionnaires assess travel behaviour in children, rather than by proxy: the Flemish PA Computerized Questionnaire (FPACQ) and the Recess PA Recall (RPAR).

In a systematic review of 158 studies where reports were used to assess AST (amongst 4 to 18.5 year olds), only 20 studies (12.7%) posed a valid and reliable question (Herrador-Colmenero *et al.*, 2014). The overall quality of the reporting was judged to be medium based on a number of aspects, such as recall period, trip direction, reliability and validity. Data from a few studies also suggested that children's answers concurred with those of their parents. However, comparison of measures was difficult due to considerable heterogeneity. Authors put forward the idea of a standard question to assess AST which should entail: a complete and precise question and answer about commuting to school; asking about both trip direction to and from school and covering the whole school week; asking about both the mode of travel and the frequency for each mode; students filling in the questionnaire first thing every weekday morning with their teacher's help; at every morning session the students should complete the mode used to travel home the previous day and the mode of travel to school that morning. It remains unclear, however, whether these recommendations apply equally to all age groups, and little consideration is given to the possibility of them being unfeasible in some contexts.

1.3.2.2 Observation in AST

Some evidence suggests that direct observation can reliably determine the number of children walking and cycling to and from school (Suminski *et al.*, 2006) although it remains an infrequent measurement strategy (Panter *et al.*, 2008b). It is a highly demanding method for the researcher, whose actual presence may influence the behaviour of the subjects in the study (Chinapaw *et al.*, 2010). An alternative is to use sensing equipment, such as counters or video cameras on specific locations or contexts, however this ignores those not engaged in active travel and provides little

information (e.g. sociodemographic) on the people being recorded (Krizek *et al.*, 2009). Ethical issues must also be considered when people are recorded unknowingly. Counting the number of bicycles parked at school may be a valid measure of cycling rates to school (Sirard and Slater, 2008) but this has not yet been demonstrated to the best of my knowledge.

1.3.2.3 Portable monitors in AST

Another approach is to attach motion sensors directly to individuals, such as accelerometers or pedometers, which yield data based on frequency, duration and intensity of body movement. While a valuable tool to assess undifferentiated PA, these types of portable monitors per se are unable to identify the type of activity under study, whether instrumental, occupational or for leisure, and the contexts in which the activity takes place. For that reason, PA monitors are usually combined with other measures in AST research, such as self-report, to account for other dimensions which are characteristic of travel behaviour. When monitored data are time-stamped, however, there is the possibility to restrict the data under analysis to a certain time of the day that is likely to coincide with the time of the commute to and from school. For example, each weekday can be divided into four time blocks, two of them being before (5am – 8am) and after school (dismissal – 6pm), taking into consideration each school's schedule (Sirard *et al.*, 2005). In this particular case, any differences in MVPA between self-reported active and non-active commuters can then be assessed in the 5am-8am and dismissal-6pm time segments. Thus, reporting overall minutes of MVPA may be useful to classify school children as active or passive travellers (Faulkner *et al.*, 2009).

Pedometers provide an inexpensive overall measure of PA, usually number of steps, but are unable to assess intensity, frequency and duration of activity, or to estimate energy expenditure (Corder *et al.*, 2007). In contrast, accelerometers can objectively detect amount, frequency, intensity and duration of movement, and are valid tools for assessing free-living activities in youth (Chinapaw *et al.*, 2010). They are able to measure acceleration of the body in one (*x - vertical*), two (*x and y - vertical and medial-lateral*) or three (*x, y and z - vertical, medial-lateral and anterior-posterior*) axes (or planes of movement) and have shown a predictive relationship between heart rate and energy expenditure (Chinapaw *et al.*, 2010). Moreover, recent models are time-stamped meaning that PA can be traced throughout the day. In a review of

studies using objective measures in AST research, the uniaxial ActiGraph MTI (model 7164) accelerometer was the most commonly used type (Faulkner *et al.*, 2009), which has shown significant correlation against doubly-labelled water (DLW), the gold standard for measuring energy expenditure under free-living conditions (Plasqui and Westerterp, 2007). Triaxial accelerometers, such as ActiGraph GT3X, are well suited for a wide range of activities (Ojiambo *et al.*, 2012) and are currently the best validated (Plasqui *et al.*, 2013). So far, there is little evidence that the estimation of energy expenditure by accelerometry is improved by adding other physiological measures such as heart rate (Plasqui *et al.*, 2013).

Accelerometry provides a practical, reliable and valid means of measuring the amount and intensity of PA, and amount of sedentary behaviour in children (Reilly *et al.*, 2008). Wrist-worn accelerometers may be less obtrusive for children compared to the hip-worn models (Routen *et al.*, 2012) but they may also be more distracting in the classroom. When measuring overall PA (i.e. not limited to school travel), a consecutive seven day period of wear and measurement is often recommended for children (Trost, 2007), although acceptable reliability has been obtained with four (Trost *et al.*, 2000) or even three days of data (Basterfield *et al.*, 2011). There is mixed evidence for whether weekend days are needed to obtain reliable data (Warren *et al.*, 2010; Basterfield *et al.*, 2011).

On the other hand, accelerometers fail to capture minimal movement at the body's centre of gravity (e.g. rowing and cycling) and isometric work, where a static contraction of the muscles occurs despite the absence of visible movement of the limbs (Lee *et al.*, 2010), for example holding a static push-up position. Other situations of limited applicability include carrying heavy loads or walking uphill, because the acceleration patterns remain essentially unchanged despite an increased effort and energy expenditure (Warren *et al.*, 2010).

Accelerometers are still relatively costly and not all models and types are appropriate for all activities, e.g. not all monitors are waterproof and some therefore need to be removed before water-based activities (e.g. swimming) (Warren *et al.*, 2010).

Interpreting little or no recorded motion may be difficult, as the child could have taken the accelerometer off or could simply be sedentary at the time (Krizek *et al.*, 2009).

Another important limitation is about how best to record and process the data collected, resulting in school travel behaviour often being measured and presented in

different units, such as counts/minute⁴ or mean accelerometer count (Faulkner *et al.*, 2009). Readings of motion have ranged from time intervals (epochs) of 1 second (s) to 60 s, and activity counts per minute are an arbitrary unit that varies between monitor brands (Warren *et al.*, 2010). Most studies assessing PA and AST seem to set the epoch at 60 s; however they may miss intermittent bursts of PA which are typical in youth (Rowlands *et al.*, 2006). Shorter epochs provide more accurate assessments (particularly of vigorous activity) but require higher memory capacity that limit the length of recording time (Rowlands *et al.*, 2006). For between-monitors comparison, an alternative is to calibrate the accelerometer using directly measured energy expenditure as the criterion through regression modelling approaches (Freedson *et al.*, 2005). This allows the establishment of threshold of counts per minute (cpm) to classify body movement as sedentary behaviour, light, moderate or vigorous intensity (Warren *et al.*, 2010). Different thresholds to classify PA according to intensity have been proposed (Chinapaw *et al.*, 2010) possibly due to variations between accelerometers and parts of the body where they are placed (Puyau *et al.*, 2002). Therefore, classification of the time spent at different intensity levels can differ substantially according to the thresholds chosen (Warren *et al.*, 2010). Compared to other cut-points, Evenson *et al.*'s exhibited considerably better agreement with estimated time spent in sedentary (≤ 100 cpm), light (> 100 cpm), moderate (≥ 2296 cpm) and vigorous (≥ 4012 cpm) intensity in children and adolescents (Trost *et al.*, 2011).

1.3.2.4 Other measures in AST

Some new technologies hold promise but remain costly, bulky or require much maintenance. For example, Global Positioning Systems (GPS) are a satellite based navigation system that can be used to locate positions on earth. A child carrying a GPS device may offer an exact mapping of the route taken but the device may be of inconvenient size and require frequent battery change or recharging (Krizek *et al.*, 2009). Other limitations are the measurement of intensity of PA without resorting to other methods (e.g. accelerometry) and in receiving transmission signals from satellites depending on the location (Duncan and Mummery, 2007). Some mobile

⁴ Counts per minute (cpm) are a product of the amplitude and frequency of the vertical acceleration of the body, used as an indicator of amount and intensity of PA.

phone applications can capture GPS positional data during the school journey, as well as time-specific and place-specific information, but their use may be limited to children who are in possession of mobile phone, more likely to be older children (Pooley *et al.*, 2010), or children escorted by an adult who is more likely to carry a mobile phone. This may explain why smartphones are still an uncommon way of measuring AST (Smith *et al.*, 2015b).

A geographic information system (GIS) allows the storage and manipulation of geographical information electronically, through different technologies, processes and methods. Distances between two points are estimated based on the shortest route but resemble GPS-measured distances (Duncan and Mummery, 2007). Objective measures of the physical environment can be obtained, assessing a wide range of variables, including distance, density, street layout, walkability index, topography and aesthetics, safety and demographic data (Wong *et al.*, 2011a). However, although GIS resemble GPS-measured actual distances, GIS estimates may differ from the actual routes taken and be of little use to study the physical environment of a discrepant journey (Duncan and Mummery, 2007). An alternative may be to obtain self-reported route mapping upon which environmental attributes can be accurately assessed with GIS techniques (Broberg *et al.*, 2013). Inconsistencies in the use of spatial concepts between GIS studies poses problems in investigating AST and future research should aim for a standardisation of geocoding⁵, buffer methods, selection of study sites and the shape of zones (Wong *et al.*, 2011a).

The use of a wearable camera measuring travel to school has shown some positive results; however, it is currently unsuitable for large-scale studies because of data processing and coding procedures and should instead be considered as a validation tool for other techniques (Kelly *et al.*, 2012).

Tracking or recording children's whereabouts raises ethical questions. Parents may feel uncomfortable with the idea, may wonder who will access the data, or feel anxious about the possibility of their child being found to be in unexpected places or involved in illicit activities. The same applies to children, who may fear that the researcher will pass on that information to their parents. It has also been argued that

⁵ Geocoding consists in converting an address into geographic coordinates, which can be used to place markers or position a map.

constant GPS monitoring may hinder children's sense of autonomy and responsibility, and calls into question their right to privacy (Fahlquist, 2015).

1.4 Trends in AST

1.4.1 International trends in AST

In a sample of over 70,000 schoolchildren from 34 African, Asian, South and Central American countries, the prevalence of walking or riding a bicycle to school ranged from 18.6% in United Arab Emirates to 84.8% in China (Guthold *et al.*, 2010). This sample excluded Japan, where AST rates have been reported to be as high as 98.3% (Mori *et al.*, 2012). In the US, often believed to have one of the lowest AST rates, the combined walking and biking frequency estimates ranged from 5% to 42.3%; among non-US (primarily European) samples, rates from 20% (in both genders) to 85% in boys and 89% in girls have been reported (Sirard and Slater, 2008). The frequency of active travel to school appears to be higher in European countries compared to the United States but data are mainly self-reported.

Another study compared AST in 10-12 years old across seven European countries (Brug *et al.*, 2012). It reported that, with an average of more than 40 minutes per week, children in Norway and Netherlands spent much more time cycling to school than children in other countries. In general, girls cycled significantly fewer days per week to school than boys, but no significant gender differences in weekly minutes of cycling were found. Spanish and Norwegian girls reported the most minutes of walking to school. In general, girls reported more weekly minutes of walking to school than boys. No significant differences according to parental education in total active transport were observed, however, differences were found in specific transport behaviours: children with low parental education were less likely to bike, but were more likely to walk to school (Brug *et al.*, 2012). All data were self-reported.

Rates as high as 95% and 97% of AST for Dutch boys and girls respectively have been reported elsewhere (Slingerland *et al.*, 2012), and cycling rates of 38% (age mean 9.7) observed in Denmark's third largest city (Cooper *et al.*, 2005). Important mediators may be the infrastructure quality, provision of public transports and the proximity of homes to school, probably higher in Northern countries.

Declining trends have been registered in numerous countries. The percentage of children walking or cycling to school over the last four decades has dropped 35% in the United States (McDonald *et al.*, 2011b) and 32.2% in Australia (Van Der Ploeg *et al.*, 2008). Declining trends have been reported in many other countries, including Switzerland (Grize *et al.*, 2010), Denmark, Finland, Norway (Fyhri *et al.*, 2011), Canada (Pabayo *et al.*, 2011), China (Cui *et al.*, 2011), Vietnam (Trang *et al.*, 2012) Spain (Roure-Cuspinera *et al.*, 2007) and Russia (Tudor-Locke *et al.*, 2008).

1.4.2 UK trends in AST

In Great Britain, school travel data at the national level are provided mainly by the National Travel Survey (NTS), running continuously since 1988. This survey is carried out by the Department for Transport (DfT) and assesses personal travel patterns including “trips to and from school per child per year by main mode” (DfT, 2015b). Since 1995/97, statistics are weighted to adjust for non-response and dropouts. Data are collected through seven day travel diaries completed by adults which record school trips (% of trips) and respective main travel mode. Table 1.1a and Table 1.1b show results from the NTS travel diary data at different times between 1995 and 2014, for two age groups (DfT, 2015a).

% trips: age 5-10	1995/97	1998/2000	2005	2010	2014
Walk	53	56	50	49	46
Bicycle	-	-	1	1	2
Car/van	38	37	42	43	46
Private bus	3	3	3	2	2
Local bus	4	3	3	4	3
Rail	0	-	-	-	0
Other	2	1	1	-	1

Table 1.1a - Trips (in percentage) to and from school per child aged 5-10 per year by main mode: in Great Britain, at different times between 1995/97 – 2014

% trips: age 11-16	1995/97	1998/2000	2005	2010	2014
Walk	42	43	43	36	38
Bicycle	2	2	2	2	3
Car/van	20	20	23	25	23
Private bus	7	7	6	7	6
Local bus	26	24	23	26	24
Rail	1	1	1	2	3
Other	2	3	2	3	3

Table 1.1b - Trips (in percentage) to and from school per child aged 11-16 per year by main mode: in Great Britain, at different times between 1995/97 – 2014

Current data suggest that 46% of the trips to school made by primary school children (aged 5-10) are on foot, the same as by car. For secondary school children (aged 11-16), walking corresponds to 38% of the trips to school, with private or local bus (30%) and car (23%) ranking next. Comparatively, primary school children walk more but are at the same time more often chauffeured by their parents, while secondary school students show a higher rate of bus usage.

These differences may relate to increased independent mobility with age and may also reflect the longer distances travelled by secondary school students (Tables 1.2a and 1.2b), for whom schools are likely to serve more extensive geographical areas. In the UK, children aged 16 or less are usually entitled to free transport when living further than the statutory walking distance (variable between two and three miles, according to school type, age and socioeconomic status), and in other exceptional circumstances (Gov.uk, 2015). When eligible, students may seize the chance to travel by bus or train for free and abstain from walking, even if only for part of the journey, or may not even be allowed to do so.

More primary children (46%) than high school students (23%) are driven to school, possibly reflecting the greater independence that parents normally grant to children as they grow. It should also be noted that parental self-reports, upon which the NTS relies, may be subject to social desirability and may have contributed to an inflation of AST rates in both surveys. Another reason for the observed home-school distances in England and Wales may relate to parents' right to choose their child's school, which may be outside the education authority area they live in, increasing distances travelled and car use (Mackett R, 2012). Changes in the average distance home-school (miles) are presented in Table 1.2a and Table 1.2b. School trips (%) by main mode, trip length and age in 2014 are shown in Table 1.3 (DfT, 2015a).

Age 5-10	1995/97	1998/2000	2005	2010	2014
Average distance (in miles)	1.2	1.4	1.5	1.5	1.6

Table 1.2a - Average school journey length in miles, for children aged 5-10, at different times between 1995/97 and 2014

Age 11-16	1995/97	1998/2000	2005	2010	2014
Average distance (in miles)	2.9	2.8	3.0	3.4	3.4

Table 1.2b - Average school journey length in miles, for children aged 11-16, at different times between 1995/97 and 2014

Main mode	Age 5-10				Age 11-16			
	Under 1 mile	1 to under 2 miles	2 to under 5 miles	5 miles and over	Under 1 mile	1 to under 2 miles	2 to under 5 miles	5 miles and over
Walk	80	29	2	0	90	59	8	0
Bicycle	1	4	1	0	3	6	3	-
Car/van	19	62	86	73	6	23	37	25
Bus	-	4	10	21	1	12	47	58
Other	-	1	2	7	1	1	5	17

Table 1.3 - Trips to school (in percentage) by main mode, trip length and age, in Great Britain - 2014

Over time, the school journey has become longer for both younger and older children, and the average distance remains approximately 1.8 miles higher for the latter group. The vast majority of school journeys of children aged 5-10 (81%) and 11-16 (93%) are on foot or bicycle when less than one mile long. For journeys 1 to 2 miles, a distance considered walkable, roughly one third of the trips for those aged 5-10 and two thirds for those aged 11-16 are walked or cycled. Understandably, greater distances are mainly travelled by motor vehicle; especially car in the case of younger children, and bus for older pupils. Once again, the higher incidence of bus usage amongst secondary school students may indicate independent mobility and more developed skills to use public transport unsupervised.

In general, these data suggest that AST promotion may be more effective if concentrated on passive travellers who could walk or cycle within walkable distances, particularly between 1 and 2 miles. For longer trips, a shift towards public transport could lessen air pollution and promote PA, since walks often precede and follow trips on public transport. In the case of young children though, a shift to public transport or active travel would probably require adult supervision. Partway active trips may constitute an alternative, whereby children would be driven part of the way and walk under supervision for the remainder of the distance (e.g. park and stride and 'walking bus schemes').

The percentage of school journeys broken down by main travel mode, as above, may provide a more accurate picture of AST and may avoid complications surrounding the definition of 'active traveller'. However, rates of trips are rarely measured and it is unclear how they relate to the rates of individuals travelling, although NTS reports use both concepts interchangeably (e.g. p.33 (DfT, 2015a)).

School travel in the UK also used to be assessed by the Department for Education's School Census, before the question was dropped in July 2011. The School Census collected information about individual pupils (parent-reported) and information about the schools themselves. Prevalence (%) of children for each school travel mode - "usual mode of transport to school of your child" - is presented in Table 1.4, based on the most recent available data provided by School Census (DfE, 2015).

	School Census 2011*	
	<i>Primary school</i>	<i>Secondary school</i>
Walk	59.5	42.0
Bicycle	1.0	2.9
Car/Van	35.7	18.8
Bus	3.1	31.7
Rail	0.1	1.5
Other	0.2	1.2

Table 1.4 - % of children by mode of school travel in 2011, for two age groups, according to the School Census.
*In England, state-funded schools only

According to the SC 2011, 59.5% of English children walked and 35.7% travelled by car/van, much more than by bicycle (1.0%) or rail (0.1%). For secondary school students, rates were higher for walking (42.0%), bus (31.7%) and car/van (18.8%), compared to cycling (2.9%) or rail (1.5%).

NTS and SC numbers appear comparable in most respects, although SC suggest higher rates of walking amongst younger children (46% of trips in NTS vs 59% of children in School Census). It is possible that parents over-report walking when asked about their usual travel mode. However, as discussed earlier, comparing NTS and School Census data requires caution, as one looks at percentages of trips and the other at percentages of children. It is also plausible that a slight decrease in walking rates may have occurred since 2011, following the trend of previous years. Additionally, School Census data are exclusively from English state-funded schools, where higher AST rates have been reported (Davison *et al.*, 2008).

NTS data stratified by region was obtained through a request (Kershaw, 2016, pers. comm. 26 January) but for some of the information the two age groups (5-10 and 11-16) had to be combined into one (5 to 16 years) for the data to be meaningful. Table 1.5 shows the percentage of trips to school by mode and the average trip length, in the North East and in rest of the country (England). Table 1.6 presents the average school trip length for both age groups, in both regions.

	Walk	Bicycle	Car/Van	Private bus*	Local bus	Rail**	Other
North East	40	1	33	5	15	-	5
England	41	2	35	4	14	1	2

Table 1.5 - Trips to and from school by main mode in the North East and England, in 2012/2013; age: 5-16years. *Includes school bus; **surface rail

	Age 5-10	Age 11-16
North East	1.5	3.3
England	1.7	3.6

Table 1.6 - Average school trip length (miles) in the North East and England, for both age groups.

There is considerable similarity between school travel by mode in the North East and nationally. In the North East, AST is slightly less prevalent, and so is car/van use, whereas bus travel is marginally more common. Other means of transport are likely to include Metro (light rail) which young people, particularly secondary school students in Newcastle, may rely upon. Interestingly, the average school trip length in the North East is shorter than nationally yet this does not reflect higher AST, which suggests an overuse of motorised travel to school.

1.5. Benefits of active school travel

This section examines the current evidence for the benefits of AST on: levels of PA; physical health-related outcomes; psychological, social and academic benefits; reducing the impact of motor vehicle usage.

1.5.1 Physical activity

A considerable number of studies indicate a positive association between AST and higher levels of PA (Faulkner *et al.*, 2009; Schoeppe *et al.*, 2012; Larouche *et al.*, 2014), although the evidence is generally only of moderate quality (Larouche *et al.*, 2014). For example, in a review of 68 studies (mainly cross-sectional), AST was associated with higher PA levels in 22 out of 28 studies involving accelerometry; the mean difference in time spent in daily MVPA ranged from 0 to 45 min (Larouche *et al.*, 2014). In another systematic review of 12 higher quality studies (all reporting the use of objective measures), the weighted mean MVPA accumulated by walking to and from school was 17 minutes per day in primary school pupils (9 samples, n=3422) and 13 minutes per day in high school pupils (4 samples, n=2600) (Martin *et al.*, 2016). Pooled analysis suggested that walking to and from school contributed

23% and 36% of MVPA on schooldays in primary school age children and high school pupils, respectively.

Links between AST and PA may be moderated by gender, age, independent mobility status and distance, with boys (Davison *et al.*, 2008; Faulkner *et al.*, 2009), older children (Faulkner *et al.*, 2009), more independent children (Schoeppe *et al.*, 2012) and those living furthest away from school (Larouche *et al.*, 2014) benefiting the most. Evidence for the role of other factors such as race and ethnicity in mediating the relationship between AST and PA was inconclusive (Faulkner *et al.*, 2009).

An important finding was that PA measured over the weekend consistently failed to reveal significant differences between school active and non-active travellers, suggesting that the higher levels of PA observed in active school travellers was limited to weekdays and therefore to the school journey (Davison *et al.*, 2008; Faulkner *et al.*, 2009; Larouche *et al.*, 2014). It remains unclear whether AST promotion impacts on the formation of other PA habits (e.g. engagement in sports), possibly because there is currently weak evidence for the effectiveness of ATS interventions (Chillon *et al.*, 2011), and how it affects PA in adulthood, mainly due to the lack of long-term prospective intervention studies (Larouche *et al.*, 2014).

1.5.2 Physical health-related outcomes

Studies investigating the relationship between AST and health outcomes have mainly focused on fitness indicators, particularly weight status/body composition and cardiorespiratory fitness. Body composition relates to “the relative amounts of muscle, fat, bone and other vital parts of the body” and cardiorespiratory fitness to “the ability of the circulatory and respiratory systems to supply fuel during sustained PA and to eliminate fatigue products after supplying fuel” (Caspersen *et al.*, 1985).

There is limited support for an association between AST and healthier body composition (Sirard and Slater, 2008; Lubans *et al.*, 2011a; Larouche *et al.*, 2014) or BMI (Davison *et al.*, 2008; Faulkner *et al.*, 2009). One review found mixed (low quality) evidence for the role of AST on body composition, possibly due to measurement inconsistencies between studies, confounding demographic variables, compensatory behaviours (e.g. reducing PA in other parts of the day), and analyses unadjusted for distance (Larouche *et al.*, 2014). More clearly, there is consistent

evidence that cycling to/from school is associated with greater cardiovascular fitness and that the mode of transport explains a substantial proportion of the variance in cardiovascular fitness (Larouche *et al.*, 2014). Few studies have investigated correlations between muscular fitness or flexibility, providing equivocal evidence (Lubans *et al.*, 2011a), and no study assessed muscular strength.

The distance to school, a strong predictor of AST, may help explain the weak link between AST and measurable health outcomes, particularly BMI (Faulkner *et al.*, 2009), yet analyses do not always control for distance (Larouche *et al.*, 2014). Active commuters tend to live closer to school and the distance they travel may be insufficient to produce any noticeable changes in body weight. Many studies also fail to examine associations by sub-group, such as ethnic background or gender, which could reveal clearer associations between AST and health (Lubans *et al.*, 2011a). Another limitation of studies investigating AST health outcomes is the range of definitions used to classify active travellers (Faulkner *et al.*, 2009; Lubans *et al.*, 2011a). Likewise, body composition relies on a range of measures including BMI, z-scores and percentiles, and parental proxy reports of their children's height and weight (Lubans *et al.*, 2011a). Thus, a more objective assessment of AST and physical effects is necessary.

Little is known about the possible long-term health benefits of walking or cycling to school compared to being driven although there are some indications of decreased risk of cardiovascular disease (Andersen *et al.*, 2011). Smaller and population-wide health gains may also be achieved through reductions in air and noise pollution, but this is yet to be demonstrated in AST research (de Nazelle *et al.*, 2011).

1.5.3 Psychological and academic outcomes

AST may have positive results at other levels, such as psychological, social and academic, but the evidence for this hypothesis is still scarce. In a cross-sectional study conducted in China (n=21,596, age 6-9), children who actively commuted to school showed lower odds of having depressive symptoms than those using passive transport to school (Sun *et al.*, 2015). Another study (US) has found a positive association between regular ATS and children's perception of its health benefits (Merom *et al.*, 2006). An increased interaction with other children is widely believed

to be a key benefit of ATS (Rissel, 2009). Bus travel to and from school was associated with higher self-reported bullying victimisation amongst Canadian male, but not female, students (n=5065, mean age 15.2±1.9 years) compared to ATS; however ATS females were more likely to report being bullied than public transport users during the journey to school (Sampasa-Kanyinga *et al.*, 2015).

Two cross-sectional studies found an association between AST and cognitive/academic performance. AST was positively associated with higher cognitive performance in adolescent girls (but not in boys), independent of a number of potential confounders including extracurricular PA (n=1700; age 13 to 18.5 years); the association between AST and cognitive performance was stronger in those girls who travelled further to school (Martinez-Gomez *et al.*, 2011). Similarly, Danish adolescents (n=10 380; age 13-15) who actively travelled to school perceived their school performance as higher than non-active travellers, even after adjusting data for potential confounders (Stock *et al.*, 2012).

1.5.4 Motor vehicle use and air quality

Few studies have explored possible links between AST motor vehicle-related outcomes. One systematic review on active travel (not exclusively in the school context) found limited evidence for a shift towards less car use following school travel plans, with many studies lacking randomisation and a follow-up of adequate duration (Hosking *et al.*, 2010). Another AST review found some evidence for a decrease in car use following 'walking school buses' and 'walking promotion' initiatives (NICE, 2007) while a more recent AST review did not report possible changes in motor vehicle before and after AST interventions (Chillon *et al.*, 2011).

Efforts towards a decrease in motor vehicle usage, or at least a shift to more efficient modes (e.g. public transport), carry a potential positive impact at the environmental and social levels. In the case of AST, very few studies have attempted to account for such outcomes. An exception is a study in Canada where a reduction in CO₂ emissions were reported during a three year 'Safe Routes 2 School' campaign (NHTSA, 2004).

On the other hand, active travel policies alone are unlikely to bring about substantial improvements in air quality and noise and such effects may hardly be detectable by

researchers (Krizek *et al.*, 2009). In other cases, improvements in walkability through traffic calming can offset reductions in car use due to more stop-and-go traffic and congestion, increasing emissions per trip (de Nazelle *et al.*, 2011). Children who shift to walking or cycling may also experience higher inhalation of air pollutants, noise and traffic hazards, but there is indication that the health benefits substantially outweigh the risks (Tainio *et al.*, 2016).

1.6 Summary and future research

Many children in the UK and elsewhere are insufficiently active, placing them at higher risk of developing a number of medical conditions such as obesity. At the same time, motorised transportation has overtaken human-powered forms of transport with further detriment to our health and environment. AST has been identified as a potential source of PA in children but the heterogeneity of AST measures complicates inter-study comparisons.

Internationally, studies point to variable rates of AST but a clearer declining trend. The findings may reflect actual differences but conclusions are often difficult to draw because of variable sampling and measurement methods between studies. In the UK, data obtained through parental report indicate that approximately 50% of primary school children use AST as well as 40% of high school students. Younger children (aged 5-10) are more often chauffeured by their parents, adolescents (aged 11-16) are more frequent bus users and cycling to school is uncommon for both age groups. The distance between home and school is likely to be a determinant for the travel modes of students.

A considerable body of research suggests that active school travel is an important source of PA. Evidence of benefits for BMI and body composition is limited but many studies have suggested an association with cardiovascular fitness for those who cycle to school. Some data suggest a link between ATS and cognitive performance and mental health. Reductions in traffic and air pollution derived from AST initiatives have also been difficult to demonstrate to date, but their potential long-term benefits are well accepted.

Based on the above data, a number of avenues for future research can be identified:

- The need for a clear definition of AST, active traveller and non-active traveller, and the consideration of the combination of two or more objective measures for report validation purposes;
- AST promotion may benefit from a focus on those living at greater distances from school, for example, by encouraging a 'park and stride' approach, or a shift from private car to public transport. This is because, within one mile from school, the vast majority of children aged 5-10 already walk or cycle to school but only one third does so when living between one and two miles away;
- The potential of AST to enhance physical and mental health, and social and academic performance, is not clear and requires further investigation;
- AST may present risks that must be weighed against the benefits. Despite recognition that gains might be greater, risks may be exacerbated across local contexts. For example, some data suggest that readier access to the food environment around secondary schools may be detrimental to students' eating habits (Smith *et al.*, 2013), or that ATS may increase the risk of bullying victimisation (Sampasa-Kanyinga *et al.*, 2015); thus, the coordination of different public health initiatives is essential.

Whilst this PhD project is unable to address all the above, it does pay particular attention to the need of a valid AST measure, and to an approach of AST promotion that contemplates partway active trips. More precisely, the aim of this PhD project is to develop and test the feasibility of an ATS intervention. A key objective is to select an appropriate outcome measure (i.e. ATS measure) for a future evaluative trial. Next, I will give an overview of the framework by which this project is guided in order to develop an AST intervention.

Chapter 2 – Intervention development

2.1 Introduction

In the UK, the Medical Research Council (MRC) is recognised as a leading source of guidance and advice in the area of health-related research (MRC, 2015). Of particular relevance to this current research is the MRC framework for developing and evaluating complex interventions in health services, public health and social policy (Craig *et al.*, 2013). Complex interventions are defined as those containing several interacting components; transport interventions are offered as an example. The guidance proposes that the process of developing and evaluating complex interventions should be systematic and iterative, and entails four main stages: development; feasibility/piloting; evaluation; and implementation. Key functions and activities are identified to characterise each phase (Figure 2.1).

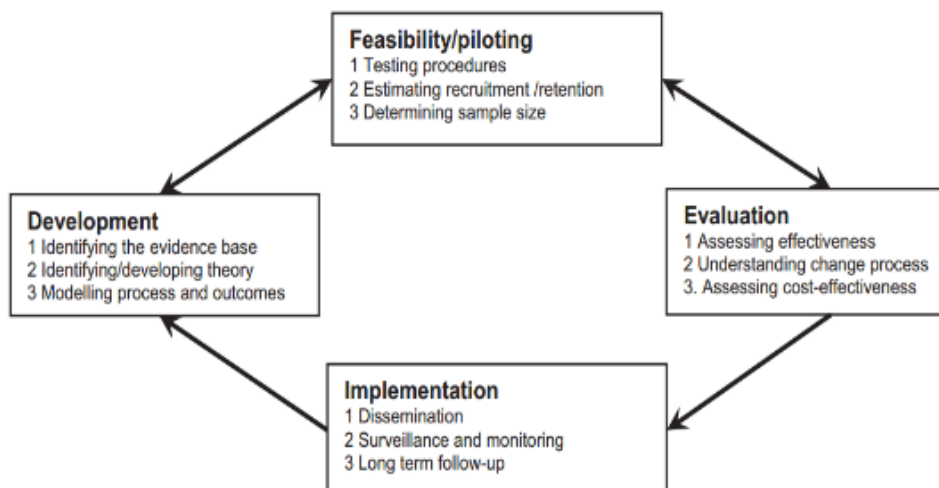


Figure 2.1 - Key elements of the intervention development and evaluation process

In this framework, interventions should be developed based on the best available evidence and appropriate theory. Then, the feasibility of the intervention needs to be established in a series of preparatory studies before it is possible to move on to an evaluation (or effectiveness) trial (Craig *et al.*, 2013). At the evaluation stage, individual or cluster randomised designs involve participants being randomly allocated to intervention or control group, at the individual or cluster level (e.g. school, hospital) respectively. Other designs can be used when randomisation is impracticable (Craig *et al.*, 2013). Finally, evaluation is followed by an implementation phase, in turn informing future intervention development and delivery (Craig *et al.*, 2013).

This project is concerned with the development and feasibility/piloting stages of a school-based intervention to increase AST. The present chapter is about the development of the intervention, including the three tasks contemplated by the MRC framework: identifying the evidence base; identifying relevant theory; and modelling process and outcomes.

2.2 Identifying the evidence base

Developing a complex intervention requires identifying what is already known about similar interventions and the methods that have been used to evaluate them. The MRC recommends that if there is no recent, high quality systematic review of the relevant literature, one should be conducted and updated as the evaluation proceeds. Systematic reviews are reviews with a clearly formulated question; they use systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyse data from the studies that are included in the review (Liberati *et al.*, 2009). When possible, a systematic review may include a meta-analysis which consists of the use of statistical techniques to integrate the results of included studies (Liberati *et al.*, 2009). Studies with a randomised controlled design, at the individual or cluster level, are considered the most robust methods of preventing selection bias (Craig *et al.*, 2008a). In practice, an experimental approach is not always possible, and quasi-experimental or observational designs may be considered. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials is an example of tools available to assess methodological quality, including aspects such as design, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting and others (Higgins *et al.*, 2011).

The aim of this section is to review the evidence base of previous AST interventions, and if necessary of other relevant interventions, in order to inform the development of such an intervention within this project.

2.2.1 Evidence base of AST interventions

A systematic review of interventions for promoting active transportation to school was published by Chillon *et al.* in 2011 (Chillon *et al.*, 2011), one year before the start of

this project. To the best of my knowledge, this is the only systematic review specifically on AST interventions. Of the 14 interventions reviewed, the two most popular ones were the Walking School Bus (WSB) and Safe Routes to School (SRTS). The WSB is a group of children walking to school with one or more adults, with children joining the group at designated 'bus stops'. The effectiveness of WSBs has been examined in a more recent literature review (non-systematic, 12 studies) (Smith *et al.*, 2015a) which reported some preliminary evidence for their value in increasing physical activity, although only three studies were RCTs and ATS changes were always self-reported. However, the authors highlighted issues such as time constraints, parents' safety concerns and volunteer recruitment associated to WSBs (Smith *et al.*, 2015a). Others have reported difficulties around children needing to arrive on time at 'bus stops' (Yang *et al.*, 2014).

SRTS is a large-scale and international initiative consisting of a wide range of interventions with the overall aim of promoting ATS. Examples include improving walking and cycling infrastructure, school travel plans, pedestrian and cycling training, WSBs and classroom activities to raise awareness about ATS. Other interventions described by Chillon *et al* usually involved a number of activities, targeted multiple health behaviours, or were implemented over long periods (e.g. school year).

The findings of the review pointed to a lack of evidence for the effectiveness of AST interventions, with all interventions reviewed being of weak quality (Chillon *et al.*, 2011). After reviewing and discussing the data, the authors listed four main conclusions: interventions were heterogeneous, due to the size, scope, and focus of the intervention and measurements; interventions with appropriate school, parent, and community involvement and that worked toward a specific goal (i.e., increasing active transportation) seemed to be more effective than interventions that were broader in focus; intervention quality was often low as measured by the EPHPP⁶ tool; and interventions evidenced a small but promising effectiveness in increasing active transportation to school. It was also noted that studies generally failed to describe their theoretical frameworks. For future research, the authors recommended a deeper consideration of: methodological issues such as experimental study designs,

⁶ The Effective Public Health Practice Project (EPHPP) Quality Assessment Tool was developed for use in any public health studies and takes into account: selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity and analysis.

valid and reliable data collection methods, and appropriate statistical analysis; the effect of the parental, school, and community involvement, and addressing the complexity of multiple factors influencing AST; and the long-term outcomes and sustainability of interventions.

2.2.1.1 An update of Chillon et al.'s review

There seemed to be little justification in conducting a new systematic review, however there was the opportunity to provide a more recent update. In November 2015, I conducted an update of Chillon et al.'s systematic review using the same search terms and on the same databases. Original searches had been run in January 2010, so time filters were applied for the period 2010-2015 or with a more specific timeframe, depending on the database (e.g. 1st Jan 2010 to 12th Nov 2015). Search terms fell within three categories: age-related; AST-related; and intervention-related. Databases searched comprised: PubMed; Web of Science; Cochrane Library; Sport Discuss; and National Transportation Library. Chillon et al. had also looked for publications in reference lists from review papers, and in their own archives, but in my case, due to time constraints, only databases were searched. The local information specialist assisted with queries regarding the review process and clarified that, although faithful to most steps of a systematic review protocol, this update was not itself a true systematic review because I was the only reviewer, due to resource constraints of the PhD.

In total, 3537 records were retrieved and downloaded to EndNote, and 845 duplicates removed. This resulted in 2692 papers that were screened based on title and abstract, of which 2669 were excluded. Thus, 23 articles were read for potential inclusion. A further four were excluded because AST was not amongst their outcome variables (n=2), the age group was too wide (14-24 years old) (n=1), or active commuting was not specific to the school context (n=1), resulting in 19 studies.

The number of eligible studies was larger than expected in a five year period (and more than the 14 in the original review). Due to the limited time available to complete this PhD, only RCTs were included for further review, since lower-quality designs were unlikely to provide robust evidence. Out of 19 studies eligible according to the replication of Chillon et al.'s inclusion criteria, 15 were excluded either because of non-experimental design or because they were pilot/feasibility studies. This resulted

in four RCTs, all with randomisation at the cluster level (by school) being included for analysis (Table 2.1):

Authors, country, duration	N participants, Age group	Intervention	Outcome (all self-reported)
(Christiansen <i>et al.</i> , 2014a), Denmark, 2 years	Adolescents (n=1014), age range 11-14 years	Multicomponent intervention, including school policy, educational initiatives, work with stakeholders and infrastructural changes.	No difference in number of active trips to school between intervention and control, OR=1.27 (CI 95% 0.81; 1.99)
(Cornelius <i>et al.</i> , 2014), USA, 5 weeks	High school students (n=165); age mean: intervention group 15.5 (0.06), control group 15.4 (0.6)	Five lessons with a wide range of activities (e.g. creating a YouTube video, games, map routes to school)	No difference in number of car trips between intervention and control, adjusted difference= 0.02 (CI 95% -0.80, 0.84)
(Ducheyne <i>et al.</i> , 2014), Belgium, 4 weeks	Primary school children (n=94); age mean 9.3 (0.5)	Cycling training course and parental involvement in weekly homework tasks (e.g. bike check-up, interpreting road signs)	No differences in minutes/week spent cycling to school between intervention and control, F=1.9, p>0.05.
(Xu <i>et al.</i> , 2015), China, 1 school year	Students (n=1182); age mean 10.2(0.5)	Educational curriculum on healthy eating and sufficient PA, family involvement and fun programmes/events.	Change in commuting mode to/from school from sedentary to active mode more likely in intervention school, OR = 2.24 (95% CI = 1.47, 3.40)

Table 2.1 - RCT studies retrieved in the update of Chillon *et al.*'s review

Three studies did not find significant changes in AST after the intervention; the exception was Xu *et al.*, who found that the intervention group was more likely to report changes in commuting mode to/from school from sedentary to active mode. However, all four studies assessed AST through report, parental (n=1) (Ducheyne *et al.*) or by the student (n=3), and none incorporated an objective measure. Based on the Cochrane risk of bias tool described earlier, I rated all the studies as being of low quality (similar to those in the original systematic review by Chilton *et al.*, 2011). Aspects such as random sequence generation, allocation concealment, blinding of participants and personnel, and blinding of outcome assessment, were considered to be at high or unclear risk of bias. Studies were generally upfront about incomplete outcome data, but I had no access to research protocols to judge the risk of selective outcome reporting.

Of the four studies, Cornelius *et al.* was the only one to allude to the theoretical basis of their intervention, the Social Cognitive Theory (Bandura, 2001).

In sum, the findings of the above four RCTs essentially reflected those of Chillon *et al.*'s systematic review, namely a lack of evidence to support the effectiveness of existing AST interventions, and the need for higher quality studies in the future.

Positive effects were reported in previous interventions (e.g. Xu et al); however these were either multi-component interventions, required considerable time from schools, were delivered over a long period of time (e.g. school year), required a large budget or staff training, all of which would have been difficult to achieve within the confines of this PhD. Other interventions such as WSBs present well-known problems (e.g. parental safety concerns) and again, addressing them in this PhD would have been challenging. The possibility of a new approach to promote ATS was considered, one that could be delivered more easily by non-trained personnel, at low cost, not necessarily during school hours and which avoided parents taking responsibility for escorting children other than their own. As a result, the effectiveness of incentive interventions in child health promotion was reviewed. Incentives were used in one of the interventions described by Chillon et al (Kong *et al.*, 2009) in which children received pedometers and Frisbees as part of a 10-week ATS project (mainly a WSB). However, these were offered to anyone taking part in the project, as opposed to being used as an ATS promotion tool, which is the scope of the next section.

2.2.2 Evidence base of incentive interventions in the context of health promotion in children

Giving incentives to the child or young person, rather than to the parent or carer, is the focus of this section because the findings of each approach may not be generalizable from one to the other, i.e. incentives may work well with adults but not with children, or vice-versa. To the best of my knowledge, there are only two systematic reviews on the evidence of incentive interventions to change children's and young people's (<18 years) health behaviours (Jensen *et al.*, 2011; Kavanagh *et al.*, 2011).

Jensen et al (2011) reviewed 28 intervention studies using economic incentives for producing sound dietary behaviour in primary and high school children (Jensen *et al.*, 2011). Two types of intervention were considered: price incentives (increasing the price of unhealthy food and/or decreasing the price of healthy food); and reward incentives (e.g. material rewards, entering a draw). The authors concluded that price incentive strategies were effective, but this conclusion was only based on a limited number of simulation experiments with older children, not from natural settings (e.g. school canteens). Out of the 28 studies, only four used an experimental design

(RCT) and all four reported significant differences in children's dietary behaviour. Two of them were evaluation studies of the Food Dudes programme (Horne *et al.*, 2009) (Lowe *et al.*, 2004) which uses heroes as role models and rewards children for tasting/eating fruits and vegetables. Yet Jensen *et al.* were unable to draw any robust conclusions, particularly with respect to reward incentives, because these were always applied in combination with other intervention elements.

Kavanagh *et al.* (2011) reviewed 16 trials assessing the impact of incentive schemes on changing young people's behaviour (age 11-19), of which nine targeted health behaviour (six RCTs). When outcome data from all nine studies were pooled together, incentives were shown to have a statistically significant positive impact (standardised mean difference (SMD) 0.17 (CI 0.07, 0.27)). However, due to their heterogeneity, the nine intervention studies were divided in three groups and meta-analysed: single health behaviours (n=3, e.g. vaccination), multiple health behaviours (n=3, e.g. orthodontic treatment) and smoking interventions (n=3, e.g. classroom competition). Only the single health behaviour group, consisting of three RCTs, showed a significant effect (RR⁷ 1.23 (CI 1.06, 1.43)). However, none of the studies in this review targeted AST or another type of PA behaviour. It is also uncertain how much these findings would apply to a different age group, for example primary school children who are normally less independent than adolescents.

From a theoretical perspective, Kavanagh *et al.* locate their review in the context of Skinner's operant conditioning (Kavanagh *et al.*, 2011) which I discuss in the next section. Jensen *et al.* refer to standard economic theory but emphasise behaviour change as a result of price changes and incentives (Jensen *et al.*, 2011), which aligns with principles of operant conditioning.

2.3 Identifying theory

Alongside a review of the evidence base of interventions, according to the MRC complex interventions framework, it is necessary to review and if necessary develop relevant theory. A scientific theory has been defined as "a well-substantiated explanation of some aspect of the natural world, based on a body of facts that have

⁷ Risk ratio of the probability of demonstrating the single health behaviour (i.e. attending the post-partum clinic or returning a vaccination form) in the group exposed to the incentive scheme to the probability of demonstrating that behaviour in the group that were not exposed.

been repeatedly confirmed through observation and experiment (AAAS, 2011). 'Explaining' usually means identifying a relationship between cause(s) and effect(s), or between independent variable(s) and dependent variable(s) (Keil, 2006).

Two closely related terms are models and frameworks. Nilsen (2015) identifies a distinction between these labels in general behaviour literature: theories consist of explanatory principles or statements about a phenomenon, and specify relationships between variables; models tend to have a narrower scope than theories and are usually more descriptive than explanatory; frameworks denote a structure or outline wherein phenomena are integrated in various descriptive categories and, as such, do not provide explanations (Nilsen, 2015). However, the author also notes that these three terms are often used interchangeably, with many models and frameworks being presented as explanatory (Nilsen, 2015).

In behavioural science, intervention effects are often observed but conclusions underlying mechanisms of change remain unclear. Theories of behaviour change can help specify the occurrence of behaviour and inform its prevention, management or solution (Fleary and Sidani, 2012). However, there is a vast range of behaviour change theories and it is not always clear how to make the best selection from this array (Noar and Zimmerman, 2005). To address this issue, a number of criteria for the selection of behaviour change theories have been proposed (Davidoff *et al.*, 2015; Sniehotta *et al.*, 2015). Some of the key criteria include a solid empirical foundation, clear definition of concepts and causal mechanisms, and range of applicability of the theory. The extent to which these principles guide the development and selection of theory in health behaviour literature is often unstated.

This section provides a brief summary and critical appraisal of existing theories, models and frameworks in AST literature, paying special attention to their practical value. An alternative approach, not identified in previous AST literature, is proposed to address the shortcomings of previous conceptual and theoretical treatments.

2.3.1 Overview of existing theories, models and frameworks in AST

There is a considerable number of theories, models and frameworks in AST research. I found twelve whilst reviewing the literature on this topic. Current

approaches are diverse, ranging from a focus on individual variables to environmental conceptualisations.

An emphasis on the individual is at the core of behavioural economics, social cognitive theory, theory of planned behaviour and habit strength, and a conceptual framework connecting preference, location choice and behaviour, all of which have been used in AST (Faulkner *et al.*, 2010; Yang *et al.*, 2010; Mendoza *et al.*, 2011; Murtagh *et al.*, 2012). Individual-focused models are common in health behavioural science and often highlight cognitive processes as an underlying mechanism of behaviour change (Jeffery, 2004). Behaviour is still recognised as influenced by environmental factors, but the effects of such distal factors are assumed to be mediated by the proximal factors specified by the model (e.g. intentions, attitudes) (Sutton, 2001). Unlike many distal factors, the proximal factors are hypothesised to be changeable (e.g. through provision of information) and can then be the basis of health behaviour interventions (Sutton, 2001). Other advantages of individually-focussed models include: the specificity of the content of cognitions, which allows the generation of items for self-report (i.e. I intend to walk with my child to school every day); high degree of standardisation of measures; and applicability to other domains or behaviours (e.g. environmental psychology, social psychology) (Sutton, 2001).

On the downside, a focus on the individual may neglect the fact that even a very individualised behaviour can be strongly affected by policy or social context (Glanz *et al.*, 2008). The appeal to internal variables has been said to obscure our understanding of behaviour because it multiplies the variables to be explained, and diverts attention from potentially relevant contextual events (Chiesa, 1994). This point will be expanded shortly.

Multi-level environmental approaches in AST comprise: the social ecological model (Martin *et al.*, 2009), the ANGELO framework (Pont *et al.*, 2009); a conceptual framework of a primary-aged child travel's behaviour (McMillan, 2005); a conceptual framework for the environmental determinants of active travel in children (Panter *et al.*, 2008b); a model of children's active travel (M-CAT) (Pont *et al.*, 2011b); a behavioural model of school transportation (Mitra, 2013); an ecological and cognitive active commuting framework (Sirard and Slater, 2008); and an integrated, interdisciplinary model of the links between transport and health in the context of

school travel (Hodgson *et al.*, 2012). All of these models incorporate psychological variables (e.g. perceptions about environment, beliefs).

A strength of ecological models is the emphasis given to multiple levels of influence which broadens options for interventions. Unfortunately, they share a general lack of clarity about important hypothesised influences and their interactions, and a difficulty in identifying critical factors for each behavioural application (Glanz *et al.*, 2008).

In behaviour change literature, a distinction is often made between factors underlying the adoption or initiation of new behaviours and those responsible for their maintenance (Marcus *et al.*, 2000). Despite the complexity of some of the existing ATS models, few of them address this issue in an explicit manner. The M-CAT hypothesises that events occurring during the journey to school, positive (e.g. socialising with other children, increased fitness) or negative (e.g. road dangers), form the beginning of a feedback loop in which parental and child perceptions are affected, ultimately impacting on ATS (Pont *et al.*, 2011a). On the other hand, Hodgson *et al.* stress the importance of establishing behavioural habits, or associative responses to environmental cues (e.g. weather), in the maintenance of ATS; they suggest ways to break habits include strategies such as prompting a review of pros and cons for each travel option, environmental changes, or to help people remember the reasons for their choices (Hodgson *et al.*, 2012). These approaches highlight the need to make ATS pleasant and rewarding so that families choose ATS in the long-term, as well as the use of verbal, social or otherwise environmental cues to encourage ATS.

Anticipating the development of an intervention, the main criticism that I wish to make about existing AST theories/models/frameworks is the difficulty in putting theory into practice, even if the theory is supported by robust evidence. Studies often conclude that future research needs to take cognitive (or otherwise psychological) factors into account, but it is not obvious which cognitive factors must be targeted nor how. This problem is echoed by Panter *et al.* (2010): “although our findings suggest that changing parental perceptions may be an important intervention strategy, how this could be achieved is currently unknown. The provision of more supportive environments for active commuting might be particularly appropriate as this may itself result in changes in attitudes or perceptions” (Panter *et al.*, 2009, p.7).

In the same vein, others have found that parental self-efficacy, i.e. the belief in their child's ability to actively travel to school, was significantly associated with AST (Mendoza *et al.*, 2010; Lu *et al.*, 2015). In one study, the authors concluded that AST interventions should aim to improve this parental psychological construct but gave no indication of how this could be achieved (Mendoza *et al.*, 2010). In another study, it was found that both children's and parents' self-efficacy with respect to AST were significantly associated with the occurrence of the behaviour (Lu *et al.*, 2015). Four strategies were recommended to boost child's self-efficacy and therefore AST: community-based interventions to secure neighbourhood safety, by involving schools, families, and communities; increased exposure to supportive role models and positive peer influence; boosting parental self-efficacy, although authors had insufficient data to make specific proposals on this point; and reducing physical and social environmental constraints (Lu *et al.*, 2015). It is fair to say that the range of suggestions to increase self-efficacy had considerable heterogeneity. In addition to the above, others have proposed strategies as diverse as self-management techniques or using rewards to increase self-efficacy (e.g. (Williams and French, 2011; Prestwich *et al.*, 2014)), making it hard to conceive the scope of a "self-efficacy intervention".

A further example is provided by Murtagh *et al.* (2012), who found that perceived behavioural control predicted intentions, which in turn predicted AST (Murtagh *et al.*, 2012). Ways suggested to increase perceived behavioural control (and consequently, intentions and AST) were the promotion of personal mastery experiences (e.g. successful performance of behaviour following guidance), vicarious experiences, verbal persuasion and emotional arousal (e.g. stressing the benefits of performing a behaviour and the risks of not doing so) (Murtagh *et al.*, 2012). It is unclear, however, how these strategies were inferred from the cognitive variable at issue.

Perceived behavioural control, for example, has been identified as increasing when targeted by a number of diverse behaviour change strategies (e.g. (van Dam *et al.*, 2003; Hardeman *et al.*, 2005; Pavlin *et al.*, 2006)). Moreover, it is unclear what is gained by targeting the perceived behavioural control (or intention) of performing AST rather than targeting the behaviour itself, or the conditions in which behaviour occurs. The same techniques are administered in other fields without the addition of cognitive concepts (Martin, 2007; Miltenberger, 2011). Murtagh *et al.* suggest that the inclusion of perceived behavioural control explains how behaviour changes come

about (“via increases in perceived behavioural control”) (Murtagh *et al.*, 2012, p.1)). However, how contextual variables lead to cognitive changes (e.g. verbal descriptions → perceived behavioural control), and how these psycho-cognitive changes determine behaviour (e.g. perceived behavioural control → AST) are questions that remain to be answered (Chiesa, 1994).

2.3.2 The behavioural ecological model

One theoretical model which tries to avoid the circular argument of those discussed above is the Behavioural Ecological Model (BEM) proposed by Hovell *et al.* (2009) (Hovell *et al.*, 2009). This model, a work in progress, is based on findings of a large number of empirical studies of which eight were RCTs. Since then the model has been applied in a wide range of contexts (Adams *et al.*, 2006; Dresler-Hawke and Whitehead, 2009; Ayers *et al.*, 2010; Carrizosa *et al.*, 2010). Consistent with other ecological models mentioned earlier, the BEM considers multiple levels of influence on behaviour, and similar to the Model of Children’s Active Travel (Pont *et al.*, 2011a), people’s actions are viewed as dynamic and as changing with experience.

Accordingly, the BEM (Figure 2.2) stresses the interaction between individual and group contingencies. The term contingency refers to relationships between context (or antecedents (A)), behaviour (B) and its consequents (C) (also known as ABC model) (Hovell *et al.*, 2009). These contingencies (“experiences”) change individuals as a whole and their behavioural propensities (horizontal arrow), both private (within the skin) and public (outside) (vertical arrow) (Skinner, 1953). The two triangles summarise the types of levels of society (upper triangle) and factors within the organism (lower triangle) that combine to determine the likelihood of behaviour.

Understanding all levels and their interactions may be required to fully understand or engineer sustained health-related practices, but one may focus on a given level for an account at that level of analysis (Hovell *et al.*, 2009). This is particularly relevant when researchers have little power to affect policies or other higher-level influences. For that reason, I will focus on contingencies in which parents and children are the main actors, at any level represented by the upper triangle. However, I do so recognising that many of the conditions that shape the behaviour of families are

embedded in wider social contingencies (e.g. how the automobile industry benefits from car travel), or from biological constraints (e.g. medical conditions).

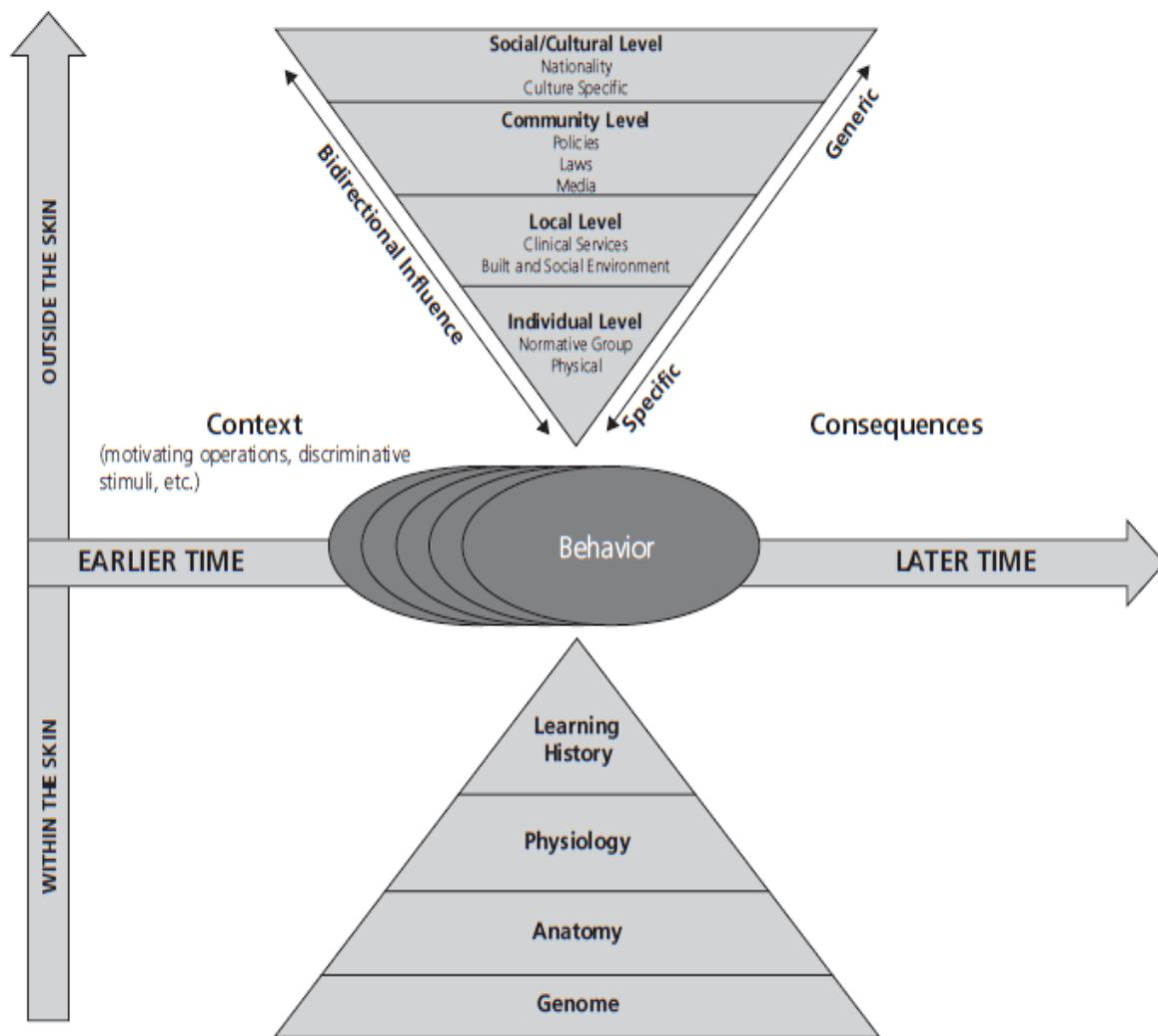


Figure 2.2 - Behavioural ecological model by Hovell et al. (2009)

Consequence-based contingencies may be immediate or delayed, continuous or intermittent, idiosyncratic or shared by the group, and interact to influence individual and group behaviour (Hovell et al., 2009). An understanding of these concepts requires some knowledge of the philosophical and theoretical background of the BEM, including functional contextualism, radical behaviourism and behaviour analysis (Hovell et al., 2009).

2.3.2.1 Philosophical underpinnings

Functional contextualism posits that causes are to be found in the environment external to the phenomenon to be explained (Biglan and Hayes, 1997). Psychological

events are treated as dependent variables which, like other forms of behaviour, are the function of environmental events (Biglan and Hayes, 1997). A theory focused on interactions between organisms and their environments is considered a more suitable means to predict and influence behaviour, which are viewed as the primary aims of psychology (Biglan and Hayes, 1997; Fox, 2006). The same position is adopted by Skinner (1953), to whom the foundations of radical behaviourism and behaviour analysis are attributed (Skinner, 1953).

Central to functional contextualism is the idea of functional relations. To avoid semantic and conceptual ambiguities, scientists began to stress functional relationships, rather than causal ones (Haynes and O'Brien, 1990). Likewise, Skinner preferred the terms "independent variable" and "dependent variable" to "cause" and "effect" (Chiesa, 1994). However, more important than the terminology, is that these terms do not suggest how a "cause" brings about its "effect", but simply that different events tend to occur together in a certain order (Skinner, 1953).

Radical behaviourism accords with pragmatism, the view that the power of science is not so much in discovering the truth but in what it allow us to do (Baum, 1994). Rather than inquiring about an indirectly known world, radical behaviourists ask what descriptions of behaviour are more economical and useful. Scientific knowledge is seen as "a corpus of rule for effective action, and there is a special sense in which it could be "true" if it yields the most effective action possible" (Skinner, 1974, p.235).

2.3.2.2 Behaviour analysis

Behaviour analysis is an approach to the study of the behaviour of organisms which aims to discover principles that govern behaviour, the extension of these principles over species, and the development of an applied technology (Pierce, 2004). It emphasises external events (environmental stimuli and overt behaviours) and has a reluctance to speculate about cognitive processes inside the organism (Mazur, 2006). A strong reference to behaviour and descriptiveness of terms could enhance reproducibility, and allow behavioural science to claim greater validity than other formulations when disagreement arises (Skinner, 1938).

Basic terms in behaviour analysis are behaviour, environment and conditioning. Some of these terms are familiar to most people but a clarification of their behaviour-

analytic meaning is appropriate here because they are not always used in the same sense (e.g. in previous models, cognitive processes were regarded as determinants of behaviour, rather than as behaviour themselves). Behaviour is defined as everything that an organism does, at the covert and overt levels; this includes what people feel and say, to others or to themselves (self-talk), which is often referred to as “thinking” (Martin, 2007). It also includes seeing or hearing stimuli which are not present, as when we visualise the Eiffel Tower when we talk about it, or when we envisage ourselves acting before we perform the behaviour (Skinner, 1953).

Environments are the people, objects, and events – stimuli - currently present in one’s immediate surroundings that impinge on one’s sense receptors and that can affect behaviour (Martin and Pear, 1992). Conditioning means behaviour change as a result of changes in its environment (Pierce, 2004).

Two theories form the main theoretical body of behaviour analysis: respondent conditioning and operant conditioning. To the best of my knowledge, this is the first time that AST is explicitly conceptualised in a behaviour-analytic perspective. However, it is worth noting that, although non-existent (or infrequent) in AST literature, techniques based on classical and operant conditioning are common in NHS weight management programmes (Newson and Flint, 2011).

2.3.2.3 Respondent conditioning

The group of behaviours studied by respondent conditioning – respondent behaviours - are involuntary and automatic responses such as reflexes, glandular responses and what we call emotions (Nord and Peter, 1980). The stimulus of this pair is called the unconditioned stimulus (US), and the response is called the unconditioned response (UR). The term unconditioned denotes that the connection between the stimulus and the response is unlearned (loud bang → getting scared).

Respondent conditioning occurs when a meaningless or neutral stimulus is paired with an unconditioned stimulus, acquiring the capacity to elicit a similar response (Pavlov, 2003). The initially neutral stimulus then becomes a conditioned stimulus (CS) which evokes a conditioned response (CR), CS→CR. After the conditioning of one stimulus, other, similar stimuli will also elicit conditioned responses (generalisation) (Mazur, 2006). For example, people often react to situations which

resemble an original context of trauma, even though these situations were not paired with pain (Arhin and Thyer, 2004; Mineka and Oehlberg, 2008).

Processes of respondent conditioning, although insufficient, may be worthwhile considering in AST. For example, parental concerns regarding 'stranger danger' and road safety have been identified as a potential barrier to children's outdoors PA, namely active travel (Carver *et al.*, 2008). Yet most UK children will never experience any significant "stranger" or traffic danger during their school years (CAPT, 2013). The excessive media coverage of cases of child abduction or murder unjustifiably exacerbates parental fears and anxieties (Zubrick *et al.*, 2010). Thus, depictions of these rare cases on TV, newspapers and on the Internet, become strong conditioned aversive stimuli in parents' environments, which can undermine AST promotion efforts. Social marketing strategies, civic journalism, and particularly more reporting of positive news of how families enjoy and benefit from AST (Zubrick *et al.*, 2010), could elicit more positive feelings and predispose more parents to allow their children to walk or cycle to school.

Related to the notion of stimulus-response relationships is the principle of habituation, a decrease in the strength of a response after repeated presentation of a stimulus that elicits the response (Mazur, 2006). For example, when presented with the same or similar food over days, children reduce their energy intake in comparison to when they are provided with a variety of foods (Epstein *et al.*, 2013). Habituation is a risk for adherence to conventional weight loss programmes, and treatments emphasising variety in times and content of sessions were found to be more successful at achieving sustained weight loss (Jeffery *et al.*, 2009).

This suggests that variables such as the sameness and novelty of environments may influence AST. Hume *et al.* (2009) found that the existence of alternative routes and the non-necessity to take the same way every time were predictive of AST over a two year period (Hume *et al.*, 2009). Qualitative data have suggested that the "diversity of views" was associated with active commuting in the population at large (Pikora *et al.*, 2003). However, the novelty and diversity in walking and cycling environments are only a small fraction of variables that must be analysed. Many AST studies refer to the (usual) route to school commuted by children (Boarnet *et al.*, 2005; Panter *et al.*, 2010b), suggesting stability rather than variation. Factors such as companionship,

safety or distance cannot be disregarded, and may explain why the school trip often occurs in the same spatial context (Timperio *et al.*, 2006).

2.3.2.4 Operant conditioning

Many of our behaviours are said to be emitted rather than elicited because they do not require an eliciting stimulus to occur. Behaviours such as walking, eating or talking are the function of a larger number of variables. In these cases, the organism operates on its surrounding environment encountering special kinds of stimuli – consequences - which alter the probability of repeating that behaviour in the future.

Consequences that increase the probability of behaviour (or strengthen behaviour) are reinforcers; consequences that decrease the likelihood of behaviour (or weaken behaviour) are aversive stimuli or punishers. Reinforcers and punishers can both be positive or negative, depending on whether behaviour is strengthened or weakened by the addition or removal of a stimulus, respectively (Skinner, 1953). In casual discourse, positive reinforcement is usually implied by what we “want” or “like” to do, and negative reinforcement by the things that we “have to do”.

Larson *et al.* (2013) tested the effects of various reinforcers in the levels of moderate-to-vigorous PA (MVPA) in young children (n=2) (Larson *et al.*, 2013) in four conditions: alone, attention contingent on MVPA (e.g. praise), adult interaction contingent on MVPA (e.g. playing with the child), and escape from task demands contingent on MVPA (negative reinforcement). Results showed that the children were most active when attention and interactive play were contingent on MVPA, stressing the role of reinforcements derived from social interaction (Larson *et al.*, 2013). The sample size in this study was very small but findings give some suggestion of the importance of companionship, for example in the context of the journey to school.

The consequences of behaviour are typically correlated with other aspects of the environment or situation. A discriminative stimulus sets the occasion upon which responding will have a particular consequence; the relationship between a discriminative stimulus, the behaviour and its consequents form a three-term contingency, or contingency of reinforcement (or punishment) (Mazur, 2006).

This notion is closely associated with that of antecedent-behaviour-consequents (ABCs) relationships. Antecedents include any contextual factors or conditions,

including discriminative stimuli, which alter the value of the reinforcer and increase likelihood of engaging behaviours to obtain the reinforcer (Kazdin, 2012). This includes the extent to which the individual has gone with or without the reinforcer, as well as previous contingencies of reinforcement or punishment (Pierce, 2004). In other words, antecedents include momentary conditions and past experiences, all of which affect behaviour.

Various examples of ABCs are found in health promotion research. In sun-protection promotion, warmth, positive social comments and attractive tan were reinforcers for sun exposure, while parental approval and avoidance of criticism were reinforcing for sun-protective behaviours (Adams *et al.*, 2009). Excessive heat, sweating, critical social comments and sunburns had a punishing effect on sun exposure; as did a greasy feeling from sunscreen, decreased time outdoors and unpleasant social attention for protective clothing, on sun protective action. Possible long-term reinforcers for sun-protection included healthy skin, avoidance of aged skin or skin cancer, and for sun-exposure, avoidance of criticism for pale colour (Adams *et al.*, 2009).

PA interventions have also been classified having the ABC model as reference (Sallis and Owen, 1998). Examples of changing antecedents included planning specific times and locations for PA, keeping running shoes in the car, and living near attractive facilities. Changing behaviour by altering the consequences included socialisation with others while doing PA, and monetary incentives for active travel to work. The authors stressed that interventions needed not only to administrate reinforcers, but also to consider ways of removing or reducing punishers, e.g. discomfort during exertion, or being laughed at because of poor sport skills.

As an operant behaviour, an assessment of school travel behaviour requires breaking down antecedents and consequents (Kirk *et al.*, 2006). Table 2.2 shows a list of potential antecedents and potential reinforcers for AST, and potential reinforcers for motorised travel. The list is non-exhaustive and suggested by the existing, mainly correlational, literature, and should be subject to further investigation. Antecedents are classed according to the various levels of the BEM. These include individual level (normative group and physical), local level (clinical services, built and social environment), community level (policies, laws, media), and social/cultural level (nationality and culture specific) (Adams *et al.*, 2009). However, because Hovell *et al.*

provide little detail about each level, this division is only approximate, and for convenience, local and community levels are presented together here (e.g. speed limits exist locally, but reflect national laws and policies).

Most literature suggests that parents are the primary decision makers of their child's travel modes to school (Davison *et al.*, 2008; Panter *et al.*, 2008a; Faulkner *et al.*, 2010) but their decision may be affected by their child's preferences (Pont *et al.*, 2011a). Thus, an ABC assessment of school travel mode is likely to benefit from attending to both perspectives.

ABC assessments have been traditionally carried out at the individual level (e.g. (Cole and Bonem, 2000)). This tailoring reflects the fact that the same behaviour (e.g. smoking) can occur for quite different reasons, or in other words, be the function of different antecedents and consequents. However, because an individual assessment or treatment is not at stake here, potential antecedents and consequents for AST are presented together, as previously reported in other contexts of health promotion (Gielen and Sleet, 2003; Adams *et al.*, 2009).

'Antecedents' essentially means stimuli which increase opportunities for reinforcement. As such, they increase the likelihood of behaviour, but always in combination with other contextual factors such as conditions favouring engagement in alternative activities and previous history.

Some correlates such as gender of the child or ethnic background are omitted because their effects are likely to be indirect. For example, in the parent environment, parents are often more protective towards girls (e.g. (De Meester *et al.*, 2014)) and safety concerns are reported more frequently for girls than for boys (Evenson *et al.*, 2006). For many parents, protective behaviour towards girls may be more accepted (i.e. reinforced), or less resisted (i.e. punished), than towards boys (e.g. (Mayhew *et al.*, 2004)). Likewise, in some social minorities, car ownership, and its daily use, is more common, and those who drive their children may be less often subject to unwanted attention than parents from other backgrounds who do the same (e.g. (Eyre *et al.*, 2013)). We still need to ask how these contingencies can be tackled, but their specification is likely to allow a higher level of practicality. Distance, a key determinant of AST, is also likely to be a moderator for other variables (e.g. house location), rather than being itself amenable to direct manipulation.

	Potential antecedents for AST	Potential reinforcers for AST	Potential reinforcers for motorised travel
Individual	<ul style="list-style-type: none"> - No car available (Sirard and Slater, 2008; Pont <i>et al.</i>, 2009) - Lower socio-economic status (e.g. less money available) (Davison <i>et al.</i>, 2008; Sirard and Slater, 2008; Pont <i>et al.</i>, 2009) (Panter <i>et al.</i>, 2013) - Independent mobility (allowed to be out alone) (Davison <i>et al.</i>, 2008) - Parents currently walk or cycle to work (Davison <i>et al.</i>, 2008; Van Kann <i>et al.</i>, 2015) - Parents encourage AST and walking (Sirard and Slater, 2008) (Panter <i>et al.</i>, 2010a) - Parents encourage PA and social interaction during AST (Davison <i>et al.</i>, 2008) - Encouragement from others (Davison <i>et al.</i>, 2008) - AST more convenient, time available (Panter <i>et al.</i>, 2013) (Trapp <i>et al.</i>, 2012) 	<p>Immediate:</p> <ul style="list-style-type: none"> - Being active/fit (Fusco <i>et al.</i>, 2013) (Davison <i>et al.</i>, 2003) (Kirby and Inchley, 2009) - Having fun (Mitchell <i>et al.</i>, 2007) (Hunter <i>et al.</i>, 2015) (Romero, 2015) - Listening to music (Kirby and Inchley, 2009) - Gives energy (Mitchell <i>et al.</i>, 2007) - Interesting things to look at/nature (Mitchell <i>et al.</i>, 2007) (Fusco <i>et al.</i>, 2013) - Interaction with other children/make friends (Davison <i>et al.</i>, 2008) (Kirby and Inchley, 2009) (Fusco <i>et al.</i>, 2013) 	<p>Immediate:</p> <ul style="list-style-type: none"> - Time saved (convenience) (Faulkner <i>et al.</i>, 2010) - Less effort (Faulkner <i>et al.</i>, 2010) - Safer (Fyhri <i>et al.</i>, 2011) - Having a car is “cool” (attention and approval from others) (Lorenc <i>et al.</i>, 2008) - Listening to music (Romero, 2015) - Cheaper (bus) (Pooley <i>et al.</i>, 2010) - Interaction with friends (bus) (Mitchell <i>et al.</i>, 2007) - Good view from the bus (Mitchell <i>et al.</i>, 2007) - Avoid bullies (Ahlport <i>et al.</i>, 2008) - Avoid cold/rain (Kirby and Inchley, 2009) - Avoid carrying bag (Kirby and Inchley, 2009) - Avoid exposure to pollution (Pooley <i>et al.</i>, 2010)
Local/ community	<ul style="list-style-type: none"> - Other children in the area walk/cycle to school (Davison <i>et al.</i>, 2008) - Shorter distance (Davison <i>et al.</i>, 2008; Panter <i>et al.</i>, 2008a; Saelens and Handy, 2008; Sirard and Slater, 2008; Pont <i>et al.</i>, 2009; Wong <i>et al.</i>, 2011b) - State-funded schools (Davison <i>et al.</i>, 2008; Sirard and Slater, 2008) - Non-religiously affiliated (Davison <i>et al.</i>, 2008) - Schools that encourage physical education and active travel initiatives (Sirard and Slater, 2008) - Proximity to shops (Panter <i>et al.</i>, 2008b; Sirard and Slater, 2008) - Walkability index (calculated by residential density, retail floor area ratio, intersection density and land use mix) (Sirard and Pate, 2001; Davison <i>et al.</i>, 2008; Saelens and Handy, 2008) - Urban areas (Davison <i>et al.</i>, 2008; Sirard <i>et al.</i>, 2008) - Pavements, cycle lanes and cycle parking facilities (Davison <i>et al.</i>, 2008; Saelens and Handy, 2008; Sirard and Slater, 2008; Pont <i>et al.</i>, 2009) - Parks and recreation facilities (Pont <i>et al.</i>, 2009) - Aesthetics and more windows facing the street (Sirard and Slater, 2008) - Good weather (Fraser and Lock, 2011) - Road and area safety (Davison <i>et al.</i>, 2008; Panter <i>et al.</i>, 2008a; Sirard and Slater, 2008; Pont <i>et al.</i>, 2009) 	<ul style="list-style-type: none"> - Cycling is “cool” (attention and approval from others) (Trapp <i>et al.</i>, 2011) (Baslington, 2009) - Feeling the sun (Mitchell <i>et al.</i>, 2007) - Breathing fresh air (Kirby and Inchley, 2009) - Faster than walking (cycling) (Mitchell <i>et al.</i>, 2007) - Feeling more alert at school (Mitchell <i>et al.</i>, 2007) (Kirby and Inchley, 2009) - Save money (Kirby and Inchley, 2009) - Approval from parents and others (Sirard and Slater, 2008) (Panter <i>et al.</i>, 2009) <p>Non-naturally occurring:</p> <ul style="list-style-type: none"> - Rewards/incentives (Kirby and Inchley, 2009) (Davies, 2012) - Raising funds for charity (Hunter <i>et al.</i>, 2015) <p>Delayed:</p> <ul style="list-style-type: none"> - Better health (Kirby and Inchley, 2009; Fusco <i>et al.</i>, 2013) - Benefits to the environment (Davison <i>et al.</i>, 2003) (Kirby and Inchley, 2009) 	<p>Delayed:</p> <ul style="list-style-type: none"> - Benefits to the environment (bus compared to car) (Baslington, 2009)
Social/ cultural	<ul style="list-style-type: none"> - Social encouragement and approval for active lifestyles (McMillan <i>et al.</i>, 2006) - Equality and environmental awareness (Garrard, 2011) 		

Table 2.2 - Potential antecedents for AST, potential reinforcers for AST, and potential reinforcers for motorised travel

“Social encouragement and approval for active lifestyles” and “equality and environmental awareness” are particularly difficult to operationalise, and may refer both to antecedents (e.g. laws, behaviour of other people) and to consequences (e.g. approval from others contingent upon behaviour). Interestingly, both may well be an umbrella term that encompasses many, if not all, of the other antecedent variables.

Punishers for AST, not covered here, are worth investigating in view of devising strategies to minimise their impact.

Table 2.2 suggests that school travel behaviour can be tackled essentially in three ways: by changing the antecedents (stimulus control), by introducing (or strengthening) reinforcers for AST, and/or by withdrawing reinforcers for motorised travel (extinction). This perspective and techniques are largely consistent with the 'nudging approach' adopted by the Behavioural Insights Team, a government institution dedicated to the application of behavioural science (BIT, 2016).

Punishment of motorised travel (e.g. fines for driving near schools) is another possibility, but on its own, may be less effective and carries well-known undesirable side effects such as fear or anger which may interfere with performance and learning, or escape or retaliation by the punished (Lerman and Vorndran, 2002). When applied, the resort to punishment is usually supplemented with the implementation of alternative behaviours using positive reinforcement, a technique known as differential reinforcement (Lerman and Vorndran, 2002; Miltenberger, 2011) (e.g. fining speedy drivers but rewarding exemplar ones).

2.3.2.5 Properties of reinforcers

The power of reinforcement is affected by a variety of factors inherent to the reinforcer. A useful framework for documenting the complexity of financial incentive interventions to change health behaviours has been proposed (Adams *et al.*, 2013). The focus is on financial incentives, and studies reviewed come from various theoretical orientations, but this framework is a good summary of the main quantifiable properties of a reinforcer. Nine dimensions were identified by the authors: direction - such as positive reward or avoidance of a penalty (i.e. positive or negative reinforcement); form - what the incentive is (voucher, cash); magnitude - the amount of incentive; certainty - the degree of guarantee that the incentive will be issued; target - whether what is incentivised are behaviours, outcomes of behaviour or proxies of the behaviour; frequency - whether all or only some instances of the behaviour are incentivised; immediacy - time elapsed between the behaviour and receipt of incentive (the sooner the better); schedule - fixed or variable, or whether the amount of incentive is fixed or changes as the intervention proceeds; and

recipient – whether the incentive is awarded to the individual, to a group or to significant others (Adams *et al.*, 2013).

One dimension identified by Adams *et al.* - certainty - corresponds to a property of reinforcers known as schedules of reinforcement in operant conditioning, a topic which has received considerable attention over the years. A schedule of reinforcement is a rule that states under which conditions a reinforcer will be received (Mazur, 2006), or the arrangement of the environment in terms of discriminative stimuli and behavioural consequences (Pierce, 2004). Continuous reinforcement refers to behaviour which is reinforced invariably at each occurrence (e.g. drinking → quenching thirst), but most of our behaviour is only reinforced intermittently (Miltenberger, 2011). There are four basic intermittent reinforcement schedules (Skinner *et al.*, 1997) but only one is directly relevant to the intervention developed in this project: the variable-ratio schedule. Under this schedule, the number of responses required for reinforcement varies unpredictably from one reinforcer to the next. Addictions are the prototype of this schedule. Gambling behaviour such as playing at slot machines (Shao *et al.*, 2013), the lottery (Burns *et al.*, 2012), or online gaming (Hussain *et al.*, 2012) are associated with an unpredictable number of occurrences needed to produce a reinforcing consequence. Reward-schemes using variable-ratio schedules of reinforcement have been applied to promote physical exercise in obese boys (Luca and Holborn, 1992), in the management of problem behaviour and acquisition of communication in children (Kelley *et al.*, 2002), or to increase AIDS-preventing behaviour (Haug and Sorensen, 2006). Of special relevance to this project, in the Boltage programme (US), children who rode their bicycle to school were entered into a weekly prize draw (\$10) (Cuffe *et al.*, 2012). A 16% increase in rides during draw periods was reported, but the absence of a control group hinders robust conclusions.

There is evidence to suggest that behaviour acquired through intermittent reinforcement is more resistant to extinction than that instigated after a continuous schedule (Horsley *et al.*, 2012; Nevin, 2012). Different schedules may be combined at the same time, and the amount and type of reinforcer may vary throughout the intervention (Mazur, 2006) (what Adams *et al.* named “schedule” (Adams *et al.*, 2013)). Some evidence suggests that a fixed-ratio schedule is most effective during initiation of the behaviour, while a variable-ratio schedule is best in maintaining behaviour over time (Burns *et al.*, 2012).

On the downside, reinforcement schedules do not always predict behaviour as expected (e.g. (Barkley, 2013)). Strategies such as loyalty cards or lotteries often work but behaviour change tends to be of short duration once the incentive is discontinued (Strohacker *et al.*, 2014). Nevertheless, some data suggest that incentive approaches may be cost-effective (Hanewinkel and Isensee, 2012; Dallat *et al.*, 2013). In the Boltage programme described above, the 16% increase in rides was limited to draw periods and following weeks, but as only six cents were spent per child there was a potential for cost-effectiveness (Cuffe *et al.*, 2012).

2.3.3 Strengths and limitations of the BEM

Similar to other ecological models discussed earlier, one of the main strengths of the BEM is the recognition of multiple levels and sources of influence on AST. This increases the number and options of possible interventions substantially. Other advantages of the BEM are its concern for conceptual clarity and its emphasis on behaviour and on observable interactions between organisms and their surroundings. Existing ecological models have been criticised for failing to explain how the environment exerts its effects on people's behaviour (Nelson, 2007); contingencies of reinforcement may help answer the question. Treating cognitive processes as behaviours, and therefore as dependent variables, has the advantage of directing attention to external variables, which are the only ones amenable to direct manipulation by behavioural researchers (Chiesa, 1994). This makes the BEM more practical, parsimonious and to some extent more testable than other models. On the issue of behaviour maintenance, often unaddressed by existing models, the BEM suggests the need for introducing some level of reinforcement over time, or making it more conspicuous, and modifying other aspects of the child's environment (see table 2.2). Both of these insights are in agreement with those provided by two previous models (section 2.3.1), i.e. the more the environment is conducive to ATS, the more chances there are for durable behaviour change. In addition, the BEM directs attention to the antecedents and reinforcers of car use (e.g. convenience), which may explain why people choose to drive and their difficulty in maintaining ATS over time.

However, similar to other ecological models, contingencies at the societal level are very difficult to test. Because of its strong reliance on laboratory research, principles of behaviour analysis do not always predict or work as expected due to the wider

range of uncontrolled variables in everyday life. At a more individual level, some contingencies of reinforcement are difficult to spot, especially if reinforcement occurs intermittently. Finally, even if specific antecedents or reinforcers can be identified, these may not be possible to change (e.g. weather, lack of financial resources).

2.4 Modelling processes and outcomes

The third task in developing a complex intervention consists of modelling processes and outcomes which can provide important information about both the design of the intervention and the evaluation (Craig *et al.*, 2008a). Logic models make explicit the underlying assumptions about causal relationships and programme theory and help understand the potential mechanisms of action (Anderson *et al.*, 2011). They also summarise key intervention elements, explain the rationale behind intervention activities, clarify intended outcomes, and work as a communication tool (NNLM, 2012). Other aspects are specified, such as resources needed for the intervention, its activities and direct outputs, as well as short and long-term outcomes (NNLM, 2012). Often logic models include the assumptions under which the intervention operates and its contextual factors (NHS Health Scotland, 2014).

Table 2.3 presents a potential logic model for the intervention and trial procedures tested in this project, consistent with the theoretical approach discussed above. The resources or inputs of this project include financial and other material assistance available, as well as human resources. The main activities consist of children who actively travel to school being entered into weekly prize draws, and of measurement procedures involving parent and child reports of travel mode to school and an accelerometer assessment. The most immediate expected output is an increase in the frequency of active trips to school. In the short-term, this increase is anticipated to lead to higher energy expenditure, increased interaction with the social and non-social environment, social approval, reduced carbon footprint and reduced traffic congestion around the school (not measured in this study). In the long-run, this may promote the physical and mental health of children, while improving air quality and noise pollution.

The concept of a lottery based intervention is simple but there is some complexity in the need to assess and report ATS in an accurate and timely manner to be eligible

for the draws, in addition to other trial procedures (e.g. report validation), hence my intervention has been referred to as a complex one (for further details, see MRC guidelines on ‘what makes an intervention complex’ (Craig *et al.*, 2008b)).

Process			Outcomes	
Resources (inputs)	Activities	Outputs	Short-term	Long-term
- Funds for PhD - Funds for incentive scheme - Material loan	Incentive scheme – children who walk or cycle to school are entered into a weekly voucher draw	Children increase their number of active trips to school (or partway active trips to school)	Increased MVPA (energy expenditure)	Improved physical and mental health; better control of body weight
Practice partners: - Sustrans	Measurement procedures – parent AST reports, child AST reports and accelerometers, are distributed and collected weekly as appropriate		Increased interaction with social (e.g. other children) and non-social environment (e.g. fresh air, parks)	Improvement in air quality and noise pollution levels
- Supervisory support			Increased approval by parents, school and others	
			Reduction in CO2 emissions	
			Less traffic congestion around the school	

Table 2.3 - Logic model for this project

This logic model makes two assumptions. The first is that children and parents will respond to the incentive scheme. Underlying this assumption is the fact that there is some evidence to suggest that incentives can encourage specific and simple health behaviours in youth, which often involves the participation of parents (Kavanagh *et al.*, 2011). However, ATS may be more appropriately regarded as a complex behaviour, considering the range of travel options, their frequency, duration and configuration (e.g. multi-mode trips). As such, it is to some extent unclear how the above evidence applies to ATS promotion. The second assumption is that AST will be frequent and sustained over time in order for long-term outcomes to occur. Although it has been difficult to demonstrate the sustainability of behaviour changes once incentive schemes are discontinued (Kavanagh *et al.*, 2011), some data suggest that running interventions for long periods (e.g. for years) may be a way of producing more durable outcomes (Cuffe *et al.*, 2012). It is also worth considering running this scheme in the future as part of wider changes in other social and infrastructural aspects, which may have greater potential for behaviour maintenance.

There a number of contextual factors to consider: socio-demographic characteristics of the families involved in the study; geographical aspects such as distance and characteristics of the route to school; attitude of the school towards active travel and towards the use of incentives; and availability of teachers and other school staff to help deliver the intervention.

The above logic model presents a rationale for the execution of this project and should be kept in mind for that reason. However, in line with the MRC guidelines, an intervention should first be tested for feasibility before a large-scale evaluation.

2.5 Conclusion

In this chapter, I have reviewed the evidence base of existing AST interventions and incentive interventions in children and young people, identified relevant theory and modelled processes and outcomes for this project.

There is currently limited evidence to support AST interventions, but some data suggest that incentive interventions are effective in changing simple behaviours in youth; the degree to which this applies to AST or to primary school children requires further investigation.

There are a number of theories and theoretical models in AST research, but their practical utility is often unclear. The behavioural ecological model (BEM) presented here, with its focus on the antecedents and consequents of behaviour, is likely to have practical advantages over previous formulations.

There are serious practical, ethical and economic difficulties in modifying many of the social and non-social (e.g. infrastructural) conditions which determine the school travel choices of parents and children. These constraints, coupled with the limited budget available to this project (and to many others), suggest that a lottery-based incentive scheme may be a realistic and affordable alternative to increase the reinforcing value of the school commute. It applies two key theory and evidence-based principles of behaviour change, namely positive reinforcement and intermittent reinforcement. The encouragement of teachers and parents to take part in an intervention, as well as having other peers in the classroom taking part, may provide additional reinforcement for participants even if in the absence of any prizes won.

Chapter 3 – Public and stakeholder involvement

3.1 Introduction

This chapter describes the development of the intervention, particularly in relation to public and stakeholder involvement. As discussed in Chapter 2, the evidence base of previous interventions, reviewing theory and modelling processes and outcomes, are key tasks in developing an intervention, according to the MRC framework. The same source recommends that appropriate ‘users’ should be involved at all stages of the development, process and outcome analysis of a complex intervention (Craig *et al.*, 2008a). A common starting point is a survey of the target population to gain knowledge of relevant behaviours and variables, upon which subsequent developments of the intervention will be based (Craig *et al.*, 2008a).

Consistent with this approach, I first planned a descriptive study comprising a parental questionnaire, information materials, and an accelerometer assessment, to help me develop a future AST intervention. Considering the limited evidence for the effectiveness of ATS interventions, an incentive approach seemed an option for this project. This was in line with the views of those consulted which pointed to the potential of incentives as behaviour change tools. Relevant theoretical models and the evidence base of interventions involving incentives are part of Chapter 2.

The next sections explain the rationale behind the materials and procedures employed in this study, and describe how Public Involvement (PI), stakeholder consultation and existing literature assisted in their development, planning and refinement.

3.2 Development of the intervention

3.2.1 Choice of setting, age group, title and logo

Two of the first decisions made were regarding the setting and age group to be targeted in this study. Schools are widely recognised as a strategic context for health promotion in young people (Kriemler *et al.*, 2011) and instilling health behaviours at an early age can establish these for life. Older children, however, have more freedom to travel to school independently (Schoeppe *et al.*, 2012) and greater ability to understand and follow research procedures (Shaw *et al.*, 2011). Thus, targeting

pupils in their final years of primary school may be advantageous, while helping prevent or lessen unhealthy behaviours characteristic of the transition to adolescence, and encouraging healthier lifestyles (Knowles *et al.*, 2011; Sawyer *et al.*, 2012). In keeping with this evidence, Year 5 pupils (age 9-10) were the group selected as the focus of this study.

In-house researchers with expertise with young populations advised the prompt choice of a child-friendly and original title and logo. This advice was consistent with studies suggesting the success of marketing strategies to enhance recruitment and retention in trials (Campbell *et al.*, 2007; McDonald *et al.*, 2011a).

The name RIGHT TRACKS (Research InvestiGaTing TRANsport Changes in KidS) was considered fit for purpose. The logo was drafted manually and improved with graphic software to convey the idea of children actively travelling to school, representing various travel modes and both genders (Figure 3.1).



Figure 3.1 - RIGHT TRACKS logo

3.2.2 Development of first materials

A number of considerations were made for the development of initial materials. Parents are the primary decision makers of their child's travel modes to school (Panter *et al.*, 2008a; Faulkner *et al.*, 2010), so it makes sense to prioritise parental views when investigating barriers and facilitators to AST. Furthermore, although (as discussed in Chapter 1) very few PA questionnaires show acceptable reliability and validity, adult reports tend to be more valid and reliable than children's (Helmerhorst *et al.*, 2012). Objective measures of PA such as accelerometers are frequently incorporated in AST studies for validation purposes (Faulkner *et al.*, 2009), which addresses a key objective of feasibility studies (Lancaster *et al.*, 2004).

As explained in section 3.1, the initial aim of the RIGHT TRACKS study was descriptive before becoming interventional. However, most documents developed in preparation for the descriptive study were retained when the incentive scheme became the focus. For most documents, their development was iterative, with multiple versions tested for clarity and modified according to the feedback received.

Due to the word limit of this thesis, only the definitive versions are shown in the appendices.

3.2.2.1 Parental questionnaire

The initial parental questionnaire (“questionnaire for the parent/carer”) was a shortened version of the parent questionnaire used in the SPEEDY study (Van Sluijs *et al.*, 2008), supplied by the author on request. The SPEEDY study (Norfolk, UK) aimed to assess PA and eating behaviours in Year 5 children (n=2065, age 9-10), and much of its published work to date has revolved around AST (Panter *et al.*, 2010a; Panter *et al.*, 2010b; Smith *et al.*, 2011; Panter *et al.*, 2013). The original questionnaire comprised 54 questions and covered a wide range of topics: socio-demographics and parents’ PA; child’s characteristics, child’s travel to school and to other destinations; views on child’s PA; rules and restrictions at home; perceptions of the environment and of the journey to school; and opinions about food. On active travel, newly developed questions about attitudinal and social support factors were tested twice for face validity (Panter *et al.*, 2010a). Items on neighbourhood and route environments were from existing scales and demonstrated high and good reliability respectively ($\alpha=0.90$ and $\alpha=0.74$) (Panter *et al.*, 2010a).

Twenty-two questions of potential relevance to AST were retained from the SPEEDY study questionnaire. These included: parent’s PA (e.g. “How do you normally travel to work?” (if applicable)); some child’s characteristics; child’s school travel and to other destinations (e.g. “How does your child travel to school on most days?”); perceptions of the environment and of the journey to school (e.g. “There are a lot of busy junctions in my local area”); and socio-demographics. Most of these variables are ATS correlates which have been discussed in Chapter 2. Answering questions involved circling values on Likert scales indicating agreement level in the case of perceptions, and ticking or completing boxes, or writing times (e.g. minutes spent travelling to work) for all other fields. Excluded items were: PA involved in parents’ work; parental sedentary behaviour and health-related lifestyle (e.g. smoking); characteristics of the child at birth; description of the child’s behaviour and energy levels; parental norms about PA and dietary behaviour; perception about social cohesion in the local area; and opinion about food. The literature reviewed in Chapter 2 suggested that these items were of less relevance to the focus of the current

research. This factor, coupled with a need to avoid overburdening parents with too many questions, led to their exclusion. The extent to which the exclusion of these items affected the validity or reliability of the original questionnaire is unknown.

Further to data pointing to the automaticity of school travel behaviour (Hodgson *et al.*, 2012), a new section on habit strength was added to the questionnaire, measured by the 12-item scale Self-Report Habit Index (Verplanken and Orbell, 2003). The heading “My usual travel mode to school is something...” was followed by each of the items, such as “I do automatically” or “I do without thinking”. A Likert response format was used, with seven response options ranging from “disagree” (1) to “agree” (7).

3.2.2.2 Information materials

In addition to the parental questionnaire, three documents were created to provide information about the study to participants: a detailed parent information sheet (longer than leaflet); an information leaflet for the parent; and an information leaflet for the child. The parent information sheet was a document detailing: the aim and procedures of the RIGHT TRACKS study; reasons why parent and child were being approached; voluntary participation; confidentiality issues; risks and benefits; funding source; use of findings; and contact details. This information was in agreement with Newcastle University’s guidance for ethics (NU, 2015). Contents were summarised in each of the two trifold leaflets, one each for parents and one for children, using age-appropriate language and visuals.

3.2.3 Input from parents and children

The four materials were tested for clarity in a convenience sample of five parent-child dyads (n=10). All parents were researchers at Newcastle University - three White British, one of Other White Background, and one Asian; all had a child in Year 5 (age 9-10). At home, parents completed the questionnaire, parents and children read their respective informative sheets, and took notes of any difficulties encountered or suggestions for improvement. Parents were asked to support their child in reading and commenting on the leaflet as needed. Annotated materials, complemented with oral feedback, were received in short one-to-one meetings at university, which only the parent attended.

The feedback provided led to a number of modifications to form and content of materials. In the questionnaire, time spent in PA proved to be hard to estimate, and the possibility of multiple answers was identified for other questions (e.g. “Who does your child go to school with on most days?”). One instance where this option already existed was the question about the child’s travel mode(s) to school “on most days”; however, there was confusion over whether this meant “different uni-mode trips throughout the week” or “multi-mode trips within the day”. Feedback also indicated that journeys “on foot or by bicycle” would require separate response options and analysis because parents felt very differently about each type. Without exception, the habit measure was the most ambiguous even for native speakers, and was left unanswered in some cases. The two non-British respondents found the English “very difficult”. In the rationale given for asking for the postcode (so that the distance home-school could be calculated), I was considered “over apologetic” by some parents, for whom the question posed no special trouble. Determining the “number of people who lived in the household in total” was challenging for recomposed families. Finally, written notes on completed questionnaires pointed out missing boxes and headings, spelling mistakes, and recommended a better usage of words (e.g. “return from school”, rather than “go from school”).

Comments on the parent information sheet related to format and phraseology; one informant stated a preference for an individualised report of findings at the end of the study (as opposed to a standardised one). Also, discussion of the risks associated with taking part was viewed as unnecessary and as having a potentially deterrent effect on prospective participants. Feedback on leaflets was minimal, with most suggestions relating to language, the need to reduce the amount of text and to include more images. Most parents mentioned the excitement of their child on reading that participants would be thanked with a £5 gift voucher.

Due to uncertainties about what was ethically permitted at this stage, the accelerometers were not tested by the five children at this point. Instead, this happened later during a user engagement meeting for young people at Newcastle University (section 3.2.7).

3.2.4 Input from a head teacher

Shortly after the first contact with parents and children, a meeting was held with the head teacher of a local primary school. The goal was to review the planned materials and procedures, and help identify possible problems from the perspective of schools. Overall, the head teacher approved of the proposal and predicted interest and receptiveness from children, parents and school staff. She indicated that schools used to have travel plans, but said that these had become less common as a consequence of funding cuts. Yet schools were required to address the issue of AST, and partnering with this type of research could be an economic way of them doing so, according to the head teacher. In the past, her school, with predominantly non-British pupils and located in a semi-rural and less affluent part of the region, had hosted academic research investigating PA with pedometers, to which pupils were very responsive. Although in her case most school trips appeared to be made already on foot, she believed that there was greater scope for change in other localities.

Suggestions for recruitment strategies were particularly informative. She suggested that the best way to approach schools was through head teacher associations, by “catching them all at once”, but unfortunately failed to provide me with the relevant contact details. Email was suggested as an alternative but it was recommended that a letter of support from the local Council should be attached, as well as all definite versions of materials. A Disclosure and Barring Service (DBS) check would be essential for any personnel entering the school or having contact with pupils. Showing empathy towards schools’ busy schedules, and stating a commitment to minimise disruption, would be appreciated by school staff. Phone calls to assess the interest of pending respondents (schools) would be acceptable. At this point, I would be expected to have a clearly defined action plan, and to be able to take its lead.

Parent gatherings could be an option for recruiting pupils but likely to be “unnecessary”. Instead, sending an envelope home via pupils’ bags would do just as well. Materials should only be written in English, as parents naturally tend to seek assistance from others and from the child when needed. Apart from the dispensability of the parent information sheet (“unless it’s a very affluent area”), the head teacher found the number, length and content of documents generally appropriate. Asking children to map their route to school, or to wear a GPS (at the time only remote

possibilities), would not carry significant risks as long as everybody was duly informed and consented.

It was explained that it is customary for schools to have groups of pupils from the same classroom working on different assignments in separate or the same rooms at the same time, so a mix of participants and non-participants in the classroom should be easily manageable. The presence of an adult female (e.g. member of school staff) when trying out accelerometers would appease schools and parents. Considering the age group (9-10 year olds), the head teacher anticipated few difficulties in children handling the devices on their own. Personal interviews should be conducted at school or at university, rather than at the family's home, for a number of reasons: for my safety; parents would rather come to school or university to avoid embarrassment if they lived in poor circumstances; or may not wish to be seen in the presence of a stranger by their neighbours who may think that he is a social worker or similar official. To communicate findings, brief reports at the end of the study, or a section in the school's newsletter, would most likely reach a larger audience than a presentation for parents in school.

One of the most resounding messages from the meeting with the head teacher was the attractiveness of the £5 voucher. Consistent with the five parent-child pairs, on various occasions she stated that children would be highly enthusiastic about the idea of receiving a voucher for taking part, and willing to comply with the study requirements. Moreover, in some cases, the strongest motivation would come from parents themselves. This observation, and the same in relation to input from parents, was consistent with an incentive approach. Most of the contents of materials produced and reviewed to this point by the parent-child dyads and head teachers were relevant to understanding how well participants would respond to the new study, and therefore were retained.

3.2.5 Input from researchers and stakeholders

Personal contacts were made and email correspondence exchanged regularly with a number of fellow researchers working with young people and/or using similar research methods, as well as with stakeholders. Most had relevant experience with primary school populations, and at least three of them had experience with accelerometry. Potential benefits of a sponsorship from the Council were highlighted

in an informal meeting with two researchers at the beginning of the development process. Knowledge of the special circumstances of each school was recommended, as well as flexibility to adjust to them, for example by liaising with head teachers before proceeding to fieldwork. Visual polishing of drafted materials was strongly advised by the two researchers, who readily made available their own instruments from previous studies (namely consent forms and info sheets). Other issues to consider were the use of multi-lingual texts to fit the needs of an ethnically diverse sample, attending a parent evening for recruitment, and pre-piloting materials and procedures in a small group. Pros and cons of 'opt in' and 'opt out' recruitment were debated. Depending on sample size requirements, active consent (opt in) was thought to be more likely to be accepted without opposition from schools or parents.

One of the two researchers consulted had a significant publication record on accelerometer-based studies with children (Basterfield *et al.*, 2008; Basterfield *et al.*, 2011; Basterfield *et al.*, 2012) and she suggested borrowing accelerometers from other research teams to overcome the lack of resources for this project. However, she alerted me to the potential scenario of equipment going missing or breaking, and was unable to offer a complete solution to the problem. It was felt that putting in place the appropriate risk assessments and incentivising the timely return of accelerometers could make a difference. A diary reporting accelerometer wear and removal times was something she would prescribe, however its use seemed controversial and was often absent from other AST studies (Faulkner *et al.*, 2009). Concerns were raised about the validity of diary reports by the other two accelerometry experts, consulted as part of this process, who favoured a diary-free assessment. Given the type of study being undertaken (feasibility), the accelerometer wear diary was kept at this point. It was discarded only after the head teachers of the recruited schools strongly advised simplifying materials and procedures (section 3.2.11.3).

Endorsement by Newcastle City Council was sought but proved to be problematic to obtain. There was a stated reluctance in assisting the RIGHT TRACKS study due to high demand for similar support from other projects. Instead, a partnership with an organisation of AST promotion such as Sustrans (Sustrans, 2016) was advised.

A Sustrans school officer working in local schools was a valuable supporter of this project. From the outset, he agreed to supply me with a list of schools who had been

or were involved with Sustrans, and to assist me when approaching schools. Any Sustrans information on current AST Figures could be especially useful for the selection of participating schools. This officer was consulted again on receipt of feedback from the research ethics committee (see sub-section 3.2.11.2), and occasionally during the pilot trial whenever Sustrans-collected data or his own opinion were considered important (see Chapter 4). One of the suggestions made by this stakeholder concerned the use of the term ‘reward scheme’, as opposed to ‘incentive scheme’, which could make it more understandable to children.

3.2.6 Development of a research protocol

Among the range of existing incentive strategies, lottery schemes are easy to implement and some data suggested their effectiveness in youth health promotion (Jensen *et al.*, 2011; Kavanagh *et al.*, 2011). The next step was to devise a research protocol to guide the delivery of the intervention and trial procedures, and for ethical approval. Early versions of the protocol lacked detail but frequent exchanges with researchers, stakeholders and with my supervisory team, allowed gradual refinement. From the start, the proposed incentive scheme resembled the Boltage programme, In the Boltage programme (US) (Cuffe *et al.*, 2012), for instance, children who rode their bicycle to school were placed in a weekly prize draw (\$10). The 16% increase in rides during draw periods and subsequent weeks was considered to be a large effect, given that only six cents were spent per child (Cuffe *et al.*, 2012). However, in this case, wheeled foot-powered vehicles seemed to predominate and measurements consisted of code-tagged helmets being scanned on a reader each morning. Walkers also passed their coded tags (without helmet) under the reader, but no validation procedures were undertaken to rule out the possibility of children scanning their codes when they were chauffeured. These limitations needed to be addressed by future studies, especially in contexts where trips on foot are in the majority.

The current protocol used a two-arm cluster randomised controlled design (randomisation at the school level), and combined reports of AST with accelerometry (the latter for validation purposes). In short, children who walked or cycled to school, part or all of the journey, were entered into a weekly £5 voucher draw. The more days the child had walked or cycled to school, the more chances he/she had to win,

with each AST journey to school reported by the parent earning one ticket in the draw. A full account of the intervention procedures is given in Chapter 4.

The time and resources required by some of the measurement techniques led to an exclusive focus on the journey to school. This decision was also based on the observation from previous research that AST is significantly lower in the morning than in the afternoon (Jago *et al.*, 2014). Consistent with the general literature in the field, I have used the term AST in most chapters of this thesis. However, from this point onwards, active travel to school (i.e. ATS) will be preferred to convey the focus of my empirical study more accurately. ATS should be regarded as subcomponents of AST.

3.2.6.1 Data collection procedures

Data were collected from parents (parent ATS report), children (child ATS report) and via accelerometers on a weekly basis, in both intervention and control groups (see next chapter for details on data collection). The parent ATS report was the primary method of determining eligibility for the draw, but the child ATS report and the accelerometer were used to assess validity and acceptability of the various measurement approaches. Each child was scheduled to wear the accelerometer twice, for seven days each time, once at baseline and once during the intervention phase, both in intervention and control arms. Another element of the study were the qualitative interviews with parents and children, for which interest could be expressed in the consent form. Depending on the interest shown, participants would be purposively sampled to share their experience of taking part, and views about, the study (this qualitative study is the topic of Chapter 5).

The parent ATS report comprised five questions, one for each day of the week: "Today (day), did your child walk or cycle to school, all or part of the journey? Please reply YES or NO". Parents had the option to report their child's travel mode to school by SMS (in which case they would receive an SMS each school morning with the same question), or on paper. The child ATS report was always in paper format and administered in my presence in the classroom. Like the parental report, the child report contained five questions, one in relation to each of the five previous school days: "Today (day), did you walk or cycle to school, all or part of the journey? Please reply YES or NO". In both paper forms, parents and children were requested to put a cross in a box to indicate yes or no (mobile respondents would reply in writing). In

addition to reporting their child's ATS or non-ATS status, parents (but not children) were asked to provide more data on the journey to school each day, on paper or via mobile, depending on chosen format. This included the time at which the child had left home, the time at which the child had arrived at school, if stops were made on the way, and how long were the stops (if applicable). Mobile respondents were asked to number each of the fields in their reply (e.g. "1. YES, 2. 8:45, 3. 8:55, 4. NO). These data were expected to help interpret the accelerometer output and learn more about participants' daily school commuting patterns. As will be explained later (section 3.2.11.3), the need to reduce the number and length of materials led to these extra questions being asked only in the two weeks in which the child was fitted with the accelerometer. For the remaining time (non-accelerometer weeks), parents (and children) were only requested to reply yes or no to the first question.

3.2.6.2 Vouchers

For convenience, vouchers of equal value were issued to participants in two situations: to the draw winner ("reward scheme vouchers"), and to thank participants who wore and returned the accelerometer on time together with the completed parent ATS report form, after filing in their own form in the classroom ("thank you vouchers"). The former type of voucher only applied to the intervention group, whereas the latter was used in both intervention and control arms.

Five-pound vouchers are commonly used in research in my Institute, and are the most readily available. This value approximates to the weekly amount of pocket money received by children aged 8-15, which is reported to be on average £6.35 nationally and £6.23 in the North East (Halifax Press Team, 2014). For these reasons, £5 was judged to be an appropriate amount for this age group; high enough to be appealing and low enough to not be seen as coercive by parents or schools.

3.2.6.3 Selection of a data source for the draws

Another consideration made while developing the protocol was how best to determine entry into the draw, by deriving draw tickets from parent and/or child reports or from the accelerometer. The likely greater accuracy of an objective measure (i.e. accelerometry) suggested the possibility of basing draw tickets on

minutes of MVPA during the morning school trip time (e.g. 1 ticket for every 5min of MVPA). Although reactivity and tampering in studies using PA monitors are under-researched phenomena (Lubans *et al.*, 2014), an attempt to discourage dishonest use of the accelerometer was also pondered at this stage. This consisted in showing children the graph of an instance where an accelerometer had supposedly been shaken on purpose, and implying that such practice would be easily recognised by the researcher. In reality, a distinction between shaking and naturally-occurring PA would be almost impossible.

Two members of the university ethics committee were approached informally and strongly advised against resorting to a deceitful method. One of the accelerometry experts suggested that a less problematic solution was to delay the initialisation of the recording time to the day following issue of the accelerometer, in order to reduce possible novelty-associated effects. Another concern was the MVPA threshold for determining trips (e.g. 5min of MVPA), which could put those living very close to school at a systematic disadvantage even if they did always use active travel modes for their journey. Furthermore, it was recognised that it would be difficult to distinguish between MVPA resulting from active school travel and that resulting from vigorous play on arrival at school by those who had been chauffeured. As a result, parental reports appeared to be the most viable source of information for the draws, while child-reports and accelerometers would be included in the study for validation purposes.

3.2.7 Input from a young people engagement group

While developing the protocol, an opportunity arose to present the proposed study to a young people's engagement group based at Newcastle University. This group holds regular sessions with researchers to collaborate in the design and delivery of interventions and services targeting young people. After a 15 minute PowerPoint presentation of my study by me, a total of 15 attendees (aged 8-17) worked in groups to discuss strengths, limitations and ways of improving materials and procedures. Seven members of the group tried the accelerometer for two hours. They reported satisfaction with the experience but alerted me to possible discomfort in longer wearing periods. Nevertheless, a quick hands-up survey indicated that nearly all

would be willing to wear the accelerometer for one week in exchange for a £5 voucher.

In general, the proposed incentive scheme was well-received and regarded as potentially effective. Mixed opinions were expressed about the adequacy of the reward (instead, money or free time were suggested by some) and about recruitment approaches (opt in vs opt out). Anticipated limitations included the risk of accelerometers going missing or being damaged, unfairness to those who were unable to walk to school because of distance, disability or other factors, and rivalry in the classroom. Ideas for improvement had to do with the practicalities of wearing the accelerometer (e.g. ensure belt was loosened enough), somehow recompensing control subjects, and adding a rule by which the same person could not win the draw two weeks in a row.

The protocol was sensitive to this feedback insofar as practicable. Belt-attached accelerometers have been used by young populations in a large number of studies, without major problems having been reported. A similar case could be made for the use of incentives (vouchers included) in research with children. The threat of material losses echoed the views held by previous consultees. Although not infallible, a reward for the timely return of the belts was seen as the best way to minimise this threat. Encouraging partway active trips was believed to address the issue of unfairness of the scheme, including in the event of a child with a medical condition or who lived too far away from school to walk or cycle all the way there. The presence of male and female staff when distributing accelerometers could further contribute to its correct handling by the users, as well as the availability of the researcher during monitoring periods. Vouchers to thank participants in both schools would decrease the possible inequity of being in the control condition. Restricting the number of consecutive draws that someone could win would likely satisfy non-winning participants, but could also demoralise winners in later weeks. Thus, the restriction-free approach could have both favourable and adverse effects, and was judged appropriate for a feasibility study.

3.2.8 Refinement of materials

The four materials developed in preparation for the descriptive study initially planned (section 3.2.2 - parental questionnaire and three information documents which

included an information leaflet for the parent, information leaflet for the child, and a participant information sheet (details of participation in the study)) were modified on the basis of preliminary feedback from parents and children, and taking into account the new aim of the RIGHT TRACKS study. Additionally, a consent form and two interview guides for the planned process evaluation were developed, one for the parent and one for the child.

3.2.8.1 Parental questionnaire

One question was dropped and one added in the parental questionnaire. The question excluded was the Self-Report Habit Index which had caused some completion difficulties for parents, namely in understanding the meaning of each item. The new question was a measure of parent self-efficacy, i.e. how much parents believed in their child's ability to travel actively to school. The addition of this scale was suggested by the work of McMinn D. (2011) who investigated psychological predictors of ATS using existing measures, and found that parent self-efficacy was the only significant predictor (McMinn, 2012). The question started with the heading "How confident are you that your child can..." and was followed by 14 items which completed the sentence (e.g. "walk to school" and "cope with busy traffic when walking to school"). Following the suggestion that walking and cycling required separate analysis (section 3.2.3), this question was divided in two parts – one about walking, the other about cycling – using the same items for each travel mode. Parents were asked to indicate their agreement with each statement, from 1 (not at all confident) to 5 (very confident).

It is unclear what implications the swap of the above variables had for this project. It is possible that a habit measure could have helped determine whether ATS occurs automatically, and whether a focus on contextual cues would have been more adequate, having in view the maintenance of behaviour discussed in chapter 2. However, the terminology of self-efficacy scales appeared to be clearer and the predictive value of this variable, well known in behavioural research (Schwarzer, 2014), could also be useful in a large-scale trial. Consideration of respondent burden precluded including measures of both habit and self-efficacy.

3.2.8.2 Information materials

The content of the updated information documents revolved around the incentive scheme, but kept much of the previous structure. The detailed participant information sheet provided a description of procedures, time commitment, participant rights, benefits and risks, confidentiality/anonymity, contact details. Leaflets (separate versions for parents and children) summarised these contents in a way which was suitable for each age group.

3.2.8.3 Consent form and interview guides

Newly created documents were the consent form and interview guides. The consent form consisted of a list of nine items and fields to initial, in agreement with university guidelines (NU, 2015). In this form, parents indicated they had understood what the study entailed, their freedom to dropout at any time, and confidentiality issues. They could also state their preferences for study participation, such as taking part in interview or not, receipt of vouchers by the child or by them, and reporting child's travel mode by paper form or by SMS. The interview guide for parents was mainly an adaptation from the one used in a school-based pilot study involving accelerometer monitoring in pre-schoolers (Barber *et al.*, 2013). Questions asked about the parent's experience and views about recruitment and randomisation, data collection (including accelerometer use) and the use of incentives. The child interview guide was a shorter and simplified version of the parent's, with age-appropriate wording.

3.2.9 Further input from parents and children

Before ethical clearance was sought, the intelligibility of these seven documents was assessed once again in a sample of three other parent-child pairs. Two of the parents (White British) were staff members at the university accommodation services and one (Asian) was a PhD student; all three had a child who was aged 9 or 10. Parents were asked to read and complete the materials at home and write down any thoughts that occurred to them during the process. As before, they were encouraged to support their child to read and comment on the relevant leaflet. The annotated materials and verbal feedback were given to me by the parent at university.

All parents were content with the procedures and none made suggestions for improvement when consulted. Materials were found to be clear and appropriate overall, but one parent commented on specific points. Her child had found the leaflet “quite wordy” and she wondered if allusions to formalities (documents and forms) could be left to parents only. In the participant information sheet, a better description of an accelerometer was recommended. On the basis of this feedback, minor modifications were made in the child’s leaflet and in the participant information sheet.

3.2.10 Input on accelerometers

Two members of my supervisory team (adults) wore an accelerometer belt for a few days and stated that they had found it comfortable and unobtrusive. I personally wore the device on several occasions, both over periods of hours and days. This allowed me not only to know what wearing the belt felt like, but also to try out basic data management and analysis procedures in preparation for later work. Alongside, informal training was provided by the three fellow researchers (outside the team) with expertise in accelerometry referred to above, in meetings and by email. Extra groundwork consisted of webinars and occasional email exchanges with the accelerometer corporation (ActiGraph).

3.2.11 Ethical approval process

The protocol and respective appendices were submitted for ethical approval by Newcastle University’s Faculty of Medical Sciences research ethics committee in April 2014 but three points had to be reviewed before approval was granted in late May 2014. Later, preliminary feedback by the two selected schools and some issues encountered during fieldwork led to two subsequent amendments of the protocol. Each of these points is described in the next three sub-sections.

3.2.11.1 Protocol and appendices

A total of 17 appendices and the protocol were submitted for approval by the ethics committee of the Faculty of Medical Sciences at Newcastle University (MFGS, 2015). The protocol was a 26 page-long document which described all the planned

materials and procedures of the RIGHT TRACKS study. The seven documents which parents and children had previously reviewed (section 3.2.8 and section 3.2.9) were: the parental questionnaire (appendix A); information leaflet for the child; information leaflet for the parent; participant information sheet; consent form; interview guide for the child; and the interview guide for the parent.

In addition to these materials, the submitted documents included: a pilot trial flow diagram with a timeline of planned procedures; photos of me wearing the accelerometer and demonstrating its handling; a risk assessment in conformity with university regulations; and an invitation letter for the head teacher. Additional documents for the child included: an assent form adapted from a study tackling hazardous drinking in youth (age 14-15) (O'Neil *et al.*, 2012), and supplied by one of the authors (who worked in the same institute as me); instructions for use of accelerometer and an accelerometer diary, both provided by fellow researchers consulted as part of this process who had used these materials in previous research; child ATS report form (appendix C); and a debrief sheet for the child. Other documents for the parent were the parent ATS form (appendix B) and debrief sheet for the parent.

3.2.11.2 Feedback from the ethics committee board

On receipt of my proposal, in April 2014, one of the allocated committee members considered that “all communications with parents should be made through the postal system to ensure confidentiality”. It was necessary to clarify that both parent and child ATS reports contained no sensitive information and were identified with a unique code rather than with personal details that would allow identification of individuals. On the contrary, the questionnaire asked about medical conditions that could affect ATS and about postcode, and consent and assent forms required the name of the parent and child. Thus, in the revised protocol, questionnaires and consent forms had to be posted to the researcher (using a prepaid envelope provided in the pack) and/or dropped off by the parent at school (if agreed by the school), but could not be returned by the child. Child assent forms were to be completed in the presence of the researcher.

The same committee member expressed concern about the potential harm to non-participants and suggested that the intervention should be run as an “after-school

activity". However, additional talks with the head teacher referred to above and a stakeholder (Sustrans school officer) pointed to the opposite picture. Activities outside school hours could lead to similar exclusion due to many having to leave, and it was not uncommon for some children to be unable to take part in ATS projects because of their physical condition or geographical distance of home from school. According to both sources, families were usually accepting of this and complaints were extremely rare. Finally, the other ethics committee member flagged up the absence of reference to potential disclosures (e.g. if concerns existed) in the parental leaflet. Modifications were made and clarifications provided as appropriate, and the protocol received ethical sign off in late May 2014 (appendix D).

3.2.11.3 Amendments to the research protocol

Two amendments had to be made to the protocol, reflecting the need to adjust to the characteristics of my sample. The first happened as a result of feedback from the head teachers of the two selected schools, in the meeting held with each of them in mid July 2014, where arrangements for the start of the study were made.

Up to that point, completion and return of the questionnaire and of the consent form by the parent were deemed essential for participation in the RIGHT TRACKS study. Precisely, the consent form (see 3.2.8.3) contained nine fields and completion of all of them was mandatory. In these fields, among other aspects, parents would have to state their preference for each of the following: whether they preferred to report their child's travel mode to school in writing or by SMS; whether they were happy with vouchers being handed to the child, or instead collected by them (i.e. by the parent) at the school office; whether parents were interested in taking part in an interview or not. Children from whom a consent form would be received would need to complete an assent form at home aided by their parent.

From the head teachers' experience, the length of the participant information sheet and of the questionnaire could deter many parents and carers from taking part, as well as the amount of text in the consent form. She suggested simplifying the eight-page parent information sheet to a short leaflet, akin to that already planned for the child participants; the consent form would ideally contain "just one box to tick". In general, her advice was to simplify materials and procedures as much as possible.

The feedback was compelling and resulted in a first amendment to the protocol. Further to conversations within the team and with a member of the ethics committee, a simple leaflet was created and added to the pack. This leaflet, adapted from the previous one, directed parents to the eight-page long participant information sheet where the study was explained in full. Although desirable, parental baseline questionnaire completion was no longer a requisite for participation, as long as the completed consent form was returned in addition to the assent form (see next paragraph). Essential items in the consent form were condensed into one page; an optional section was presented in a second page where different preferences for participation in the study could be specified. Failure to complete this section would have no consequences other than assigning participants to three default options: parental report of school travel mode being on a paper form, and not via SMS; any vouchers awarded to the child were to be left at the school office for later collection by the parent; and an assumption that the parent was not interested in taking part in an interview.

The proposed accelerometer diary, the use of which had already been identified as controversial (see section 3.2.5), was also dropped, as the relevant data would still be reported on the parent ATS report. The child assent form was to be completed in the classroom under my guidance, and no longer required the parent's signature, as long as the returned parental consent form had been appropriately completed and signed.

Originally, the plan was for me to check that the accelerometer had been worn long enough (at six hours a day, on at least three days), before issuing the thank you voucher to the child; however, this was also modified to smooth the running of the study, and thank you vouchers were provided on receipt of the relevant materials, irrespective of accelerometer wear time. The protocol amendment was put forward after the meetings with the head teachers, and approved prior to the start of the fieldwork.

A second protocol amendment was submitted for ethical committee consideration in mid-October 2014. The main points addressed in this amendment were related with issues experienced in the first week of data collection, i.e. at baseline. First, it became clear that any data on school commuting times asked to parents would be of little use when the child was not be wearing the accelerometer; therefore, the

questions about times of departure from home, arrival at school, stops on the way and respective duration (see section 3.2.6.1 for details) were only asked in the two weeks in which the child would wear the accelerometer. For the remaining time of the study, all the parent would have to reply was YES or NO, to the question of whether the child had walked or cycled to school, all or part the journey, on that day (appendix B).

Second, it also soon became evident that materials would often be returned late, and that a consequent exclusion from receiving a thank you voucher or from entering the draw could cause distress for some children. Therefore, one of the points covered by the second protocol amendment was the greater flexibility in the provision of vouchers. In both arms of the study, children could still receive a thank you voucher, even if materials were returned after the deadline set. In the intervention group, whenever the parent ATS form was unavailable on a draw day, the child ATS report would replace it for the same purpose. However, every time this happened, I would remind the child of the importance of returning the parental ATS report next time, in order to avoid normalisation of forgetting this form amongst participants. Unanswered questions on the parental ATS report would be taken as indicative of no active travel, as well as days when the child would be absent (i.e. even if the parental ATS report suggested otherwise). However, if absent on a draw day, the child could still be entered into the draw, as long as parent-reported data were available, either on the paper form (which the parent could have dropped at the school office for me) or by SMS text messages.

Finally, the low recruitment rate (section 4.3.2) allowed some of the budget to be allocated to thank-you vouchers for interviewees, in the interest of boosting participation in this component of the research. Following discussions within the team, the second protocol amendment stated that children taking part in the interview would receive a £5 voucher (in addition to any that had already been issued), while interviewed parents would be thanked with a £10 voucher. This information would be given to parents over the phone, where they would reiterate their interest and availability for this element of the study and consent verbally to their child being interviewed by me at school. Approval of this second protocol amendment was obtained in early November 2014.

3.3 Conclusion

This chapter described the steps taken in the development of the intervention tested in the RIGHT TRACKS study, namely public involvement prior to the piloting stage. According to parents, children and a head teacher consulted, vouchers could exert a strong influence on children's behaviour, an observation which was in line with the interventional and theoretical literature of the topic (Chapter 2). Further contacts with young people, parents, researchers and stakeholders helped develop a research protocol for a school-based lottery incentive scheme to enhance ATS, with their feedback informing the shaping of materials and procedures of the intervention and of the pilot trial.

Chapter 4 – Pilot trial

4.1 Aim and objectives

The aim of the RIGHT TRACKS pilot trial was to test the feasibility and acceptability of a lottery-based financial incentive scheme to promote ATS in Year 5 children.

Under this scheme, children in the intervention arm of the trial who actively travelled to school, all or part of the journey, were entered into a weekly draw to win a £5 gift voucher. Chances of winning were proportional to the number of active trips to school, primarily as reported by the parent, with one ticket being allocated for each trip made, wholly or partially, by active means. School travel behaviour was also assessed via child-report and accelerometry to inform the selection of a valid and reliable measure of ATS.

Thus, having in view a future definitive evaluation trial, the objectives of the RIGHT TRACKS pilot study comprised:

- Estimating recruitment, consent, adherence and retention rates for schools and child participants;
- Informing sample size calculations for the future trial;
- Assessing the integrity and fidelity of delivery of the study protocol;
- Testing study materials and procedures;
- Selection of an appropriate outcome measure;
- Assessing acceptability of the intervention from the perspectives of parents, children and school staff.

Alongside the pilot trial, a qualitative process evaluation was undertaken to provide further insights into the feasibility and acceptability of the intervention and study procedures. Thus, this qualitative study should be viewed as part of the feasibility study (O’Cathain *et al.*, 2015) and as a source of supplementary data to address some of the objectives described above. To keep each chapter at a reasonable length, the methods and findings of the qualitative study are presented in Chapter 5.

4.2 Methods

4.2.1 Study design and timeline

This pilot trial used a two-arm parallel-group cluster randomised controlled design⁸. Schools were the unit of randomisation and were allocated (one per arm) to the intervention group (incentives for ATS) or control (data collection only). Data were collected at nine time points in both arms: once at baseline in late September 2014; then, after randomisation, once a week throughout an eight-week intervention period, from early October to early December 2014. This schedule eased data collection for me and made the data more representative of any seasonal variations than if assessments had only been conducted at baseline and at the end of the intervention period. It also provided preliminary data on the pattern of ATS over time, going some way to addressing the issue of whether behaviour was maintained once the novelty of the intervention had worn off. Data collection and contact with participants always occurred on the same weekday, but on a different day for each school. All activities associated with the RIGHT TRACKS study were suspended during half-term. Full participation in the baseline assessment and intervention period lasted two and a half months. This corresponded roughly to one school term, a length that seemed acceptable for schools and which has been the duration of a number of previous school-based ATS interventions (e.g. (McKee *et al.*, 2007)). Study design and data collection time points are shown on Table 4.1.

Ethical approval by the Faculty of Medical Sciences at Newcastle University (application case number 00759) (appendix D) was received and an enhanced Disclosure & Barring Service (DBS) check for me as the lead researcher was carried out in May 2014. The trial was prospectively registered on Clinicaltrials.gov (Id: AST-00759). Schools were recruited between May and June 2014. Their contact details were provided by Sustrans and these were approached by email, and later by phone if a response was pending (section 4.2.4 for details on school recruitment). A meeting in person was held with the head teacher of each of the two selected schools, in July 2014. Arrangements were made for the start of the study in the next term, in early

⁸ Despite the fact that there were only two schools taking part, this study classifies as a cluster RCT because it involves randomisation of clusters (schools) to intervention and control conditions, unlike other designs (e.g. quasi-experimental). This is consistent with the common definition of cluster RCT (e.g. Eldridge, S., Kerry, S. and Torgerson, D.J. (2009) 'Bias in identifying and recruiting participants in cluster randomised trials: what can be done?', *BMJ*, 339, p. b4006.) and with the views of an expert in both cluster RCTs and pilot studies (Prof Sandra Eldridge) who was consulted to help clarify the response to this question.

September 2014. Data collection and intervention procedures terminated in the second week of December 2014.

Pre-intervention (late September 2014)			Intervention period (early October to early December 2014)									
	Baseline week		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8		
School 1 (Year 5)	X	Randomisation	Intervention group	X	X	X	X	X	X	X	X	X
School 2 (Year 5)	X		Control group	X	X	X	X	X	X	X	X	X

Table 4.1 - Study design and data collection time points throughout the study

4.2.2 Resources and materials

This 3-year PhD project was funded by the Sir James Knott Fellowship (Sir James Knott Trust, 2014). At the start of the project, 10 accelerometers and accessories (worth £1750) were awarded to the research team by the Newcastle Institute for Research on Sustainability (now Institute for Sustainability). Another 90 accelerometers and respective accessories were available on loan from Durham University. Following a call for grants by the Catherine Cookson Foundation, a successful application for £2104 further assisted in the execution of this project, mainly to help fund participant incentives. Licensed ActiLife 6 software (version 6.11.5) was supplied by the Institute of Health and Society, Newcastle University.

4.2.3 Measures

Primary outcomes for this pilot trial were dimensions associated with feasibility, including rates of recruitment, adherence and dropout, integrity of study protocol and acceptability. These dimensions were assessed, quantitatively and qualitatively, from a number of indicators: invitations issued and responses (at school and participant level); materials sent out and returned, and their level of completion/use; how long participants remained in the study; duration and logistics of sessions; accelerometer

use; research logs; fidelity (the extent to which the study ran as planned); adjustments made; and informal feedback from participants and school staff.

Also amongst the objectives was the selection of an ATS outcome measure for a future definitive trial, i.e. how best to ascertain the number of trips to school using an active travel mode (ATS trips). In the pilot trial, three approaches were used - parental and child ATS report forms, and accelerometer.

As described in Chapter 3, two versions of the parental ATS report were employed: a more comprehensive version for the weeks in which the child wore the accelerometer (accelerometer weeks) (appendix B), and a simplified version for the remaining period (non-accelerometer weeks). Details about trips during the accelerometer week were aimed at facilitating the interpretation and use of accelerometer data. Both versions contained five main questions, each in relation to one of the five school days: a) "Today (day/date), did your child walk or cycle to school, all or part of the journey? Please reply YES or NO". In addition, the parental ATS report form for accelerometer weeks included four supplementary questions for each trip: b) "At what time did your child leave home?"; c) "At what time did your child arrive at school?"; d) "Did your child make any stop on the way?"; e) "If so, how long was the stop for?". At baseline, the response format of question a) consisted in circling YES or NO. However, an unusually large number of returned forms where question a) was left blank led to a minor change of response format, to ticking one of two boxes (YES or NO). Response formats in the remaining fields remained unchanged and consisted in writing times (questions b) and c)), ticking a box (question d)), and writing a stop duration if applicable (question e)). Simple instructions for completion were included, as well as the deadline by which form and accelerometer had to be returned to the classroom. Instructions also asked parents to complete the form day-by-day, as opposed to in one go at the end of the week.

Parents had the option to provide their report by mobile phone. Each school day at 9am, parents received a text message with question a) to which they were asked to reply 'YES' or 'NO'. For the intervention school, on draw days, the message included a note at the end: "Please send your reply before 12noon so that today's trip can be counted for the draw". Replies were directed to my email address. Mobile communications were managed via Green Text, an online service that allows sending and receiving SMS text messages at low cost from an email system (Green

Text, 2015). Due to the amount of questions required for validation of accelerometry data, this report method was only possible in non-accelerometer weeks.

The child ATS report (appendix C) was a simpler version of the parental report which children were asked to fill out in my presence in respect of the preceding week. It included five questions, one for each school day, and excluded any queries on travel times. The format was identical for each question: "(Day of the week) morning, did you walk or cycle to school, all or part of the journey? Please reply YES or NO". As for the parents, the heading requested children to tick only one box per question and to recall the information to the best of their ability.

Accelerometers provided an objective PA measure - minutes of MVPA - during the times indicated by the parents as pertaining to the journey to school, and during the 60 minute period preceding the start of the classes (7:56am-8:55am). The selection of this time frame for similar purposes has been previously reported (Southward *et al.*, 2012). The accelerometer model was the ActiGraph GT3X+ version 3.1.0 (AG, Pensacola, FL, USA), which has demonstrated validity in youth (Lee *et al.*, 2014), high inter-instrument (0.97 ICC; $p < 0.001$) and intra-instrument reliability within frequencies that are common in human activities (Santos-Lozano *et al.*, 2012).

This triaxial accelerometer is small ($4.6 \times 3.3 \times 1.5$ cm), lightweight (19 grams) and water-resistant (ActiGraph.NL, 2015). The raw acceleration data from each axis are stored in memory for future analysis, directly or further processed into counts per unit of time by the ActiGraph propriety software (ActiLife). Depending on usage of features, over 30 days of battery life can be expected, and over 40 days for memory limit (at 30Hz) (ActiGraph, 2013).

Consistent with previous research (e.g. (Ridgers *et al.*, 2014)), the GT3X+ was set to collect data at 30 Hz in this study. Data were stored every 10s (i.e. epoch) for a better capture of intermittent bursts of activity characteristic of young people. The accelerometer was attached to an elastic waist belt operated with a clip and placed in line with the axillary line of the right iliac crest.

Instructions given to children on how to use the accelerometer are provided in section 4.2.6. The decision of wearing the device all day was made mainly on the grounds of practicality. Experts had advised a continuous wear of the monitor after arrival at school to reduce risks of loss and misuse, which could incur by taking it off in the classroom.

In total, each child wore the same accelerometer twice, one week at baseline and one week after baseline. The first time all participants were monitored concurrently, whereas the second time small subsamples of children (two or three) were assessed each week in random order. This made the study more manageable for me, and made data more representative of outcome variations that could occur naturally over time (e.g. seasonal effects) which could affect measurement procedures.

In some cases, school attendance records provided an additional source of validation of the nature of school journeys. By knowing that a child had been absent on a particular day, situations where parent and/or child reports of ATS suggested otherwise could be clarified.

Participant background information was explored through the parental baseline questionnaire (appendix A). Aspects assessed included socio-demographics, PA, travel practices of parent(s) and child, psychological variables of possible predictive value, and postcode. Most questions were adapted from instruments used in previous AST studies with similar populations (Panter *et al.*, 2009; McMinn, 2011) and other questions were new (section 3.2). Completion of the parental questionnaire was optional for participation in the RIGHT TRACKS study (see section 4.2.5).

4.2.4 School recruitment

All schools approached - primary, junior or first schools – were Sustrans partner schools located in four local authorities - Newcastle, Gateshead, North Tyneside and South Tyneside - in the North East of England. (Sustrans is a British charity promoting sustainable transport by working with schools, communities and partner organisations (Sustrans, 2016)). These were the closest locations to my workplace (Newcastle), and therefore the most suited to my financial and time resources. The number of schools in these local authorities was also deemed large enough to inform on likely school recruitment rates, and to provide me with at least two as required by my study protocol.

A database of schools which were, or had in the past been, involved with Sustrans, and the characteristics and contact details of each of them, was provided by one of its school officers. The list included a wide range of school types and age groups, including high schools, academies, sixth forms, colleges, middle schools, primary schools, first schools, junior schools and infant schools. A number of entries were

repeated, or had missing or outdated data. To determine whether schools were eligible (i.e. had pupils in Year 5), information such as the age range served by the school, local authority, head teacher's name and contact details, had to be sought for a number of schools on the English School Tables. This resource is available online through the Education section of the BBC website (BBC, 2014). Whenever possible, the accuracy of information was double checked on the school's own website. After screening all original entries provided by Sustrans, a total of 123 schools met our eligibility criteria: a) having Year 5 pupils and b) being in one of the above four local authorities. Given the difficulty in predicting school recruitment rates, no criterion regarding minimum Year 5 classroom size was set at this stage.

Contact with all 123 eligible schools was made between late May and June 2014. I first sent invitations by email to each of the schools, starting with a formal salutation personalised to the head teacher and then describing the aim and main procedures of the RIGHT TRACKS study. This first email directed the reader to a second email sent minutes later which contained two attachments: one compiling several documents including an overview of the study for head teacher, information leaflet for the young person, participant information sheet for parents, parental consent form, child assent form, information on and photos of the accelerometer and instructions for its use, accelerometer diary, parental ATS report form (appendix B), child ATS report form (appendix C), classroom poster, interview guide for child, interview guide for parent/carer, debrief sheet for young person, and debrief sheet for the parent/carer; and a second document, the parental baseline questionnaire (appendix A), which was considerably longer than any other document. The invitation requested a response from the school within two weeks, with an indication that at the end of that period I would approach pending schools by phone to confirm their decision. Contact details of my research team were provided and the schools were encouraged to phone or email the team if they wished.

The number of responses obtained was very low. Some schools had inadvertently been emailed on the last day before half-term, possibly contributing to this. For that reason, in mid-June 2014, two weeks after issue of the first invitation, invitations were re-sent to schools (except the few who had replied) asking for confirmation within one week. The response rate was again poor, and schools with a response pending were contacted by phone at the end of June 2014. In many cases several attempts were needed before the call was successful. Typically, phone calls were answered by

school office staff who were either unaware of, or had forgotten about, the invitation for the RIGHT TRACKS study. In these cases, they agreed to chase up the matter with the head teacher and to inform me of the outcome, or stated that they were not interested. Common reasons given for not having responded were school workload at this time of the school year, and probable lack of interest or availability on the part of the head teacher.

Four schools (3.3 % of those approached) expressed willingness to host the RIGHT TRACKS study. Two of them were selected based on a match of characteristics which included proximity to Newcastle, the percentage of pupils whose first language was not English, data available on current levels of ATS, and recommendation by a stakeholder (Sustrans officer). The proportion of free meals was of secondary importance, as suggested by UK research which has found no association between ATS and socio-economic status (Owen *et al.*, 2012). Time taken to reply, and whether the response was pro-active (i.e. by email, in reply to the invitation) or reactive (i.e. following phone follow-up) were also less relevant because schools' busy schedules and heavy email influx were considered legitimate reasons for delay in responding. Unexpectedly, both schools had two Year 5 classrooms. However, the resources available were deemed to be sufficient even in the event of a large response rate from children, and the study proceeded as planned.

Once the two participating schools were identified, a face-to-face meeting was arranged with each head teacher in mid July 2014. Both meetings took place on school premises and after school hours. In one school, a member of administrative staff also attended the meeting; in the other school the two Year 5 teachers were present. I provided an overview of the RIGHT TRACKS study, materials and procedures, both those associated with the trial in general and those specific to the intervention. Other points of discussion included the best way of approaching parents or children (e.g. parent gatherings) and of sending materials home, and timescale for the study (which ideally would be concurrent in both schools). There was a general agreement with most aspects of the proposal, which the head teachers had already read by email. Availability for the proposed period was stated by both schools, including a start in the second week after the beginning of the new school year (early September 2014). Sending materials home via pupils' bags was recommended as the most appropriate way to approach and recruit participants because attendance at parent evenings could be very low at times. It was recommended that, during any

sessions of intervention delivery or data collection, non-participants would remain in a different room working on another activity or project. The likely duration of weekly sessions (20-25min) was seen as non-problematic and any conflict with other school commitments could be re-arranged in due course.

However, a concern was raised over the amount of paperwork and parental involvement required, particularly by one of the schools. This resulted in a simplification of materials and procedures, and in a protocol amendment before the start of the study (see section 3.2.11.3 for details).

4.2.5 Child and parent recruitment

I made a presentation of the study in each school during the second week of the school year 2014/2015. In both schools, the audience included the two classes of Year 5 pupils and their respective teachers. Other attendees in one of the schools were the head teacher and a Living Streets school officer⁹ (Living Streets, 2012), who was in the school that day by coincidence. One pupil from one of the classrooms was absent but received the information pack through the teacher at a later time.

Age-appropriate PowerPoint slides illustrated the various procedures and materials of the RIGHT TRACKS study. This included recruitment methods, parental and child report of school travel modes and accelerometer measures, principles and processes of randomisation and details of the incentive scheme. I also explained that they could end up in the school randomised not to receive the scheme. Children were told that taking part was voluntary and that participants had the freedom to drop out of the study at any time without giving justification. Three other aspects were given particular importance. The first were the accelerometers; I wore one and demonstrated its handling. The second were the vouchers which participants could earn (a) by complying with measurement procedures, and (b) potentially by entering the draw if their school was randomised to the intervention arm. The third was the fact that partway active trips (e.g. being dropped off part way to school and walking the rest of the way) would be given the same weight as fully active trips in the draws for those in the incentive arm.

⁹ Living Streets is a charity that advocates the rights and interests of pedestrians and runs initiatives in schools around walking promotion.

Following the 20 minute-long presentation, pupils had the opportunity to ask questions, but only one question was asked and only in one of the schools (whether participation was 'free'). At their own initiative, teachers in both schools run a quick hands-up survey for an idea of how many were willing to take part, and in both cases, approximately three quarters did so.

Finally, information packs were left with the Year 5 class teachers who volunteered to distribute them in the classroom for the children to take home in their bags. Each pack contained a parental questionnaire, an information leaflet for the child, an information leaflet for the parent, a participant information sheet (longer document for parents explaining the study in full), a parental consent form and a prepaid envelope addressed to my research institute. I showed the pupils copies of each of the documents and briefly explained what they were, and to whom they were addressed. The parental consent form was to be completed, signed and returned by the parents or carers within one week, either by post in the prepaid envelope or dropped at the school office, in the case of those taking part. Completion of the parental baseline questionnaire, although desirable, was not essential for participation. I stressed that consent forms and questionnaires would only be accepted when returned by parents/carers. As requested by the ethics committee, this was to ensure the safeguarding of confidential information (e.g. postcode, possible medical conditions of the child). Spare packs were left at each school in case of losses.

One of the teachers explicitly said she would go over each document again in the classroom. All teachers said they would remind pupils of the recruitment deadline throughout the week. After the presentation, I informally approached each of the teachers for any comments about the session. All stated they had found it very clear and one believed that was why there were few questions from the audience. At its own discretion, one of the schools issued SMS reminders to all Year 5 parents, on the eve of the scheduled deadline for returning consent forms.

Due to a small number of responses one week later, the recruitment period was extended for another week. Through their teacher, children were informed of the new deadline for parents to complete and return the appropriate document(s) by post to me or to the school office. They were also reminded that the parental consent form sufficed for participation, and were encouraged to prompt their parents/carers if they were willing to take part. On request, both school offices stated that they were happy

to inform parents of the new recruitment deadline through their SMS communication system.

Contact details of the research team were provided in the information materials for the parents. Enquiries by email or phone could be made during working hours, or in person while I was visiting the school. Exceptionally during the recruitment fortnight, I was available for personal consultation at school once a week, for the whole morning. However, I was never contacted nor approached in person by any parent or child at this stage. All completed and signed consent forms, and completed questionnaires, returned by post or at the school office during this period were accepted. Staff were instructed to take materials only from parents, however the possibility that some were dropped off by children cannot be fully discarded.

4.2.6 Baseline assessment

The baseline assessment started in both schools at the end of the extended recruitment period, in late September 2014. Under my guidance, children from whom parental consent had been obtained filled out an assent form in the classroom. Completion consisted of YES or NO answers to questions such as “Do you understand what this study is about?” or “Are you happy to take part?”, and writing their name at the end. Owing to time pressure, those completing their form at play time were asked to come back at lunch break if they were unsure about, or had answered NO to any of the questions.

Each child for whom consent and assent forms had been received was handed a plastic pocket containing an accelerometer, written instructions for use and a parental ATS report form. For each participant, the pack was marked with a three-digit unique ID code which matched the one on the accelerometer sticker, and on all other documents associated with the child. Reuse of the plastic pocket to carry study materials in subsequent weeks was encouraged, to cut down on expenditure and on environmental impact.

Children were instructed to wear the accelerometer clip belt around their waist, every day for the following seven days, including weekdays and weekend. They were asked to keep it on at all times, except while sleeping and during aquatic activities (e.g. bathing or swimming). Removal was also recommended during the practice of sports or other activities where it could cause discomfort. The presence of a female

member of staff was requested in the session to assist with the adjustment of belts, taking into consideration gender sensitivity. Other than wearing and taking care of the devices, no special handling was needed from the child or parents, as battery-life was sufficient and any light-flashing signal was disabled to avoid confusion. All necessary information was provided in the instruction for use sheet which was to be consulted in case of doubt. For any difficulties throughout the wearing period, children were advised to seek adult support or to contact me.

Information on ATS was gathered in two paper reports. The parental ATS report form was to be taken home, completed by the parent (or carer) and returned to me along with the accelerometer on my next visit to the school, seven days later. All parents were required to complete their report on paper at baseline, even if they had opted for the SMS mode in the consent. Unlike previous documents, parent-completed ATS forms contained no sensitive or identifiable information and could be returned to the school by the child.

On returning the accelerometer and completed parental ATS report to me, children completed their own ATS report for the week in the classroom and in my presence. Thus, children returning their parent ATS report were not blind to what their parent had reported on paper. Children who had ridden a bicycle to school were prompted to circle the word 'cycle' for every day they had done so, on the respective question(s). If someone had circled 'cycle' on the morning of completion of the report, they were asked to show me the bicycle (or other active travel vehicle, such as a scooter or skate board) at break time. The child ATS report was completed once a week, the parent ATS report in paper was also returned to me once a week (whether it was completed day-by-day as requested or in one go cannot be ascertained), and parent ATS reports by SMS were sent to me every day.

A £5 high street voucher was issued to each child from whom returned accelerometer, completed parental ATS report, and completed child ATS report, were obtained. Vouchers went inside windowed envelopes with an appreciation message identified with the child's name. For clarity, these were referred to as 'thank you vouchers' and were used in both groups, whereas 'reward scheme vouchers' were those awarded to the weekly draw winner in the intervention school only.

Participants were thanked with the voucher as long as the appropriate materials were returned to me, irrespective of any delays in doing so (see section 3.2.11.3).

Similarly, insufficient accelerometer wear time and partially completed forms were disregarded to smooth the running of study procedures. Further to arrangements with the school receptionists, children could drop any late materials at the office throughout the week, in a box made available for the purpose.

In the interest of boosting recruitment, any further completed consent forms received during the baseline assessment week were accepted. In such cases, it was agreed that participants would be baseline-assessed (i.e. wear the accelerometer) in the seven-day period immediately following the first baseline week. This 'second round' of baseline was possible due to a planned gap week between the end of the baseline - 'first round'- and the start of the intervention period. Having two rounds of baseline assessment was considered acceptable by the research team because of the non-evaluative nature of the study. Any responses gathered after the start of the second baseline week were excluded, and respondents notified by paper or SMS.

4.2.7 Randomisation

Each of the two schools was randomly allocated to one of two conditions, intervention group or control group. To decide, a coin was flipped once by one member of the research team who was blind to the specifics of each school. Heads would mean that a designated school – verbally agreed upon before the toss - would host the intervention, whereas tails would mean allocation to control condition (the second school would be automatically assigned to the other condition).

I informed head teachers and children of the randomisation outcome at the start of the intervention period by email and in person, respectively. In turn, children were requested to take a paper notification home to their parents/carers. This notification, and verbal presentation from me in the classroom, reiterated the logistics of the measurement procedures (identical in both groups). For those in the intervention group, it also specified that travel mode to school would make a difference to earning the reward scheme voucher, but not to earning the thank you voucher. For those in the control group, it stated that travel mode to school would have no bearing on receipt of a thank you voucher. In the intervention group, the importance of submitting parental reports of school travel mode in a timely manner was highlighted once again, as they were the basis of the incentive scheme.

4.2.8 Intervention

The main aspects of the intervention are summarised in Table 4.2 based on the Template for Intervention Description and Replication (TIDieR) checklist (Hoffmann *et al.*, 2014); characteristics of the incentive used are compiled in presented in Table 4.3 based on the framework discussed in section 2.3.2.4 (Adams *et al.*, 2013).

1. Brief name	Lottery-based incentive scheme to promote ATS
2. Why (rationale and theory)	Many of the reinforcing consequences of ATS are long deferred. According to operant conditioning, ATS behaviour can be made more reinforcing if more immediate consequences follow it, such as material incentives.
3. Materials	- £5 gift vouchers (Love2Shop), spendable in a number of high street shops - Parental ATS report, by paper or by SMS - Child ATS report
4. Procedures	- Children who walked or cycled to school, all or part of the journey, were entered into a weekly prize draw. - The prize was a £5 gift voucher. - Each active trip to school reported by the parent, either on paper or by text message, corresponded to one ticket with the child's ID on placed into the draw. - In total, each child could accrue between zero and five tickets per week, depending on the number of active trips to school reported by the parent (i.e. five school days). - Unreported or misreported trips could not be carried over from one week to the other. - Children travelling to school by active modes other than walking or cycling (e.g. scooter, skateboard) were instructed to class themselves as 'cycling' to school.
5. Who provided*	- Me; BSc in Psychology, MSc in Clinical Psychology.
6. How*	- Delivered face-to-face to the whole group.
7. Where*	- In the classroom, at school
8. When and how much	- There were eight draw sessions with an average duration of 14min each, between October and December 2014. Most of the draw sessions was spent collecting materials, distributing materials and completing the child ATS report. The draws themselves were very brief, just a couple of minutes.
9. Tailoring*	- The intervention was not developed to be personalised.
10. Modifications	- Further to a protocol amendment, children who failed to provide the completed parental ATS report on a draw day were able to take part based on their own report.
11. How well (fidelity)	- All eight sessions were delivered as intended, but one had to be re-scheduled to a different day on one occasion due to other classroom commitments.

Table 4.2 - Main aspects of the intervention tested in this study

Direction	Positive reward (as opposed to avoiding a penalty)
Form	Voucher exchangeable for a range of goods
Magnitude	£5 per voucher; a maximum possible of £40 (eight draws)
Certainty	Certain chance incentives; participants with at least one ATS day reported can be sure of entering the draw but they will not necessarily win
Target	Intermediate (ATS behaviour)
Frequency	Some instances incentivised
Immediacy	Likely to take a few days, as there was only one draw per week and ATS trips could have taken place on any week day
Schedule	Fixed (always £5)
Recipient	Individual (as opposed to the group)

Table 4.3 - Characteristics of the financial incentive used in this study

In the absence of parental ATS report, the child could still be placed into the draw on the basis of his/her own ATS report completed in the classroom. Every time this happened, however, I stressed the necessity to bring the parental report next time. This was in order to avoid normalisation of forgetting the report among participants. In the case of mobile-respondents, a child from whom the parental SMS reply had not been received on a draw day would enter the draw based on the number of SMS replies gathered in the previous four school days; tickets based on child ATS report would not be used as long as at least one SMS reply had been received that week.

Partway active trips were given particular emphasis as they could be the only viable alternative for those living far away from school. When travelling by a motorised vehicle, children could get dropped off at some distance from school and walk the remainder of the journey. To reduce ambiguity, a five-to-seven minute walk in these cases was often offered as an example. Like fully active trips, each partway active trip was credited by one draw ticket for the child.

The rules of the RIGHT TRACKS study were described in two posters on display in the school corridor. Coloured cartoons illustrated various ways of travelling actively to school, fully or partway, and their weight on the draw (“=1 ticket”). A bar chart was posted next to the posters, presenting the total number of active trips made by study participants, week on week. One bar was added to the chart after each session, in a size proportional to the ticket count. Further to advice by the teacher, absolute values were used to ease interpretation, rather than percentages.

The routine of draw days was generally consistent. The teacher gathered all parental ATS reports in the classroom and sent them to the office together with the register. Upon arrival, I collected the forms and retired into the staff room where I produced the required number of draw tickets. In preparation, I had previously cut a large number of small paper squares to form these tickets. On receipt of the paper-based parental ATS reports, I entered the information on a table summarising weekly active trips each day (columns) per child (rows). For those children whose parents had opted to report by SMS text messages, the same table was used to annotate replies in previous days, as they came through my mailbox. Exceptionally on draw days, parents responding by SMS were asked to reply before a certain time (12 noon), in order to allow inclusion of that morning’s trip to school in the draw. Before the session, I accessed my mailbox and added any tickets based on last minute text messages received. Active trips reported in late replies (i.e. after 12 noon) that day

were excluded from the draws. Child ID codes were written down on the tickets in accordance with parent-reported active trips.

At the scheduled time, usually around 1 pm (i.e. during school hours, straight after lunch break), study participants were taken to a different room by one of the teachers, while the remainder of the children stayed in the classroom working on something else. Sessions lasted about 15 minutes, although this varied as everybody became familiar with the procedures. Following arrangements between the two Year 5 teachers, the one involved with the RIGHT TRACKS study was usually the same across weeks. When prompted, I joined the participants and teacher, taking all necessary materials with me. Most of the times, I began by confirming that paper parental ATS report forms missing from the box in the school office had indeed been forgotten, and were not just in pupils' bags. Blank copies were available for those who had lost the form, and they were requested to return them to the school office, once completed by the parent, any day during the week. Late forms were collected by me on my next visit to the school.

Accelerometers in use that week were collected and their users were told of the thank you vouchers, available for later collection at the office, provided that the two relevant forms (i.e. parental and child ATS forms) had also been returned. When one or more of the three elements was lacking, children were requested to bring them at their earliest opportunity in order to receive their thank you prize. Another subsample of participants was fitted with the accelerometer to be worn over the following seven-day period. A surplus of accelerometer packs was always prepared beforehand in anticipation for possible pupil absences.

Next, child ATS report forms were distributed and completed. Pencils and rubbers were available. Children who had ridden a bicycle to school, or used a scooter or skate-board, were instructed to circle the word 'cycle' as appropriate. Anyone who had cycled that morning was requested to show the bicycle to me at dismissal, if available. After completion, forms were piled up and put aside. Participants from whom parental forms were missing wrote their ID codes on blank paper squares according to the number of 'YES' answers on their child report, which I then added to the other tickets.

The final part of the session in the intervention school was the draw. To demonstrate the transparency of the process, an opaque bag was turned inside out and back in

front of the group. Tickets were transferred from a plastic pocket to the bag and thoroughly mixed. Very briefly, the reward scheme voucher was exhibited to the participants to enhance motivation. The teacher was then invited to pick one ticket out of the bag. Public engagement feedback had suggested involving non-participants by giving them the chance to choose the ticket. However, this was regarded as potentially disruptive by the teacher, who was deemed to be the most suitable person for the task. After the announcement of the winner, he/she and the remaining participants were praised for their work and reminded of upcoming opportunities to win.

Depending on parental preferences, vouchers could be given to the child or kept at the office for collection by the parent/carer. In either case, the prize was available moments later, after a congratulations message had been filled out and put in an envelope together with the voucher. Written notes on the envelope specified its recipient (child or his/her parent/carer) in view of facilitating the receptionist's job.

4.2.9 Control group

Similar measurement procedures were carried out in intervention and control groups, and equal contact made between me and the participants. Accelerometers, parental ATS reports (paper forms and SMS replies) and child ATS reports were collected on a weekly basis, and thank you vouchers issued as appropriate. Shortly after the outset of the study, a request was made by the head teacher of the control school to run any study-related activities at play time (morning break). The intervention school remained happy with the sessions taking place during school hours throughout the study.

4.2.10 Data analysis

A coding frame was developed in Word (Microsoft Office 2013) to ease data entry and processing for parental baseline questionnaires and other forms, specifying each variable name and respective codes for responses. Data were entered manually into Excel (Microsoft Office 2013) and then imported into SPSS for analysis (IBM Corp, 2012). I cleaned the data to ensure its accuracy, by calculating ranges and frequencies of responses, and by checking sequence logic. For example, minutes of

MVPA during the journey to school were usually fewer than 10 (when greater than 10, this was checked again on the original source); reported trips could either be active (=1), non-active (=2), missing (=9) or NA (=8), and any value other than these would be subject to inspection; and MVPA data could not have been entered when the accelerometer had not been worn.

Normality tests (Shapiro-Wilks) were used to assess data distribution of continuous variables. Data were split by school for analyses at the school level. Median and interquartile range, five figure summaries (minimum, lower quartile, median, upper quartile, maximum), total values, or categorical responses (number and percentages when appropriate), were used to report aspects of school and participant recruitment, participation in interviews, session attendance, return of materials and reminders from school, report availability, draws, and questionnaire responses. Bar charts were used to present questionnaire responses on child's active travel to other destinations, parental perceptions and attitudes towards ATS, parental self-efficacy about the child's ATS, distribution of active trips to school and accelerometer wear. No significance tests (chi-squared or Mann-Whitney test) were undertaken to compare schools or participants due to the small sample sizes and in line with guidance on analysis of pilot trials.

Cross tabulations with total values, percentages, chi-squared tests and kappa statistics were undertaken to assess agreement between parental and child reports of mode of travel to school. Mann-Whitney U tests were used to assess differences in MVPA between ATS and non-ATS trips. Significance level (p value) was set at 0.05, and 95% confidence intervals were reported. A scatter plot was used to depict the relationship between the independent variable of duration of the trip to school (based on parent ATS report) and the dependent variable of minutes of MVPA during the parent-reported times of the trip to school, and the strength of association measured through a Spearman correlation coefficient. Bar charts were used to illustrate the distribution of accelerometer wear during the journey to school, and five figure summaries reported the time (minutes) of accelerometer wear during the times specified by the parental report of the timing of the journey to school and during the hour preceding the start of the classes (7:56am-8:55am). Five figure summaries were also calculated to report total daily wear (24h period) and total daily MVPA. Total values and percentages were used to express how many participants reached the accelerometer wear target (Basterfield *et al.*, 2011) and PA guidelines.

The accelerometer software was the ActiLife6 version 6.11.5. This software allowed the calculation of wear periods using time filters during the whole day (6am-5.59am on the following date), during parent-specified times of the trip to school, and during 7:56am-8:55am, as well as MVPA (both minutes and percentages) during these three timeframes. Wear periods of less than one minute were excluded. The MVPA cut points applied were those suggested by Evenson *et al.* (2008), which have been demonstrated to be both sensitive and specific cut points for sedentary, moderate and vigorous activities in children (Evenson *et al.*, 2008). Consistent with Basterfield and colleagues (Basterfield *et al.*, 2011), recordings were included in the analyses when the accelerometer had been worn for at least 6h/day on three days or more, weekdays or weekends, as this has been shown to provide acceptable reliability previously (Trost *et al.*, 2000; Penpraze *et al.*, 2006).

The 'compute variable' function in SPSS was used on a number of occasions to create new variables (e.g. overall parental self-efficacy). To determine the number of days in which parent and child reports agreed and disagreed, cross tabulations of data (parent vs child; reported ATS vs reported non-ATS) were produced. Average accelerometer wear during parent-specified times, and during 7:56am-8:55am, corresponded to the sum of all wear times divided by the number of valid days. All data analyses were saved as SPSS Syntax and Output files to provide an audit trail of data management and analysis.

4.3 Results

4.3.1 School recruitment

A total of 123 schools were contacted to take part in the RIGHT TRACKS study. On average, schools had been involved with Sustrans for three years (median) (LQ 2- UQ 3), and most (58.5%) were intensively involved in Sustrans-led projects when approached. Table 4.4 summarises the main characteristics of schools contacted. Figure 4.1 depicts the process of school recruitment.

On average, schools contacted had 240 students, only a small fraction (3.8%) of students had a first language other than English, and one fifth were eligible for free meals. There was an even distribution across local authorities, and the vast majority were community (65.9%) and primary schools (94.3%). The median number of days

(IQR) that schools took to reply was 21 (20-22), including those who replied proactively by email (12.2%) or reactively when I contacted them by phone (83.7%). Table 4.5 shows the reply status of schools contacted.

School size	239.5 (206- 362)*	
% pupils for whom English not first language	3.8 (1.9-9.2)*	
% pupils eligible for free meals	19.7 (12.1-35.6)*	
	n (%)	
Local authority	Newcastle	23 (18.7%)
	Gateshead	43 (35.0%)
	N. Tyneside	27 (22.2%)
	S. Tyneside	30 (24.4%)
School type (by admin/ funding)	Community	81 (65.9%)
	Foundation	10 (8.1%)
	Voluntary aided	29 (23.6%)
	Voluntary controlled	2 (1.6%)
	Other independent	1 (0.8%)
School type (by age)	Primary	116 (94.3%)
	Middle/junior	7 (5.7%)

Table 4.4 - Main characteristics of schools contacted. *Median (inter-quartile range (IQR))

Reply	Yes	4 (3.3%)
	No	51 (41.5%)
	Asked email to be sent again (on the phone) but never replied	26 (21.1%)
	Would let me know if interested (on the phone) but never replied again	29 (23.6%)
	Asked to call again later (on the phone), but either did not respond or kept asking to call later	3 (2.4%)
	Provided new contact details (email or phone) from which there was no answer or which did not work	5 (4.1%)
	No reply after many attempts	5 (4.1%)

Table 4.5 - Reply status of schools contacted

A definite negative answer was obtained from 41.5% of the schools contacted and who did not take part. Less often, but still commonly, schools requested me to send them a second email (21.1%) or stated that they would let me know if interested (23.6%), and never replied again.

Of the 123 schools approached, four (3.3%) replied positively. These four schools generally compared well with the others but had a larger roll size, higher proportion of children eligible for free meals, were more likely to be located in North Tyneside and to be a foundation school (Table 4.6). No significance tests were undertaken in this comparison due to the low number of schools who agreed to take part.

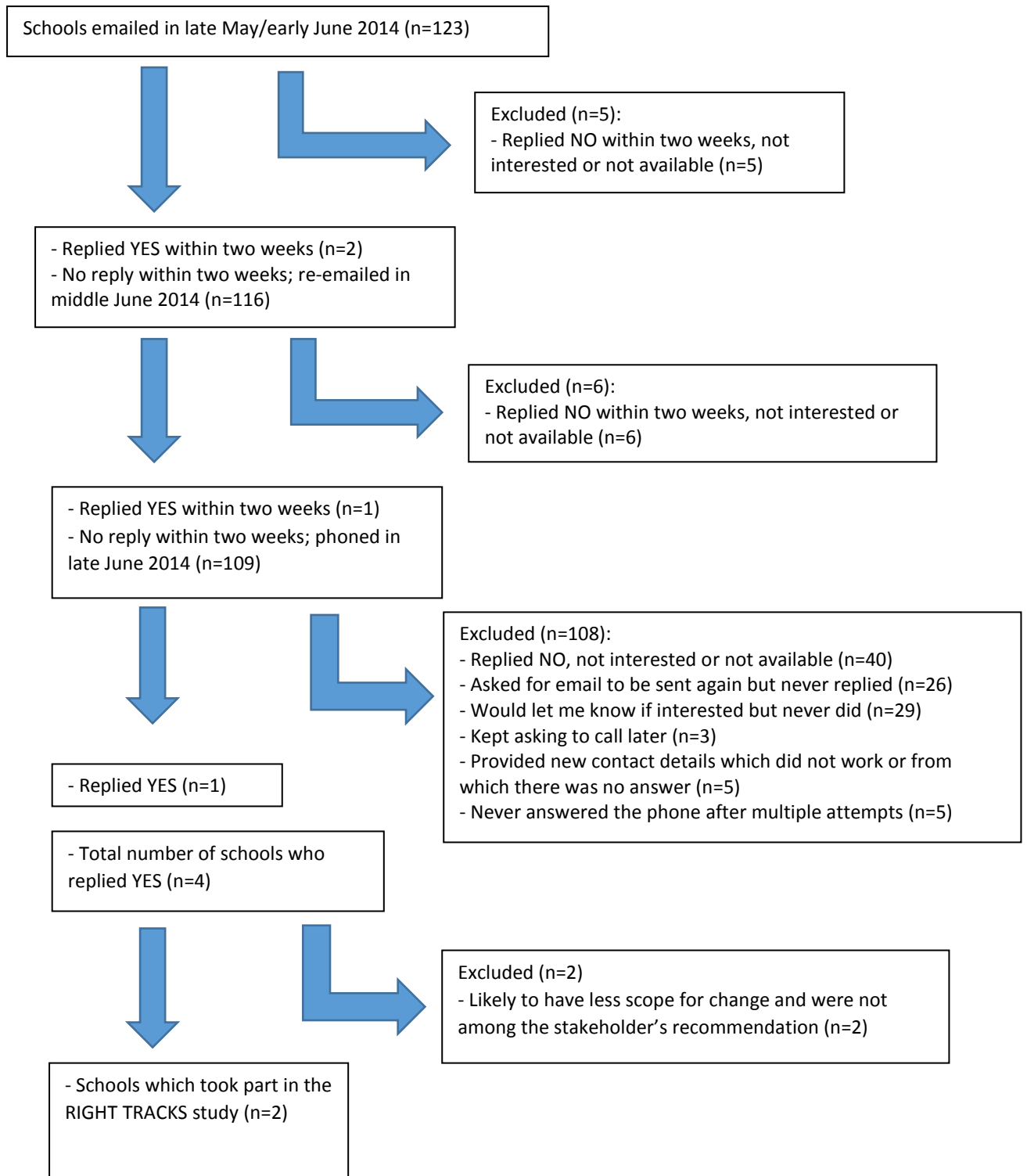


Figure 4.1 - School recruitment flowchart

		Schools who replied YES 4 (3.3 %)					Schools who explicitly replied NO, whose response was pending or who did not reply 119 (96.7 %)					
School size	Median (IQR)	317 (263-378)					236 (104-724)					
% pupils English not first language		5.0 (4.9-7.4)					3.5 (0.0-84.6)					
% free meals		31.4 (10.6-35.7)					19.6 (1.4-59.2)					
Time with Sustrans (years)		3.0 (3-3)					3.0 (2.0-3.0)					
Time taken to reply to invitation (days)		21.0 (9.3-24.5)					21.0 (20.0-22.0)					
Local authority	N (%)	Newcastle 0 (0)	Gateshead 0 (0)	North Tyneside 4 (100%)	South Tyneside 0 (0)		Newcastle 23 (19.3%)	Gateshead 43 (36.1%)	North Tyneside 23 (19.3%)	South Tyneside 30 (25.2%)		
School type (admin/funding)		Community 2 (50%)	Foundation 2 (50%)	Voluntary aided 0 (0%)	Voluntary controlled 0 (0%)	Other independent 0 (0%)	Community 79 (66.4%)	Foundation 10 (8.1%)	Voluntary aided 29 (23.6%)	Voluntary controlled 2 (1.6%)	Other independent 1 (0.8%)	
School type (age)		Primary 4 (100%)	Mid/junior 0 (0%)				Primary 112 (94.1%)	Mid/junior 7 (5.7%)				
Involvement with Sustrans		Intensive 1 (25%)	Supported 1 (25%)	At distance 1 (25%)	Disengaged 1 (25%)		Intensive 71 (59.7%)	Supported 22 (18.5%)	At distance 18 (15.1%)	Disengaged 8 (6.7%)		
Reply							No 51 (42.9%)	Pending - Asked for email to be sent again 26 (21.8%)	Pending - Would let me know if interested 29 (24.4%)	Pending – Kept asking to call again 3 (2.5%)	Pending – Provided new number/ email from which there was no reply 5 (4.2%)	No reply to phone calls 5 (4.2%)
Main justification for not taking part							Not interested/ not available 47 (90.4%)	Too few children in Year 5 2 (3.8%)	Year 5 children had a mixed age 1 (1.9%)	Head teacher was away 2 (3.8%)		

Table 4.6 - Characteristics of schools who replied positively vs those who declined or did not reply to the invitation

The selection of the schools was to be made on the basis of matching characteristics as much as possible, but also depended on likely scope for change and stakeholder advice. Table 4.7 outlines the criteria for the choice of the two participating schools, school 1 and school 2.

	Selected		Not selected	
	School 1	School 2	School 3	School 4
N of Year classrooms	2	2	NA	NA
% pupils English not first language	5.0	7.4	4.9	4.9
% free meals	30.8	10.6	35.7	31.9
% AST estimate (based on Sustrans)	NA	NA	NA	80
% AST in Y5 (based on the school estimate)	70	NA	NA	NA
Suggested by stakeholder upon consultation	Yes	Yes	No	No

Table 4.7 - Criteria for the selection of two schools. NA - Information not available

Over the phone, when asked about AST levels in his school, the head teacher of school 3 was unable to provide an estimate but stated that “low AST was not a problem in his school”. Upon consultation, a stakeholder (Sustrans) advised selection of school 1 and school 2, but gave no further justification.

Table 4.8 compares the characteristics of the two schools who took part in the study with those who did not. In addition to differences in free meal eligibility, the two participating schools differed in terms of school size, however both were foundation schools and had a reduced involvement with Sustrans by the time of the study.

		Schools who took part 2 (1.6%)					Schools who did not take part 121 (98.4%)				
School size	Min-max and median (LQ-UQ)	263-378					237 (206-359)				
% pupils English not first language		5.0-7.4					3.6 (1.9-10)				
% free meals		10.6-30.8					19.7 (12.3-35.6)				
Time with Sustrans (years)		3					3 (2-3)				
Time taken to reply to invitation (days)		19-25					21 (20-22)				
Local authority	N (%)	Newcastle 0 (0%)	Gateshead 0 (0%)	N. Tynes. 2 (100%)	S. Tynes. 0 (0%)		Newcastle 23 (19.0%)	Gateshead 43 (35.5%)	N. Tynes 25 (20.7%)	S. Tynes. 30 (24.8%)	
School type (admin/funding)		Community 0 (0%)	Foundation 2 (100%)	Vol. aid ¹ 0 (0%)	Vol. contr. ² 0 (0%)	Other ind. ³ 0 (0%)	Community 81 (66.9%)	Foundation 8 (6.6%)	Vol. aid ¹ 29 (24.0%)	Vol. contr. ² 2 (1.7%)	Other ind. ³ 1 (0.8%)
School type (age)		Primary 2 (100%)	Mid/junior 0 (0%)				Primary 114 (94.2%)	Mid/junior 7 (5.8%)			
Involvement Sustrans		Intensive 0 (0%)	Supported 1 (50%)	At dist. 1 (50%)	Disengage d 0 (0%)		Intensive 72 (59.5%)	Supported 22 (18.2%)	At dist. 18 (14.9%)	Disengag 9 (7.4%)	

Table 4.8 - Characteristics of schools who took part vs those who did not take part. 1 – Voluntary aided; 2- Voluntary controlled; 3- Other independent school

The two schools were located in North Tyneside (Figure 4.2), in the North East of England. According to the 2011 Census (ONS, 2015), the North East has 4% of the UK population, 93.6% of which is White British. The unemployment rate of 10.3% is the highest in the UK, however the crime rate is among the lowest (ONS, 2015).

Likewise, North Tyneside has a predominantly White British population (95.1%) and an unemployment rate at 8.8% (1% above the national average) (ONS, 2015). In 2010, out of 326 local authorities, North Tyneside was the 113th most deprived in England (NTCCG, 2013).

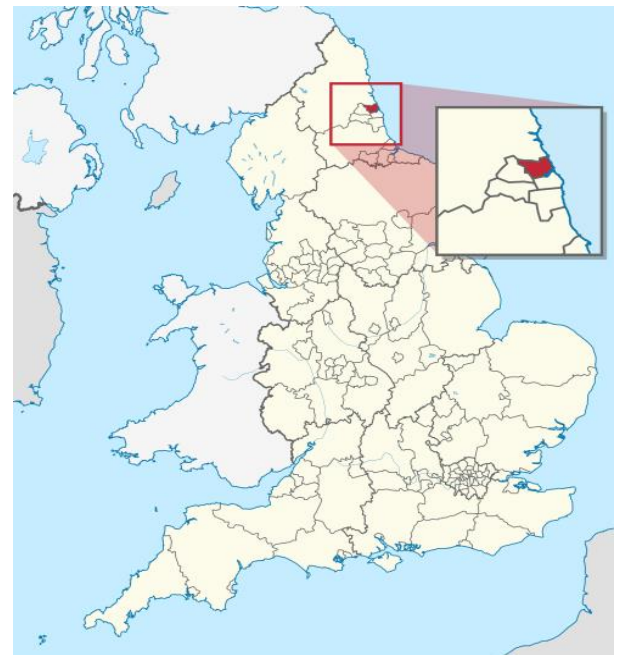


Figure 4.2 - North Tyneside, England

The IMD scores for the post code of school 1 and school 2 are 27.72 and 28.07 respectively, both in the fourth quintile (21.36 - 34.17) (OpenDataCommunities.org, 2015). In this classification, the least deprived communities have an IMD score of ≤ 8.49 (first quintile), whereas the most deprived communities have an IMD ≥ 34.18 (fifth quintile).

4.3.2 Individual recruitment and retention

The CONSORT flowchart (figure 4.3) shows the participant flow in this cluster randomised pilot trial. For clarity, from this point onwards, I will refer to the participating schools as the control school (school 1 in previous section) and the intervention school (school 2 in previous section) as appropriate. However, the reader should bear in mind that many of the data presented in this and in subsequent sections refer to the pre-randomisation period.

Table 4.9 summarises some general aspects of recruitment and retention. At its own discretion, the intervention school sent an SMS to the whole group of parents (Year 5's) reminding them of the recruitment deadline. No reminders were issued in the control school at recruitment. Overall, 88 pupils and respective families were approached, 48 in the control and 40 in the intervention school. Recruitment rates were 29.2% in the control school and 37.5% in the intervention school. There were

two dropouts in this study, both in the control school, one in week 1 and one in week 2 (both after school randomisation).

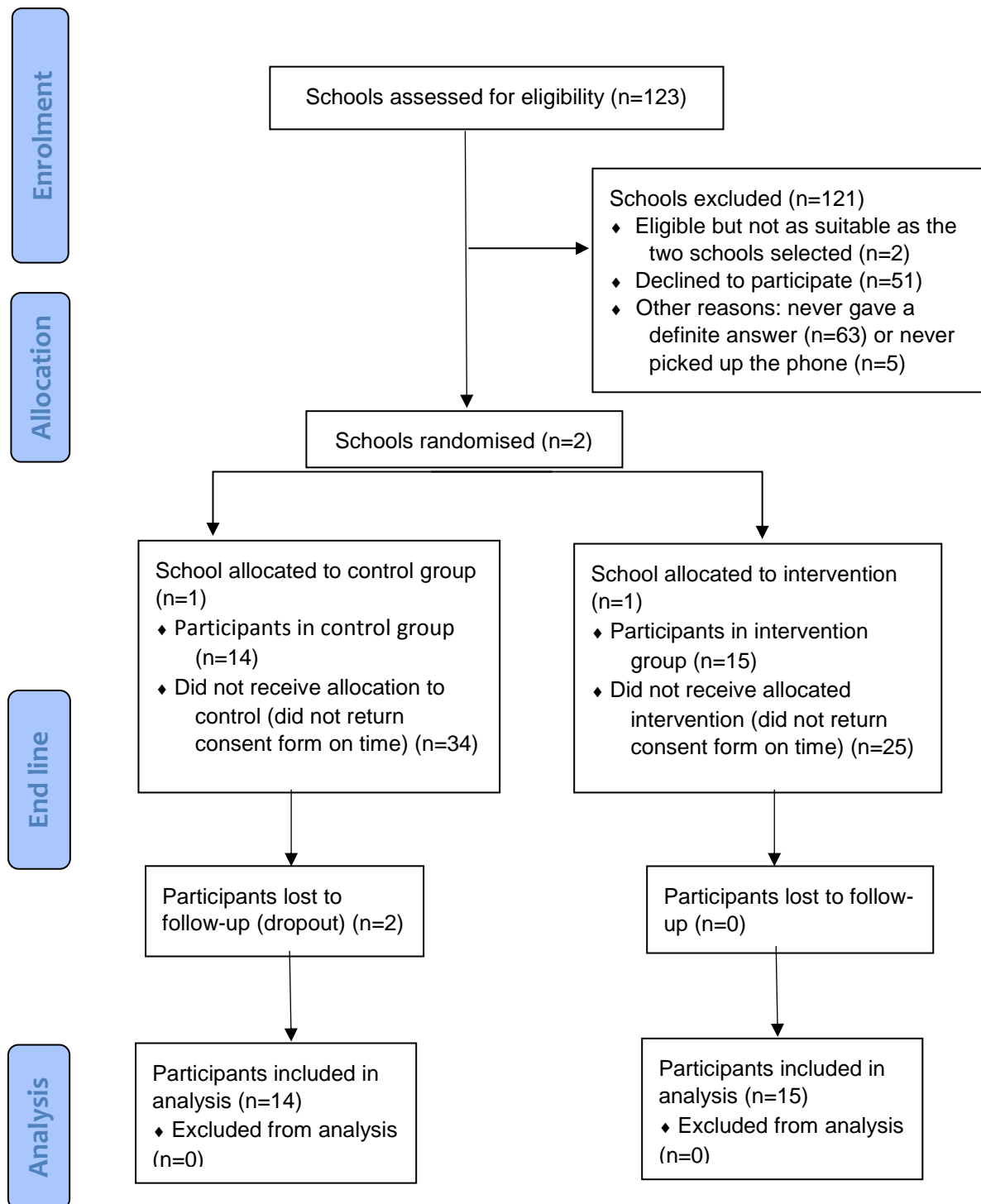


Figure 4.3 - CONSORT flow diagram for the RIGHT TRACKS pilot cluster randomised controlled trial

	Control school	Intervention school	Overall
N pupils approached	48	40	88
N (%) pupils who responded before baseline started (i.e. on time)	14 (29.2%)	15 (37.5%)	29 (33.0%)
N (%) pupils who responded after baseline had started (i.e. too late)	2 (4.2%)	0 (0.0%)	2 (2.3%)
N (%) pupils who did not respond at all	32 (66.7%)	25 (62.5%)	57 (64.8%)
N (%) participants who remained until the end of the study	12 (85.7%)	15 (100%)	27 (93.1%)

Table 4.9 - General aspects of recruitment and retention

Based on the difference between the date when packs were distributed and the date written on completed consent forms, parents were quicker at completing consent forms in the control school (2 days (0.8-3.8) vs 5 days (2-6)) (median (IQR)). The time elapsed between issuing and receipt of the consent form by me (median (IQR)) was the same in both schools (7 days (6.3-7) vs 7 days (7-7)). No parents ever contacted me to ask questions or to change their options for participation, either at baseline or afterwards.

Preferences for reply mode, voucher recipient and interest in being interviewed could be stated on the consent form; a default option was assigned when the field was left blank (Table 4.10). Completion of mandatory fields (ticking one box, providing names and signature) was 100% in both schools, with the exception of one parent who signed but failed to tick the relevant box. In the control school, I decided to change one parent's reply mode from SMS to paper form. This was after the parent, who had opted to report ATS by SMS at recruitment, failed to reply to any of the text messages I had sent in the first two weeks (delivery reports notified me that the SMSs were being received).

	Control school	Intervention school	Overall
<i>ATS report mode preference</i>			
Paper form (stated)	3 (21.4%)	5 (33.3)	8 (27.6%)
Mobile phone (stated)	9 (64.3%)	7 (46.7%)	16 (55.2%)
Left blank (default: paper)	2 (14.3%)	3 (20.0%)	5 (17.2%)
<i>Voucher recipient</i>			
Can be handed to the child (stated)	12 (85.7%)	11 (73.3%)	23 (79.3%)
To be collected by parent/carer (stated)	0 (0.0%)	1 (6.7%)	1 (3.4%)
Left blank (default: collected by parent)	2 (14.3%)	3 (20.0%)	5 (17.2%)
<i>Interest in interview</i>			
Yes – box ticked and contact details	5 (35.7%)	4 (26.7%)	9 (31.0%)
Yes – box left blank but gave contact details	1 (7.1%)	1 (6.7%)	2 (6.9%)
No (default) – box left blank and no contact details	8 (57.1%)	10 (66.7%)	18 (62.1%)

Table 4.10 - Preferences for participation based on completion of consent form

4.3.3 Questionnaire data

4.3.3.1 Socio demographic characteristics

Completion of the parental baseline questionnaire was not essential for participation but it was returned by almost all participants (n=28, 96.6%). In all cases, either the mother (89.3%) or the father (10.7%) completed the questionnaire.

Sociodemographic characteristics of the participating children and families are reported in Table 4.11. To avoid possible ambiguity in case of parents with more than one child, questions about the child specified that it was the child in Year 5 (schools confirmed that there were no siblings taking part in this study). For the number of young people in the household per age band, modal values were used because of the small number of cases reported. Parents were asked to select all the qualifications they had, which resulted in the sum of percentages being more than 100%. One respondent failed to indicate the ethnic group of parent/carer 1. Two parents reported not living with a partner, but nonetheless indicated the ethnic group of parent/carer 2.

	Control school	Intervention school	Overall
Gender of the child			
Boy	5 (38.5%)	8 (53.3%)	13 (46.4%)
Girl	8 (61.5%)	7 (46.7%)	15 (53.5%)
Age of the child*	9 (9-9)	9 (9-9)	9 (9-9)
Total number of people living in household*	3 (2-4)	4 (3-4)	3.5 (3-4)
Families with two parents/carers in the household	6 (46.2%)	10 (66.7%)	16 (57.1%)
Number of young people in each of the age bands (including child participating) in household			
0-3 years old**	0	0	0
4-6 years old**	0	0	0
7-11 years old **	1	1	1
12-16 years old**	0	0	0
Car available to drive child <u>to</u> school	9 (69.2%)	12 (80.0%)	21 (75.0%)
Car available to drive child <u>from</u> school	8 (61.5%)	12 (80.0%)	20 (71.4%)
Parent's qualifications			
Degree or Higher Degree	2 (15.4%)	6 (40.0%)	8 (28.6%)
A Levels, professional qualification or equivalent	3 (23.1%)	10 (66.7%)	13 (46.4%)
GCSE's, CSE's, O Levels or equivalent	11 (84.6%)	13 (86.7%)	24 (85.7%)
None of the above	0 (0.0%)	2 (13.3%)	2 (7.1%)
Ethnic group of the parent/carer 1			
White British	11 (91.7%)	14 (93.3%)	25 (92.6%)
Black African	1 (8.3%)	0 (0.0%)	1 (3.6%)
Chinese	0 (0.0%)	1 (6.7%)	1 (3.6%)
Ethnic group of the parent/carer 2 (if applicable)			
White British	6 (85.7%)	11 (91.7%)	17 (89.5%)
Black African	1 (14.3%)	0 (0.0%)	1 (5.3%)
Chinese	0 (0.0%)	1 (8.3%)	1 (5.3%)

Table 4.11 - Sociodemographic characteristics of participating children and families; * Mdn (IQR); **Mode Note: Data from the two participants who dropped out, both from the control school, are included in this table.

Nearly half of participating children were boys (46.4%), aged on average 9 years. The median number of people in the household varied between 3 and 4, and those in the intervention group were more likely to live with two parents/carers (66.7% vs 46.2%). All the parents who lived with a partner indicated that the partner was either the child's father or mother. Most children had a car available to travel to and from school, although this percentage was higher in the intervention group (80% vs 65.4%). Parents in the intervention group were also more likely to have higher qualifications, degree or higher degree (40.0% vs 15.4%) or A levels or equivalent (66.7% vs 23.1%). The sample was predominantly White British (89.5%).

4.3.3.2 Parents' travel behaviour and PA

Data related with parents' travel to work are presented in Table 4.12a, and data on general parental PA behaviour is displayed in Table 4.12b. Some variables related to time spent travelling to and from work are excluded from the tables due to the low number of responses available (either zero or insufficient to provide a range). Two parents specified a time for the duration of their partner's commute to work on the 'car' row, but failed to tick the relevant box on travel mode; therefore, both were treated as implied responses of 'yes' to the use of car to travel to work. Percentages of travel modes added up to over 100% because some parents selected more than one option, probably reflecting walks at either or both ends of journeys on public transport, or possibly different modes of travel on different days of the week.

Most parents who completed the questionnaire, both in the control (76.9%) or in the intervention school (83.3%), were employed. Whereas in the control school active travel to work was reported by 50% and motorised travel by 60% of employed parents, all respondents in the intervention school reported travelling to work by car (83.3%) or public transport (25%), except for one parent who worked from home (again, multiple travel modes were allowed in the responses).

	Control school	Intervention school	Overall
<i>(Parent completing the questionnaire)</i>			
Are you currently employed			
Yes	10 (76.9%)	13 (86.7%)	23 (82.1%)
No	3 (23.1%)	2 (13.3%)	5 (17.9%)
How do you normally travel to work			
By car	4 (40.0%)	10 (83.3%)	14 (63.6%)
By public transport	2 (20.0%)	3 (25.0%)	5 (22.7%)
On foot	4 (40.0%)	0 (0.0%)	4 (18.2%)
By bicycle	1 (10.0%)	0 (0.0%)	1 (4.5%)
Work from home	0 (0.0%)	1 (7.7%)	1 (4.3%)
Time spent travelling to work (min) - by car		20 (15-42.5)	
Your partner's relationship to the Year 5 child			
Mother	1 (16.7%)	2 (20.0%)	3 (18.8%)
Father	5 (83.3%)	8 (80.0%)	13 (81.3%)
Is your partner currently employed – Yes	6 (100%)	10 (100%)	16 (100%)
How does your partner normally travel to work:			
By car	5 (83.3%)	10 (100%)	15 (93.8%)
By public transport	2 (33.3%)	0 (0.0%)	2 (12.5%)
On foot	1 (16.7%)	0 (0.0%)	1 (6.3%)
Time spent travelling to work (min) by your partner - by car		20 (13.5-80)	

Table 4.12a - Parents' travel to work

All partners, when applicable, were employed. In both schools, car was the predominant travel mode to work reported by the partner of the responding parent, 83.3% in the control, and 100% in the intervention group. The median commuting time for questionnaire respondents and respective partners was 20min in both schools.

	Control school	Intervention school	Overall
<i>Parent completing the questionnaire</i>			
In a typical week during the past 4 weeks, how many hours did you spend on:			
Walking (work, shopping and leisure)	4 (2.5-4)	4 (2.5-4)	4 (2.8-4)
Cycling (work and leisure)	1.5 (1-3)	1 (1-1)	1 (1-2)
Other physical exercise	2 (2-3)	2 (1-3)	2 (1.8-3)
In a typical week during the past 4 weeks, how many hours did your partner spend on:			
Walking (work, shopping and leisure)	2 (2-3.3)	3 (2-4)	2 (2-4)
Cycling (work and leisure)	1 (1-1.3)	1 (1-2)	1 (1-2)
Other physical exercise	2 (1-2.5)	1 (1-2.3)	2 (1-2)

Table 4.12b - Physical activity of parents

On average, in a typical week, parents from both schools reported spending 4h walking, 1 to 1.5h cycling, and 2h performing other forms of physical exercise. Their partners were reported to spend less time walking (2h to 3h), but similar time engaging in cycling or other physical exercise.

4.3.3.3 Child's school travel behaviour

None of the children was reported to have a condition that affected their ability to be physically active, all had regular access to a bike (100%) and nearly all could ride one (n=27, 96.4%). The decision about how to travel to/from school was mostly made by parents (64.3%), less often by the child (28.6%) or by both together (7.1%). As with parental travel to work, the issue of percentage of travel modes adding up to over 100% applied to the travel modes associated to the child's journey to/from school (Table 4.13). While it is unclear whether this means multiple travel modes within the same day or different single modes in different days, or both, notes written by three parents provide some evidence for the latter interpretation (e.g. "Walking on X day, car on X day, etc."). One of these parents selected four travel modes to school – car, walking, cycling and scooter – which are unlikely within a single journey. See section 3.2.3 for more details about the terminology chosen ("on a typical day").

Based on parental report, the majority of children (77.8%) needed to travel less than one mile to get to school. Compared to distances based on postcode, parents slightly overestimated the distance to school. For example, two parents reported living more than two miles away from school, but this was not confirmed based on postcode. One parent in the control school did not provide postcode. The median distance travelled, based on postcode, was half a mile in both schools. In both schools, the predominant travel mode to school was walking (66.7% for control school and 80.0% for intervention school), followed by car (46.7% and 25.0%), bicycle (25% and 13.3%) and scooter (16.7% and 0.0%). None of the respondents reported travelling to/from school by public transport or school bus. On average (median), trips took 5min by car, 8.8min on foot, and 10min by bike. Duration of car trips in the control school, and bicycle trips in the intervention school, were omitted from Table 4.13 due to the low number of cases reported. Most parents escorted their child to school, but in the intervention school a considerable percentage was escorted by other adults (33.3% to school and 40.0% from school). Little difference was observed between the journey to and from school, although slightly more walked home in the afternoon.

	Control school	Intervention school	Overall
How far does your child need to travel to get to school			
Less than 1 mile	9 (75.0%)	12 (80.0%)	21 (77.8%)
1-2 miles	3 (25.0%)	1 (6.7%)	4 (14.8%)
Over 2 miles	0 (0.0%)	2 (13.3%)	2 (7.4%)
Distance from school (miles) based on postcode calculated on Google Maps (Mdn-IQR)	0.5 (0.3-0.8)	0.5 (0.3-0.7)	0.5 (0.3-0.7)
Less than 1 mile	9 (83.3%)	13 (86.7%)	23 (85.2%)
1-2 miles	2 (16.7%)	2 (13.3%)	4 (14.8%)
Over 2 miles	0 (0%)	0 (0%)	0 (0%)
How does your child travel to school on a typical day			
By car	3 (25.0%)	7 (46.7%)	10 (37.0%)
By bicycle	3 (25.0%)	2 (13.3%)	5 (18.5%)
By walking	8 (66.7%)	12 (80.0%)	20 (74.1%)
Other (scooter)	2 (16.7%)	0 (0.0%)	2 (7.4%)
Time your child spends travelling to school on average (min)*			
By car		5 (3-5)	5 (4.5-6.3)
By bicycle	8.8 (4.9-13.8)		10 (6.6-23.8)
By walking	8.8 (5.8-15)	5 (5-10)	8.8 (5-10)
Who does your child go to school with on most days			
Child goes alone	1 (7.7%)	3 (20.0%)	4 (14.3%)
With me or my partner	11 (84.6%)	10 (66.7%)	21 (75.0%)
With an older sibling	2 (15.4%)	0 (0.0%)	2 (7.1%)
With other children	3 (23.1%)	2 (13.3%)	5 (17.9%)
With other adults	2 (15.4%)	5 (33.3%)	7 (25.0%)
How does your child travel from school on a typical day			
By car	3 (23.1%)	6 (40.0%)	9 (32.1%)
By bicycle	3 (23.1%)	1 (6.7%)	4 (14.3%)
By walking	9 (69.2%)	13 (86.7%)	22 (78.6%)
Other (scooter)	2 (15.4%)	0 (0.0%)	2 (7.1%)
Who does your child return from school with on most days			
Child returns alone	1 (7.7%)	2 (13.3%)	3 (10.7%)
With me or my partner	10 (76.9%)	11 (73.3%)	21 (75.0%)
With an older sibling	2 (15.4%)	0 (0.0%)	2 (7.1%)
With other children	3 (23.1%)	1 (6.7%)	4 (14.3%)
With other adults	2 (15.4%)	6 (40.0%)	8 (28.6%)
Other	1 (7.7%)	0 (0.0%)	1 (3.6%)

Table 4.13 - Child's travel to and from school; *Mdn (IQR)

4.3.3.4 Child's travel behaviour to other destinations

Questions about child's walking and cycling to other destinations (questions 21 and 22 – appendix E) are presented in bar charts to ease interpretation. For these and subsequent bar charts, items to which none of the participants in either of the schools replied are not included on the x axis.

More frequent walking (i.e. a higher number of times per week) to the various destinations (friend's house, parks or playground, shops, sports venue) was reported for children from the control school. Likewise, children from the control school cycled

more frequently to the various destinations. With the exception of walking to a friend's house, those in the intervention school were more likely to never walk or cycle to the various destinations.

4.3.3.5 Parental perceptions, attitudes and self-efficacy

Question 23 assessed parental perceptions and attitudes towards active travel to school. This consisted of statements about the child's journey to school for which parents rated their level of (dis)agreement (bar charts 23a-23o – appendix F).

Most parents disagreed that traffic and distance were barriers to ATS. However, in the intervention group, one third agreed that traffic is dangerous for cycling and that using the car is more convenient. In both groups, 30 to 40% expressed concern that something might happen to their child on the way to school. The majority of parents reported being around to take their child to school and usually doing so on the way to somewhere else (e.g. work). About half of respondents from both schools agreed that there were no safe cycle paths, but there was agreement about the suitability of pavements for walking. Most parents liked or would like their child to walk or to cycle to school, particularly in the control school. The possibility of the child purchasing unhealthy snacks or drinks, engaging in anti-social activities, or of being bullied on the way to school, were not reported as being a problem in the control school, but caused concern amongst a small number of parents in the intervention group. Overall, these findings were supportive of the potential for ATS.

Question 24 assessed parental perceptions about their local area (bar charts 24a-24x, appendix G). In both schools, most parents somewhat or strongly agreed that their local area had shops within walking distance, was pleasant to walk in, had enough crossings for pedestrians, and easy access to a bus stop. However, also in both schools, most agreed that there were a lot of busy junctions, and 20 to 30% somewhat or strongly agreed that there were major obstacles to walking. Nearly all agreed that pavements for walking were adequate and most considered that there were many alternative routes to get from place to place. Although the majority of parents across both schools agreed that there were cycle paths to get from place to place, control participants were more likely to report agreement on this issue. The perception that the crime rate was unsafe for night walks was indicated by 30% (control) and 50% (intervention); in the control group, 25% somewhat agreed that

there was a high crime rate in their local area, whereas around 35% intervention subjects somewhat agreed, and 5% strongly agreed, with the same statement.

There were mixed views about the number of dead-end streets in both groups, and while most intervention participants agreed that there was a verge separating the pavement from the road, most control subjects expressed the opposite view.

Between 50-60% disagreed or strongly disagreed that there were interesting things to look at where they live. There were differences in agreement about the presence of trees along streets between control (50%) and intervention (70%). In both schools, most parents disagreed that the excessive traffic made walking unpleasant; in the intervention school, half of the respondents somewhat or strongly agreed that the traffic was excessive for cycling, whereas only 25% in the control group shared the same view. Around two thirds in each group agreed that the traffic was usually slow, but most parents in the intervention group also considered that most drivers exceeded speed limits. There was general agreement that streets were well lit at night, and that walkers and cyclists can be easily seen from homes, although more so in the intervention group.

Question 25 assessed parental self-efficacy about the child's ability to walk to school (25a-25n, appendix H). The majority of parents in both schools were quite confident or very confident that their child could walk to school, or that they could ask a parent or other adult to walk to school with them. Parents in the control school were more likely to feel quite or very confident about their child asking a friend to walk to school with them (60% vs 25%), or about the child walking to school even if their friends did not walk (75% vs 50%). Around half in both groups believed in their child's ability to walk to school even in bad weather. In the control group, more parents were confident about their child crossing difficult roads when walking to school (40% vs 12%), but more were also likelier to feel not at all confident (25% vs 5%).

Half of the respondents in the intervention school were not at all confident, or not particularly confident, about their child coping with busy traffic, compared to 25% in the control school. In the intervention group, parents were also less confident about their child walking even if there were many cars near the school entrance. Unlike in the intervention school, most parents in the control school were confident that the child was able to walk to school: even if there were not enough lollipop people; even if the child was frightened of meeting strangers or of being bullied; even if there was

poor lightning; or if would take longer. The majority of parents from both schools expressed confidence about their child's ability to find a route to walk to school.

Exploring the same aspects, question 26 assessed parental self-efficacy about the child's ability to cycle to school (bar charts 26a-26n), applicable only to when the child was able to ride a bike (n=27). Parents in the control group were consistently more confident about their child cycling to school and other cycling-related behaviours. For most items, the majority of parents in the control school were quite confident or very confident, against only a minority in the intervention group who selected these response options. This was true for the child's ability to cycle to school (80% vs 45%), to ask a parent or other adult to cycle to school with them (60% vs 7%), to ask a friend to cycle to school with them (80% vs 20%), to cycle even if their friends did not cycle (80% vs 20%), to cycle to school even in bad weather (55% vs 12%) or even if there were many cars near the school entrance (60% vs 10%), even if they were frightened of meeting strangers (80% vs 25%) or of being bullied (70% vs 32%), if there was poor lightning (55% vs 12%), and for the child's ability to find a route to cycle to school (65% vs 37%).

Inter-group differences in the same direction were also evident in relation to the other items, but only half or less of the respondents in the control group expressed being quite or very confident about them. These items included the child crossing difficult roads (45% vs 8%) and coping with busy traffic (50% vs 0%) when cycling to school, cycling to school even if it there were not enough lollipop people (50% vs 15%) and even if the journey would take a long time (45% vs 5%).

Composite scores were calculated for the perceived neighbourhood walkability score and parental self-efficacy about the child walking and about cycling to school (Table 4.14). Neighbourhood walkability score consisted of the sum of each item's score, which could range from 1 (strongly disagree) to 4 (strongly agree). Items g, j, k, r, s, u and x were reverse scored (see questionnaire, appendix A) prior to calculation of the total walkability score. Thus, the sum of all 24 items could fall anywhere between 24 and 96, the mid-point being 60. Higher scores meant higher walkability (Panter *et al.*, 2013). The results suggest a spread (roughly normally distributed) around the mid-point and because some scores were below it, some considered the area less walkable than others. The area was generally perceived as walkable, as 75% of respondents had a score above the theoretical mid-point of 60.

	Control school	Intervention school	Overall
Neighbourhood* walkability score (range 24-96)	71.0 (62.7-72.7)	68 (65-75.3)	69.5 (64-74)
Parental self-efficacy - walking (range 14-70)	46 (28.5-55.5)	40 (34-48)	42.5 (34.3-51.3)
Parental self-efficacy - cycling (range 14-70)	52 (35-55.5)	31 (26.8-39.8)	39 (27-54)

Table 4.14 - Perceived neighbourhood walkability and self-efficacy about child walking and cycling to school. *In the questionnaire, the term local area was used. All values refer to Mdn (IQR). All three variables had a normal distribution, (Shapiro-Wilk test, $p>0.05$)

Likewise, total parental self-efficacy corresponded to the sum of each item score, which ranged from 1 (not at all confident) to 5 (very confident). Thus, the sum of the 14 items could fall anywhere between 14 and 70, mid-point 42, both for walking and cycling. Higher scores (above mid-point) indicated stronger parental confidence, while lower scores (below the mid-point) were indicative of lower confidence levels (McMinn, 2011). Both overall scores of parental self-efficacy were near the mid-point of 42. The percentage of those who scored above 42 was 46.4% for parental self-efficacy about their child walking, and 37.0% for parental self-efficacy about their child cycling. However, control parents held a stronger belief about their child's competence to walk to school, and a stronger belief about their child's ability to cycle to school. Once again, these data are supportive of the potential for ATS.

4.3.4 Weekly sessions

There were eleven ($n=11$) weekly sessions run in each school throughout the study, including presentation at baseline ($n=1$), week after baseline ($n=1$), post-randomisation (including draw sessions in the intervention school) ($n=8$) and final session ($n=1$). One post-randomisation session had to be re-arranged to a different day in the intervention group, but none had to be completely cancelled. Presentation sessions happened during school hours (i.e. not during break times), whereas all sessions at and following baseline were during morning play time in the control school, and during school hours in the intervention group. Sessions in the control school were generally noisy, with some pupils walking around the room and others arriving later because they had gone outside and forgotten about the session. In the intervention group, the ambiance was quiet and sessions run very smoothly (non-participants were taken to another room by one of the teachers).

In both schools, both Year 5 teachers attended the presentation of the study. On subsequent weeks, only the head teacher attended one session in the control school (to help sorting out accelerometers), and no member of staff was present ever again in this group. (The presence of a female school staff could have been requested if necessary but that did not happen as children were able to wear the accelerometer belt unassisted the second time). In the intervention school, a Year 5 teacher (female) attended all the sessions, with the exception of two initial sessions (one at baseline and one at post-baseline) which were attended by a different teacher who happened to be teaching in the classroom at that moment. Details about the duration and child attendance of the study sessions are provided in Table 4.15.

	Control school	Intervention school	Overall
Duration of the initial presentation session (min)	20	20	20
Duration of baseline session (min)	20	30	25
Average duration of a session after presentation (including baseline session) (min)*	12.5 (7-15)	15.9 (10-20)	14.2 (10-17.5)
N (%) children who attended the presentation session	14 (100%)	14 (93.3%)	28 (96.6%)
N (%) children who attended baseline session	14 (100%)	15 (100%)	29 (100%)
Proportion (%) of children who attended sessions after baseline	114/125 (91.2%)	146/150 (97.3%)	260/275 (94.5%)

Table 4.15 - Duration and child attendance of study sessions. *Mdn (IQR)

Initial presentation and baseline sessions took on average 20 and 25min respectively. Draw sessions in the intervention school lasted on average 15.9min, and post-baseline sessions in the control group 12.5min. Session attendance was always very high in both schools. The average number of children who attended post-baseline sessions includes the session in the week after baseline. This session involved collection of accelerometers and forms from the previous week, and was the start of baseline week for one child in each school, from whom consent had been obtained several days after all the other children had started their baseline assessment.

In the intervention school, there were eight draws planned from the beginning and all took place. In all but one there was a different winner; the exception was a child who won a draw on two occasions. There was one week on which the child was absent but entered the draw because SMS data were available, and one week on which the child was absent but entered the draw because the paper parental ATS report had

been left in the school office that morning by the parent (and the thank you voucher was left in the school office).

4.3.5 Return and completeness of materials

Details about the timely return of accelerometers, parental and child ATS reports, on the two accelerometer weeks, are shown in Table 4.16. These data are presented separately from data on the general availability of materials during all the weeks of the study (Table 4.18) due to their relevance for the analysis of accelerometer data and corresponding ATS report validity. An availability rate of 70% or more was taken as indicative of feasibility.

	Control school	Intervention school	Overall
Accelerometers returned on time at baseline	11/14 (78.6%)	15/15 (100%)	26/29 (89.7%)
Parent ATS reports returned on time at baseline	10/14 (71.4%)	15/15 (100%)	25/29 (86.2%)
Child ATS reports returned on time at baseline	14/14 (100%)	15/15 (100%)	29/29 (100%)
Accelerometers returned on time in the second week of wear	8/12 (66.7%)	12/15 (80.0%)	20/27 (74.1%)
Parent ATS reports returned on time in the second week of wear	5/12 (41.7%)	11/15 (73.3%)	16/27 (59.3%)
Child ATS reports returned on time in the second week of wear	12/12 (100%)	15/15 (100%)	27/27 (100%)
Accelerometers lost or damaged	0 (0%)	0 (0%)	0 (0%)

Table 4.16 - Return of materials on accelerometer weeks

With the exception of the child ATS report which was completed in my presence, more materials in the intervention school were returned in a timely manner than in the control school. In addition, there was a decrease in both schools in the rate of materials returned on time from the first to the second accelerometer week. Overall, at least 70% of materials were always available with the exception of the parental ATS report in the second accelerometer week (the date of which varied from child to child). At their own discretion, schools sent SMSs to parents to remind them of returning materials or collecting vouchers from school (Table 4.17). In addition, at my request, the control school issued an SMS to one specific parent to prompt the return of an accelerometer, after the child failed to return it many weeks in a row.

	Control school	Intervention school	Overall
N occasions on which a parent was texted by the school (individually) to be reminded of returning late materials	1	3	4
N occasions on which a parent (a different parent each time) was texted by the school (individually) to collect a voucher	1	5	6

Table 4.17 - SMS reminders issued by the school to parents

The availability of parental paper and SMS reports at baseline and after (week 1 to 8; week 1 is the first post-baseline week) is summarised in Table 4.18. "At least 1 SMS replied to" is the equivalent to a report form available; even if only one reply was provided on the paper form, others could be worked out by the following implied response rules. For both parent and child reports, when only ATS days were reported, any missing day(s) was (were) treated as an implied non-ATS day(s), and vice-versa, unless the child was known to have been absent from school. When there was a mix of ATS and non-ATS days throughout the week, the implied response rule was not applied, and the data for the day(s) in question were considered to be missing. SMS reply mode was only available to parents after baseline and only in weeks when the accelerometer was not being worn.

Availability of the parent report at baseline was high in the control group (78.6%) and very high in the intervention group (100%); on the remaining weeks, just over half (54.3%) of these reports were returned in the control school, while the vast majority continued to be returned in the other school (88.7%). The total availability of the child report was nearly 100%. The deadline to receive SMS reports on a draw day (12noon) was to allow inclusion of that day's trip on the draw (usually at 1pm), in case of an active trip being reported.

In total, there were 979 valid days actually reported (952 (97.2%)) or implied (27 (2.8%)) by the parental reports, and 261 days with missing data (21.0%), mainly from the control school (183 out of 261). In the child reports, 1150 days' reports were valid (only 2 were implied) and 90 (7.3%) were missing (54 out of 90 in control school).

	Control school	Intervention school	Overall
<i>Out of the parents who opted for paper form to report ATS</i>			
Parent ATS report form available at baseline	11/14 (78.6%)	15/15 (100%)	26/29 (89.7%)
Average of parent report form availability (post baseline, week 1- 8)	25/46 (54.3%)	63/71 (88.7%)	88/117 (75.2%)
Child ATS report form available at baseline	14/14 (100%)	15/15 (100%)	29/29 (100%)
Average of child report form availability (post baseline, week 1- 8)	94/98 (95.9%)	119/120 (99.2%)	213/218 (97.7%)
<i>Out of the parents who opted for SMS text messages to report ATS¹</i>			
Average of weeks (from all participants) on which at least 1 SMS was replied to	51/53 (96.2%)	56/56 (100%)	107/109 (98.2%)
Average of weeks (from all intervention participants) on which at least 1 SMS was replied to before deadline		56/56 (100%)	

Table 4.18 - Parent and child report availability at and after baseline

In the control group, 22 out of 382 valid days (5.8%) were implied responses; the corresponding value in the intervention group was 5 out of 597 (0.8%). These implied responses were mainly from paper reports (65.2%) and were almost invariably implied NOs (91.3%), i.e. situations where only YESs had been ticked on days of that week. In terms of the completeness of the child report (always on paper), only 2 of 1150 valid days (0.2%) were implied responses, both from control group and both being implied NOs. One parent ATS report returned at baseline in the intervention school had all five NOs circled and scribbled on at the same time. Due to its ambiguity, my research team and I decided to exclude this form from analysis.

All parents replied to at least one SMS text, with the exception of a parent in the control group who never replied in the first two weeks, despite having expressed preference for this response mode and provided a contact number in the consent form. Consequently, I changed this parent's reply mode to paper form after the second post-baseline week and notified the parent of the change by SMS. From that point on, completed parental ATS report forms were returned to me via the child.

Of 114 parent ATS report forms returned, seven (6.1%) had some written notes on the side; five were descriptions of the journey ("dropped off at school in the morning, walked home in the afternoon", "drove partway" or "mum was off so walked to school"), one stated "forgot to wear belt" and one was "post box" next to the report of a 0.5min stop made on the way to school. Two child ATS reports (0.8%) had written notes: "dropped off in the morning, walked back home" and "maybe". All comments

were from different children and parents, except one parent who wrote notes on two different reports. Other than 'yes' or 'no', SMS replies never contained anything else.

4.3.6 Distribution of active trips to school

Figure 4.4a shows the distribution of active trips to school based on parental report, and Figure 4.4b the corresponding distribution based on child report, only taking into account valid reports. Thus, bars show the proportion of active trips to school, while the remaining percentage (of 100%) corresponds to non-active trips. As presented earlier (Table 4.18), although nearly all SMS reports were available in both schools, the availability of the paper parental ATS report varied between 54.3% and 100%.

According to parental report at baseline, the percentage of active trips was approximately 60% in the control school and 70% in the intervention school, and rose in week 1, by 17.8% in the control group and 13.3% in the intervention school. Subsequently, in the control school, ATS levels varied between 76.4% and 86.4%, dropping from 76.5% to 58.6% in the last week. For the same period, in the intervention school, the percentage of active trips varied between 82.1% and 89.6%, remaining high in the last week (82.1%).

Child reports suggest higher ATS rates than parents'. In the control school, there was a progressive increase, according to child report, from baseline (86.4%) until week 7 (100%), ending in a small decrease in week 8 (94%). In the intervention school, a slow rise from baseline (82.2%) to week 6 (87.8%) was observed, followed by a slight decrease in the last two weeks, ending at 86.3% on week 8.

On average, across all weeks, ATS rates based on parental report were higher in the intervention (84.2%) than in the control school (76.0%); based on child report, ATS rates were very similar in intervention (88.3%) and control school (90.8%).

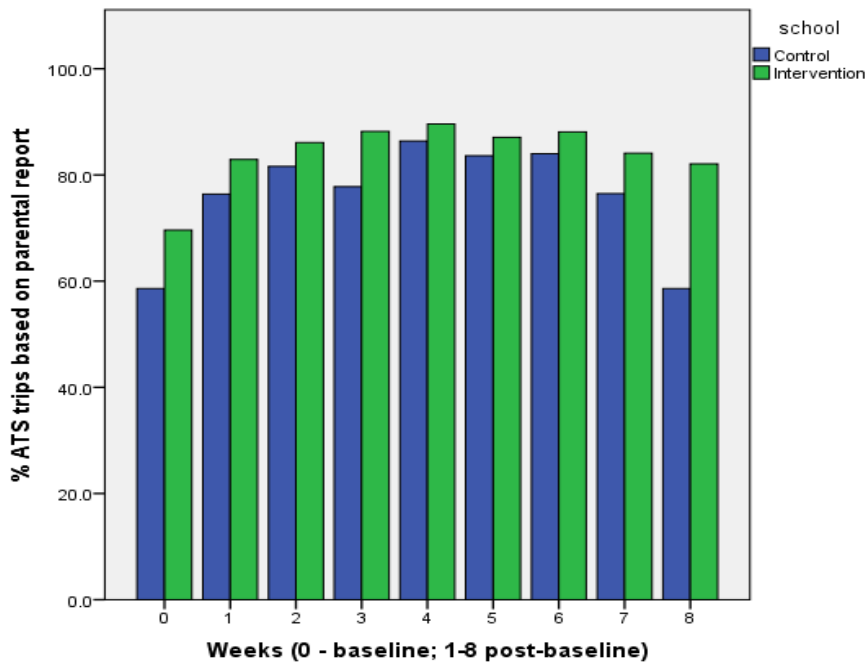


Figure 4.4a - Distribution of active trips to school based on parental report

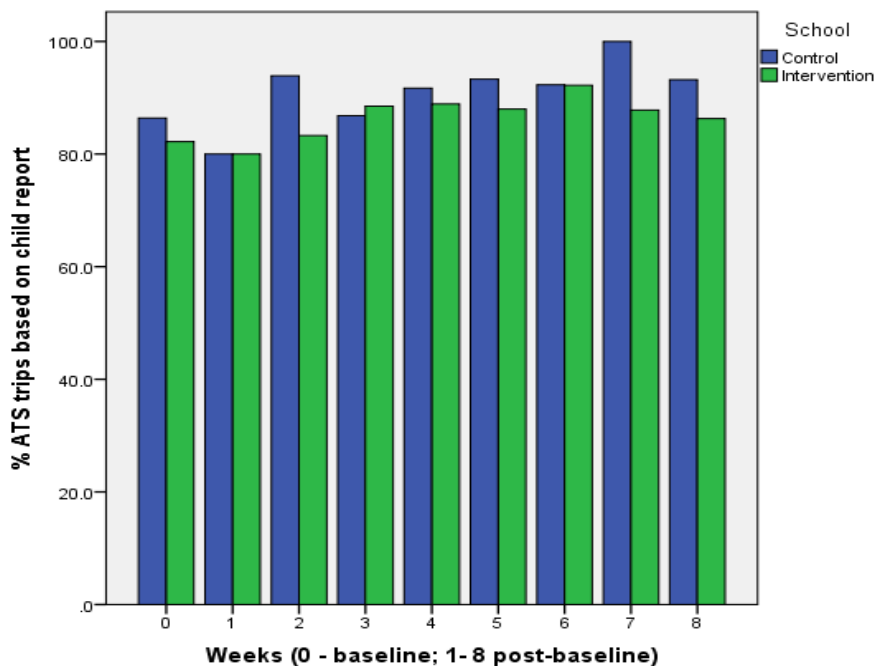


Figure 4.4b. Distribution of active trips to school based on child report

An analysis of ATS rates by distance may provide useful information for a future intervention, namely on the scope for change. Table 4.19 presents the percentage of ATS trips stratified by distance to school, for control, intervention and overall in both schools. It compares baseline week and post-baseline weeks (week 1-8). The distance is based on the postcode provided on the parental questionnaire. The three distance groups were created in SPSS by applying three cut points, i.e. roughly one third lives in each distance group. N corresponds to the number of children from

whom data were available. Percentages take into account missing data, i.e. an ATS rate of 40% in a given week means that 40% of all the trips based on parental report were ATS, irrespective of how many were reported.

	Control school		Intervention school		Overall	
	Baseline week, n=7*	Average week 1-8, n=12	Baseline week, n=10*	Average week 1-8, n=15	Baseline week, n=18	Average week 1-8, n=27
0.1 to 0.3 miles	100% n=2	100% n=5	73.3% n=3	92.1% n=4	70.0% n=6	96.5% N=9
0.4 to 0.6 miles	56.7% n=3	71.5% n=4	78.3% n=3	94.3% n=7	67.5% n=6	86.0% n=11
0.7 to 2.0 miles	40.0% n=2	56.8% n=3	60.0% n=4	65.4% n=4	53.3% n=6	61.7% n=7

Table 4.19 - Total percentage of ATS in the control school, intervention school and overall in both, reported by the parent, stratified by distance to school. *The lower n of baseline participants is due to many parent ATS reports having been returned without YES/NO being circled at baseline, which led to a change in the response format in subsequent weeks, which consisted in ticking a box (see section 4.4.3 for details)

ATS rates were generally higher when participants had to travel shorter distances. One exception was for those living between 0.4-0.6 miles from school in the intervention school, who reported on average a higher ATS rate than those living between 0.1-0.3 miles in the same school. Baseline rates were lower compared to subsequent weeks, except for those living closest to school in the control group who always reported an ATS rate of 100%. However, the average number of participants per distance group is very small, particularly at baseline.

Figure 4.4c presents the percentage of cycling trips to school. As only valid reports of ATS are considered, for each bar the remaining percentage (of 100%) corresponds to trips made on foot.

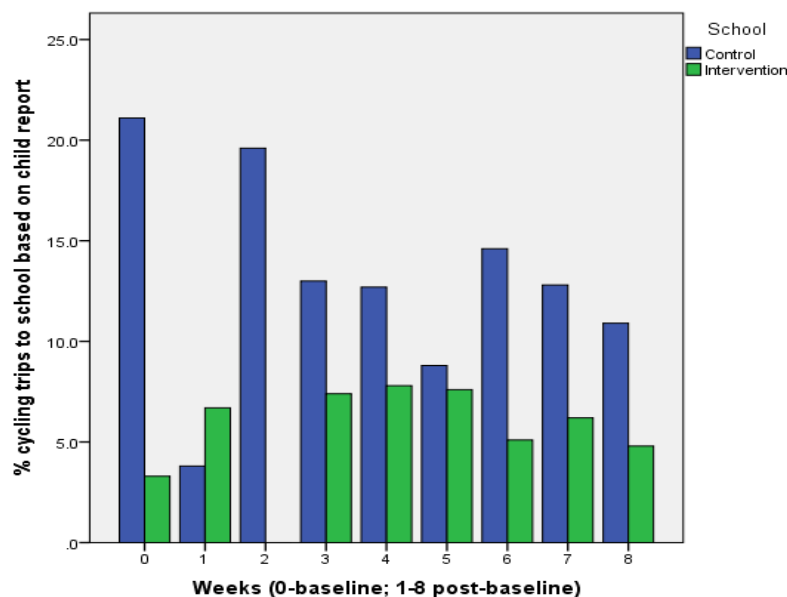


Figure 4.4c - Distribution of cycling trips to school based on child report

Rates of cycling trips to school between control and intervention were markedly different, particularly at baseline (control = 21% vs intervention = 3%) and week 2 (20% vs 0%). While there was a slow decrease over time in the control school from 21 to 11%, levels of cycling trips varied little in the intervention school, between 3 and 7%. Children who had cycled to school were asked to show me their bikes (or scooters, etc.) during breaks, on the day of my visit to the school. Although quite a few trips were reported to be made by bike, most had either not been made on the day of my visit, or if they had, the child explained that the bike was taken back home by the escorting parent straight after arrival at school. Only one child (intervention school) showed me his bike on three occasions, which he was happy to do.

4.3.7 Agreement between parent and child reports

Results of the interrater analysis, including cross tabulation, Chi-squared test and Kappa are presented on the Tables below for the control school (Table 4.20a), the intervention school (Table 4.20b) and overall (Table 4.20c). The number of ATS trips for analysis only includes cases where both parental and child reports were available.

<i>Control school</i>	Child report – ATS trips	Child report – non-ATS trips	Total	Chi-Squared Test Kappa
Parent report – ATS trips	258 (72.5%)	21 (5.9%)	Parent-reported ATS trips=279 (78.4%)	X ² (1)=27.812, n=356, p<0.001 K=0.264, CI 95% 0.138; 0.384, p<0.001
Parent report – non-ATS trips	54 (15.2%)	23 (6.5%)	Parent-reported non- ATS trips=77 (21.7%)	
Total	Child-reported ATS trips=312 (87.7%)	Child-reported non-ATS trips=44 (12.4%)	Total valid trips=356 Missing=209/565 (37.0%)	

Table 4.20a - Agreement between parental and child report in control school

In the control school, the association parent - child report was highly significant, X²(1)=27.812, n=356, p<0.001. However, there was only a fair chance-corrected agreement between both reports, K=0.264, CI 95% 0.138; 0.384, p<0.001. Overall, control parents and children agreed on 79.0% of reports (i.e. 72.5% + 6.5%).

<i>Intervention school</i>	Child report – ATS trips	Child report – non-ATS trips	Total	Chi-Squared Test Kappa
Parent report – ATS trips	480 (82.5%)	17 (2.9%)	Parent-reported ATS trips=497 (85.4%)	X ² (1)=299.041, n=582, p<0.001 K=0.716, CI 95% 0.635; 0.791, p<0.001
Parent report – non-ATS trips	23 (4.0%)	62 (10.7%)	Parent-reported non-ATS trips=85 (14.7%)	
Total	Child-reported ATS trips=503 (86.5%)	Child-reported non-ATS trips=79 (13.6%)	Total valid trips=582 Missing=93/675 (13.8%)	

Table 4.20b - Agreement between parental and child report in intervention school

In the intervention school, the association between parent report and child report was highly significant, X²(1)=299.041, n=582, p<0.001. In addition, there was substantial chance-corrected agreement between both reports, K=0.716, CI 95% 0.635; 0.791, p<0.001. Overall, intervention parents and children agreed on 93.2% of the reports (i.e. 82.5% + 10.7%).

<i>Overall</i>	Child report – ATS trips	Child report – non-ATS trips	Total parent-reported trips	Chi-Squared Test Kappa
Parent report – ATS trips	738 (78.7%)	38 (4.1%)	Parent-reported ATS trips=776 (82.8%)	X ² (1)=266.210, n=938, p<0.001 K=0.526, CI 95% 0.451; 0.596, p<0.001
Parent report – non-ATS trips	77 (8.2%)	85 (9.1%)	Parent-reported non-ATS trips=162 (17.3%)	
Total child-reported trips	Child-reported ATS trips=815 (86.9%)	Child-reported non-ATS trips=123 (13.2%)	Total valid trips=938 Missing=302/1240 (24.4%)	

Table 4.20c - Agreement between parental and child report overall in both schools

Overall, the association between parental report and child report was highly significant, X²(1)=266.210, n=938, p<0.001. There was moderate chance-corrected agreement between parental and child reports, K=0.526, CI 95% 0.451; 0.596, p<0.001. Parents and children agreed on 87.8% of reports (i.e. 78.7% + 9.1%).

4.3.8 Accelerometer wear during the journey to school

To assess the association between travel mode to school and levels of PA (minutes of MVPA), it was necessary to determine first the extent to which the accelerometer was worn during the relevant time segments (Table 4.21).

	Control school	Intervention school	Overall
Duration of the trip to school (min) (i.e. difference between time of arrival at school and time of departure from home)	Min=5 Q1=10 Med=10 Q3=15 Max=40 N trips=96 Missing trips=34	Min=1 Q1=5 Med=10 Q3=13 Max=52 N trips=137 Missing trips=15	Min=1 Q1=6 Med=10 Q3=15 Max=52 N trips=233 Missing trips=49
Time (min) the accelerometer was worn during the times specified by the parent*	Min=4 Q1=10 Med=10 Q3=15 Max=30 N valid recordings=70 Missing=60	Min=3 Q1=5 Med=10 Q3=14.8 Max=50 N valid recordings=112 Missing=40	Min=3 Q1=7 Med=10 Q3=15 Max=50 N valid recordings=182 Missing=100
% time the accelerometer was worn during the times specified by the parent*	Min=60% Q1=100% Med=100% Q3=100% Max=100% N valid recordings=70 Missing=60	Min=6% Q1=100% Med=100% Q3=100% Max=100% N valid recordings=112 Missing=40	Min=6% Q1=100% Med=100% Q3=100% Max=100% N valid recordings=182 Missing=100
Time (min) the accelerometer was worn during the hour preceding the start of classes (7:56am-8:55am)	Min=1 Q1=24 Med=54 Q3=60 Max=60 N valid recordings=97 Missing=33	Min=8 Q1=51 Med=60 Q3=60 Max=60 N valid recordings=125 Missing=27	Min=1 Q1=38.8 Med=60 Q3=60 Max=60 N valid recordings=222 Missing=60
% time the accelerometer was worn during the hour preceding the start of classes (7:56am-8:55am)	Min=2% Q1=40% Med=90% Q3=100% Max=100% N valid recordings=97 Missing=33	Min=13% Q1=85% Med=100% Q3=100% Max=100% N valid recordings=125 Missing=27	Min=2% Q1=64.5% Med=100% Q3=100% Max=100% N valid recordings=222 Missing=60

Table 4.21 - Five Figure summaries of accelerometer wear during parent-specified times and during the hour preceding the start of the classes.

*When the child wore the accelerometer, parents were asked to report the time at which the child had left home, and the time at which they had arrived at school. Times specified by the parent were worked out by subtracting the reported time of arrival at school by the reported time of departure from home. This could not be calculated if one or both times were missing on the parent report.

In the control school, as there were 14 participants at baseline, and later two dropouts (one in week 1 and one in week 2), the number of times that the accelerometer could have been worn was $14 + 12 = 26$ (the two dropouts did not stay long enough for a second accelerometer assessment). Although the accelerometer was to be worn on all seven days of the week, for the purpose of ATS-related analyses only the five school days could be taken into account (there were no bank

holidays throughout the duration of the study). Thus, the total number of school days in which the accelerometer could have been worn in the control school was 130, i.e. $(14 \times 5) + (12 \times 5) = 130$.

Likewise, in the intervention school there were 150 school days on which the accelerometer could have been worn, corresponding to 15 participants and zero dropouts, with each child expected to wear the accelerometer for a total of 10 days. However, due to a session that had to be re-arranged to an earlier day, two participants wore the accelerometer for an extra school day each, i.e. six instead of five. Thus, the maximum number of valid recordings in this school was 152.

For two participants, one in each arm of the trial, baseline assessment took place in the seven days after assessment of the remainder of the group and before randomisation (“second round of baseline”), due to late receipt of the parental consent form. In addition, in the control school, one participant had her equivalent of baseline assessment after randomisation because she had been off school in previous weeks; however, her consent form had been returned prior to the start of the study. Given the non-evaluative nature of this study, these three assessments were analysed together with those of other participants at baseline. Two other participants returned a consent form after the start of the “second round of baseline” and therefore were unable to take part.

Recordings excluded from analysis include cases where the accelerometer failed to be used at all during the relevant times, was worn for less than 1min, the child was absent from school, or parents failed to specify times of departure from home and/or arrival at school which made it impossible to examine MVPA during this specific timeframe (although still possible to assess MVPA between 7:56am-8:55am). For reasons which are unclear, one accelerometer failed to record any data in one of the assessment weeks in the intervention school, and this was also classed as missing data.

On average (median), for all participants, the trip to school lasted 10min, the duration of accelerometer wear during the times specified by the parents was 10min, and the percentage of time that the child had the accelerometer on during these times was 100%. In other words, when children wore the accelerometer in the morning school run, they usually did so during the whole journey. However, for the two variables – accelerometer wear (minutes) and percentage of wear - there was a wider range of

values between minimum and maximum in the intervention school (3 – 50 minutes and 6% - 100%), compared to the control school (4 – 30 minutes and 60% - 100%).

As to the hour preceding the start of the classes, the median value of wear length during this time was 54min amongst control participants, and 60min amongst intervention participants, which corresponds to the belt being worn on average 90% and 100% of the designated time respectively. However, an examination of lower and upper quartiles suggests that the control group had higher data dispersion (IQR 24min – 60min) compared to the intervention group (51min – 60min).

More recordings were available for the period preceding the classes (which did not require written specification of times) than for the period indicated by the parents as corresponding to the trip to school. There were considerably more valid recordings in the intervention school, both for parent-specified times (73.7% vs 53.8%) and during the pre-class hour (83.2% and 74.6%).

On their ATS reports, parents also provided information about any stops made on the way to school, and their respective duration. Although this was thought to help interpret accelerometer data in some specific cases (e.g. drop-offs at grandparents' house), it turned out to be of limited use, and data on stops are presented here mainly for descriptive purposes. Out of 282 possible accelerometer recordings (130 + 152), stops on the way to school were reported in 10 of them (3.5%). These were all from the same school (intervention); five from the same child, three from another one, and two (one each) from two other participants. The median duration of the stops was 22.5min, with interquartile range of 1.8-45.0, and overall range of 0.5-45.0.

A comparison of MVPA between ATS and non-ATS children only included cases where the accelerometer was worn in full during parent-specified journey to school times (usually a short time frame), but included all those where the accelerometer was worn, partially or in full, during the pre-classes hour. Figure 4.5a shows the percentage of children who wore the accelerometer for the full period of time specified on the parent ATS report, in the corresponding percentage of days. Although less important for analysis, Figure 4.5b presents the percentage of children who wore the accelerometer for the full hour preceding the start of the classes (i.e. from 7:56am to 8:55am), for each corresponding percentage of days.

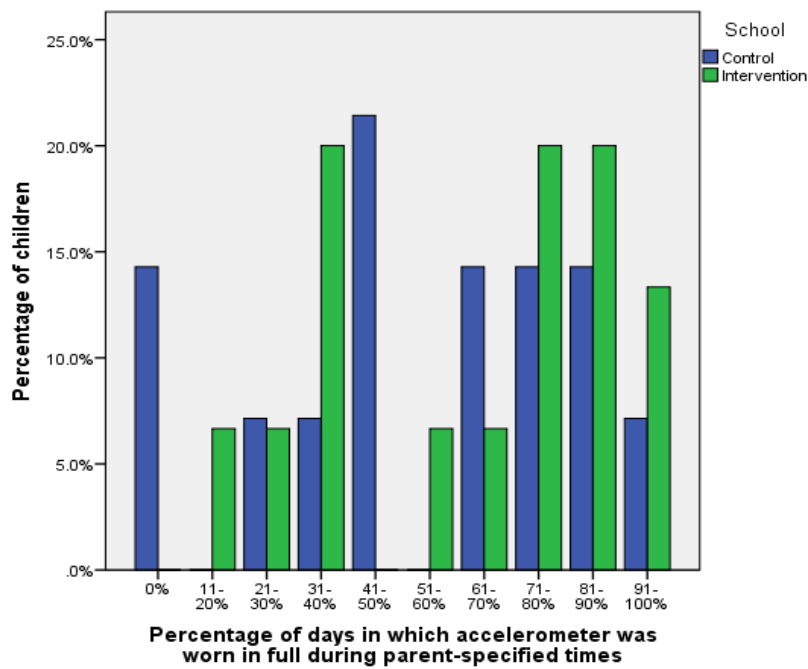


Figure 4.5a - Accelerometer wear in full during the times specified by the parent.

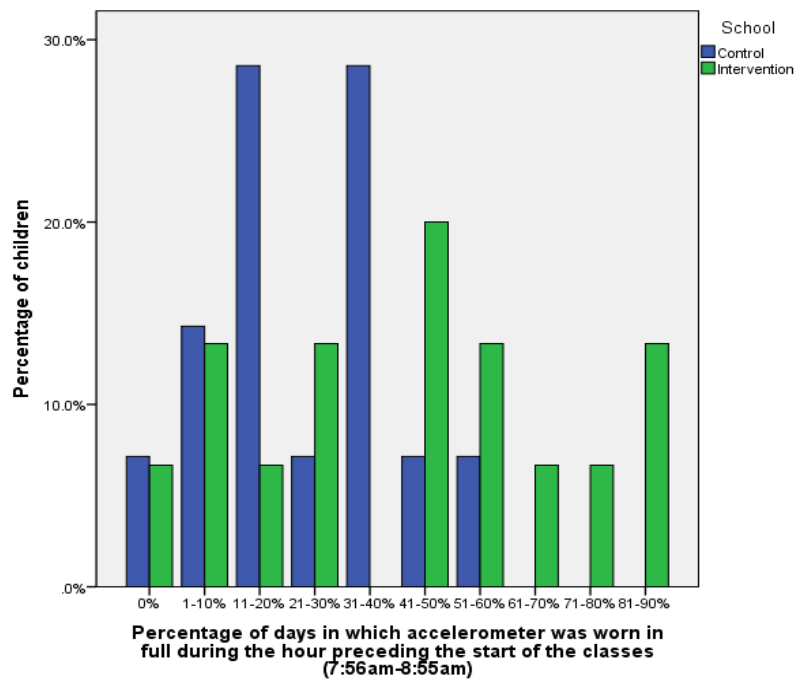


Figure 4.5b - Accelerometer wear in full during the hour preceding the start of the classes

For both time segments, there were clear differences in the rates of full accelerometer wear between schools. Approximately half of the participants in the control group, and two thirds in the intervention, managed to wear the accelerometer during the totality of the period specified by the parent in most of the days (i.e. between 50-100% days). Around 15% of children in the control school, and 60% in the intervention group, managed to wear the accelerometer during the whole hour

preceding the start of the classes on the majority of the days (i.e. between 50-100% days). This resulted in 174 recordings available for MVPA analyses during parent-specified times, and 222 for the pre-classes hour.

4.3.9 MVPA and journey to school

Comparisons of levels of PA (minutes of MVPA) between active and non-active trips were made based both on parental report and on child report (Table 4.22). However, they could not be performed for each school independently due to low numbers of non-ATS trips (see below the number of non-ATS trips available with the respective accelerometer data). The number of trips available to calculate MVPA is much smaller than the number available for inter-rater analysis (parental vs child report), because the former requires the provision of accelerometry data which were available for only 10 school days per child. MVPA analyses based on parental report include 15 trips reported as bike trips to school by child. In line with common practice, these 15 trips were excluded from children report-based analyses due to the difficulty in measuring body movement whilst cycling. However, they were included in parental report-based analyses because parents were not asked to distinguish between walking and cycling; parents could have reported non-ATS on a day reported as ‘bike trip’ by the child, and the child’s report could not be confirmed. Normality tests indicated that MVPA data were not normally distributed (Shapiro-Wilk $p < 0.001$), so the Mann-Whitney U test was used, as well as the mean (SD) of MVPA for all trips to ease comparison with other studies.

	Based on parent ATS report (ATS or non-ATS)	Based on child ATS report (ATS or non-ATS)
MVPA of trips during the times reported by the parent	U=390.5 Z=-2.3 p=0.02 ATS trips (n=99): 2.46 min (2.83) Non-ATS trips (n=13): 0.76 min (0.95) Missing trips=170 (60.3%)	U=596.5 Z=-2.4 p=0.02 ATS trips (n=128): 2.40 min (2.68) Non-ATS trips (n=15): 0.81 min (0.87) Missing trips=139 (49.3%)
MVPA of trips during the hour before the classes (7:56 – 8:55)	U=665.5 Z=-2.3 p=0.02 ATS trips (n=104): 4.99 min (4.11) Non-ATS trips (n=19): 2.55 min (1.69) Missing trips=159 (56.4%)	U=955.0 Z=-2.5 p=0.01 ATS trips (n=146): 4.99 min (3.91) Non-ATS trips (n=20): 2.59 min (1.60) Missing trips=116 (41.1 %)

Table 4.22 – Differences in MVPA between ATS and non-ATS trips

The Mann-Whitney U tests indicated that there was a significant difference in the minutes of MVPA during the times specified by the parent as pertaining to the school journey between parent-reported ATS trips (M=2.46, SD=2.83) and non-ATS trips

(M=0.76, SD=0.95), U=390.5, p<0.05; mean difference=1.70. There was also a significant difference in the minutes of MVPA during 7:56am-8:55am between parent-reported ATS trips (M=4.99, SD=4.11) and non-ATS trips (M=2.55, SD=1.69), U=665.5, p<0.05; mean difference=2.44.

A significant difference was found in the minutes of MVPA during the times specified by the parent as pertaining to the school journey between child-reported ATS trips (M=2.40, SD=2.68) and non-ATS trips (M=0.81, SD=0.87), U=596.5, p<0.05; mean difference=1.60. There was also a significant difference in the minutes of MVPA during 7:56am-8:55am between child-reported ATS trips (M=4.99, SD=3.91) and non-ATS trips (M=2.59, SD=1.60), U=955.0, p<0.05; mean difference=2.40.

A larger number of the above trips with concurrent MVPA data came from the intervention school than from the control school: based on parental report – during the times specified by the parent 70 vs 42 trips, and during the hour pre-classes 78 vs 45; based on child report – during the times specified by the parent 86 vs 57, and during the hour pre-classes, 96 vs 70.

MVPA levels were hypothesised to increase with the duration of ATS trips. A scatter plot was used to depict the relationship between the duration of the trip to school based on parent ATS report and the minutes of MVPA during the parent-reported times of the trip to school (Figure 4.6). The strength of association of this relationship was measured through a Spearman correlation coefficient. Only ATS trips were included in both the scatter plot and the correlation coefficient.

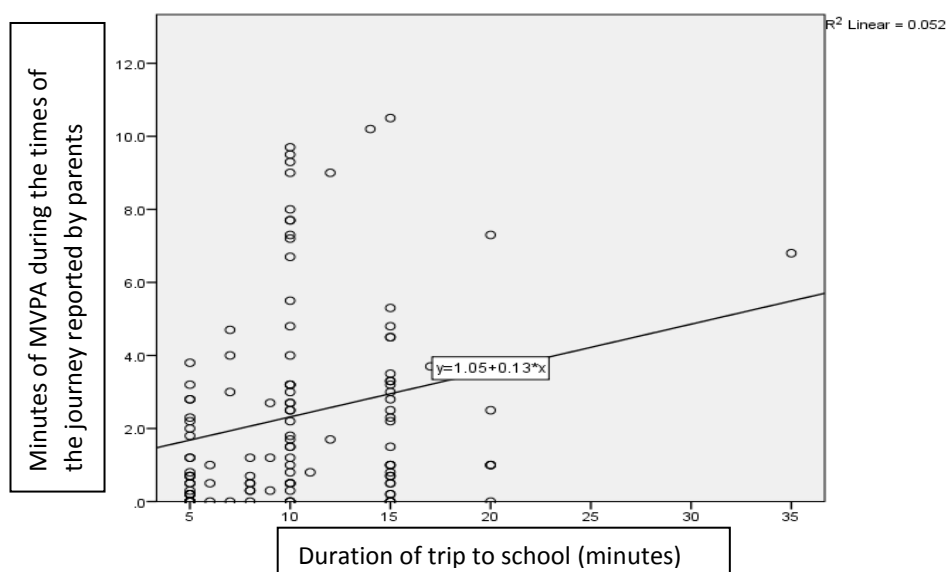


Figure 4.6 - Scatter plot of the relationship between duration of trip to school (x axis) and MVPA during times reported by the parent (y axis)

There was a wide range of MVPA values within some commonly reported trip durations, namely 5, 10 and 15 minutes. Some long trips (e.g. rightmost dot on the scatter plot) had relatively low levels of MVPA because they are likely to include drop offs at relatives', as suggested by some interviews (section 5.3.4.3). The Spearman rho value is 0.27; this is positive but below 0.3, which is indicative of a weak correlation (Cohen, 1988). The R-squared value shows that just 5.2% of the variability in MVPA is explained by trip duration. This suggests that the duration of the trip to school as reported by parents has little impact on MVPA amassed.

4.3.10 Total accelerometer wear and MVPA

Details of accelerometer wear during the whole day (6am-5:59am) are provided in Table 4.23. Total wear was calculated by adding up all the wear spells of 1min or more within the 24h period. The first day, in which the accelerometer was received by participants, and last day, when the accelerometer was returned to me, were excluded due to being incomplete days. (However, the day when the accelerometer was returned was part of AST-related accelerometer analyses described above since children were still expected to have the belt on that morning before school, including during the journey to school). In total, six days (including weekends) were considered for analyses of total wear and MVPA. As for ATS-related analyses, two intervention participants wore the accelerometer for an additional day, i.e. seven in total each.

	Control school	Intervention school	Overall
Overall accelerometer wear	Min=0h1m Q1=1h28m Med=7h44m Q3=11h20m Max=21h14m	Min=0h1m Q1=6h31m Med=10h49m Q3=12h46m Max=20h43m	Min=0h1m Q1=4h26m Med=9h50m Q3=12h26m Max=21h14m
N (%) children who met minimum wear required (6h/day on at least 3 days)	1st accelerometer week (baseline): N=11/14 (78.6%), 2nd accelerometer week: N=9/12 (75.0%), Overall both weeks: N=20/26 (76.9%),	1st accelerometer week (baseline): N=14/15 (93.3%), 2nd accelerometer week: N=13/15 (86.7%), Overall both weeks: N=27/30 (90.0%),	1st accelerometer week (baseline): N=25/29 (86.2%), 2nd accelerometer week: N=22/27 (81.5%), Overall both weeks: N=47/56 (83.9%),

Table 4.23 - Total accelerometer wear

The average (median) accelerometer wear time was 7h44min in the control group, and 10h49min in the intervention group. Most children in the control (73.1%) and

intervention schools (90.0%) managed to meet the minimum wear time required - 6h or more on at least three days - in both monitoring weeks. Children who accumulated less than 6h of wear each day, or 6h+ on only one or two days were excluded from the total MVPA analyses reported below. Overall, in both assessments, 47 children achieved sufficient wear.

Details of total MVPA, including weekdays and weekends, are provided in Table 4.24. Total MVPA corresponds to the sum of all spells of MVPA on all wear periods (1min+) throughout the day, amongst those who met the minimum wear time required.

Average time spent in MVPA was 34.4min for control participants, and 37.2min for intervention participants. Overall, out of all the recordings with enough wear time, 3 participants in the control group (15%), and 3 in the intervention group (11.1%), met PA guidelines (60min of MVPA/day).

	Control school	Intervention school	Overall
Minutes of MVPA	Min=2.0 Q1=23.4 Med=34.4 Q3=49.9 Max=101.2	Min=4.5 Q1=24.5 Med=37.2 Q3=55.5 Max=137.2	Min=2 Q1=23.5 Med=36.3 Q3=52.8 Max=137.2
N (%) who met PA guidelines (60min MVPA a day)	1st accelerometer week (baseline): N=2 (18.2%), (N participants with valid wear=11) 2nd accelerometer week: 1 (11.1%), (N participants with valid wear=9) Overall both weeks: 3 (15%), (N participants with valid wear=20)	1st accelerometer week (baseline): N=2 (14.3%), (N participants with valid wear=14) 2nd accelerometer week: N=1 (7.7%), (N participants with valid wear=13) Overall both weeks: N=3 (11.1%), (N participants with valid wear=27)	1st accelerometer week (baseline): N=4 (16.0%), (N participants with valid wear=25) 2nd accelerometer week: N=2 (9.1%), (N participants with valid wear=22) Overall both weeks: N=6 (12.8%), (N participants with valid wear=47)

Table 4.24 - Total MVPA throughout the day

4.4 Discussion

The aim of this pilot cluster randomised trial was to test the feasibility of a lottery-based incentive scheme to promote ATS. More specific objectives included:

informing sample size calculations for the future trial; assessing the integrity and fidelity of delivery of the study protocol; testing study materials and procedures; estimating recruitment, consent, adherence and retention rates for schools and child participants; assessing acceptability of the intervention from the perspectives of parents, children, school staff and other stakeholders; and selection of an appropriate outcome measure.

Questionnaire data were mainly intended to characterise my sample and to help explain any differences between groups. Although the questionnaire data provided a good characterisation of my sample, the extent to which it explained inter-school differences is less clear as will be discussed in the next sections.

Overall, most objectives were met and data suggested the feasibility and acceptability of the procedures and materials used. However, two dimensions in particular require improvement: recruitment strategies and the selection of an appropriate outcome measure.

Aspects of feasibility investigated in this pilot trial overlap considerably with those explored in the interviews (Chapter 5) (e.g. rates of materials returned, and views expressed about materials used). Discussing each set of findings in relation to previous literature would result in repetition across chapters. For that reason, many links with other studies and with theory, as well as intersections between quantitative and qualitative data, are drawn together in a final discussion in Chapter 6. In the present chapter, the discussion focuses primarily on data from the pilot trial.

4.4.1 Recruitment, retention and adherence

School recruitment was very low (3.3%). In the first two weeks of recruitment, the poor response could have been attributable in part to my email being missed or ignored in busy mail boxes, as it became evident on the phone that it had been overlooked by many head teachers. However, because the vast majority of schools were contacted by phone (those who had not already replied), it cannot be said that schools were unaware of my study, although this may be true of some head teachers since calls were almost always taken, and replies given, by the school office. It is also unlikely that increasing the wait time for email replies would have made a difference, as the few schools who replied usually did so in the first days after the invitation had been sent. Another possible reason was the fact that this was a

student-led project, although this reason was not explored with those who rejected my invitation to take part. It is safe to say that a different school recruitment strategy would be necessary for a full-scale trial.

Selecting the two participating schools was a difficult decision. The stakeholder who advised going for the two selected schools did not specify his reasons, so the study could have been less deliverable in other contexts. An almost perfect match in terms of percentage of free meals and of children for whom English was not the first language was possible. However, the study required reasonable scope for change in respect of school travel mode. Even within the selected schools, most children were reported to actively travel to school already, but in the non-selected schools ATS levels were either explicitly noted as being higher or were not regarded as problematic by the head teacher. Thus, my selection of schools may have had larger scope for change, i.e. a larger number of parents who drove their children to school.

Compared to the non-selected schools (n=121), the two selected schools had a larger size, were more likely to be in North Tyneside and to be foundation schools. Within the two selected schools, the ratio of the percentage of free meals between control and intervention schools was 3:1, and consistently, the questionnaire indicated that intervention parents held higher qualifications and were more likely to have a car available to drive their child to/from school. However, levels of ATS at baseline were reasonably similar in both groups, whether based on parental or on child report, which suggests that sociodemographic differences may have been of little importance for ATS.

The recruitment of individual participants, children and parents, was 33.0%. Although the slight difference in recruitment rate between schools could be due to chance, it is also possible that the SMS reminders issued by the intervention school could have had a positive effect. Reflecting the demographic characteristics of the area, 93.1% of participants were White British. It is uncertain how much the findings of this study can be generalised to contexts where other ethnic groups predominate.

Two indicators of adherence are the session attendance and return of materials. Attendance at sessions was excellent (always above 90%), even amongst those in the control school who had them during the morning break and could leave the room if they wanted, and who did not have the excitement of the draw. Session attendance also speaks to how much of the intervention participants received. After the

presentation, only two pupil absences were logged in the intervention school, one in week 3 and one in week 7. By the third week, everybody was already thoroughly familiar with the procedures, so it is improbable that an absence impacted on participation in the study. (It could have been different if, for example, the study included an educational component). The return of materials varied according to the material in question. In line with common practice, a return rate of 70% was considered acceptable. In this study, this target was achieved for all the materials. However, when looking at schools separately, only 54.3% of parent paper ATS reports were returned in the control school. This suggests that parental reporting methods may need to be optimised in a future large-scale trial (see Chapter 6 for more details on this topic and recommendations).

4.4.2 Sample size calculation

One of the objectives of this study was to estimate parameters for a sample size calculation, with a future definitive cluster randomised trial in mind. Because an objective measure is likely to provide clearer answers than self-report, the primary outcome measure here considered are the minutes of MVPA during the pre-school period (7:56am-8:55am) assessed by accelerometer, compared between intervention and control groups. The unit of randomisation is the school (cluster) which would be randomised on a 1:1 basis between intervention and control.

The sample size calculation (Table 4.25) is based on the formula for a two sample t-test at the individual level which is adjusted for a design effect (DE) to take account of clusters (Campbell and Walters, 2014). The intra cluster correlation coefficient (ICC) is assumed to be 0.372 which was the maximum ICC value reported in two AST studies conducted in schools (Mendoza *et al.*, 2010; Christiansen *et al.*, 2014b). My pilot study suggested an achieved cluster size of 15, but both schools had two Year 5 classrooms. Considering that most schools will only have one Year 5 classroom, three cluster sizes will be assumed here: 7, 10 and 15.

The standard deviation (SD) of the mean MVPA minutes per child during the pre-classes hour at baseline is 3.26 and will be used, as this is greater than the standard deviation observed at the post-randomisation phase (SD=2.75). This allows for the worst case scenario in the sample size calculation.

As to a minimum relevant clinical difference, sample size calculations targeting objectively-measured MVPA in AST studies could not be found in the literature. For the present purpose, a minimum clinically relevant difference of 5 minutes of MVPA between control and intervention groups during the hour before classes has been chosen. This decision is based on two assumptions. First, guidelines for adults recommend that PA should be performed in bouts of at least 10min (WHO, 2015) but this does not apply to children, to whom “anything counts”. Thus, in the absence of a more specific suggestion, perhaps it is reasonable to apply this rule to children as well. Ten minutes is also the average duration of the trip to school observed in my study (section 4.3.8), so a 10min target would roughly correspond to an extra active trip to school per week. The second assumption is that 10min spent walking would lead to least 5min of MVPA (Southward *et al.*, 2012).

A power of 80% and a type I error probability of 5% is assumed (Campbell and Walters, 2014). This study had a 7% drop out rate therefore a 10% dropout rate within each cluster was used to allow for the possibility of a higher dropout rate in a larger study and ignoring the possibility of a cluster dropping out.

Minimum clinically relevant difference	Standard deviation	Power	Cluster size	Design effect	N per arm inflated for design effect	N of clusters per arm	N per arm to fill clusters	Total sample size (0% dropout out)	Total sample size – adjusted for 10% dropout within each cluster
5	3.26	80%	15	6.208	42	5	75	150	170
5	3.26	80%	10	4.348	30	5	50	100	120
5	3.26	80%	7	3.232	22	5	35	70	80

Table 4.25 - Sample size calculation for an evaluation trial

Thus, for example, assuming a cluster size of 10 and allowing a 10% dropout, 12 children would need to be recruited per cluster, i.e. $12 \times 5 \times 2 = 120$. Based on my pilot study’s school recruitment rate (3.3%), 308 schools would need to be approached so that ten could be recruited to take part in an evaluation trial.

It is important to note that the above calculation is simply a guide. If used for a grant application, ICC, cluster size and SD variations should be considered in order to investigate the effect on sample size. In addition, the analysis would employ a random effects model with a random intercept for each cluster adjusting for baseline

measures, known confounders/explanatory variables and stratification factors (e.g. pupils' cultural and socioeconomic background, distance home-school).

4.4.3 Testing materials and procedures

Difficulties associated with the materials and procedures used in this pilot were to be identified, as well as its acceptability by those concerned. This topic will be discussed in more detail in Chapter 5, as interviewees were often asked to comment on specific documents or procedures. However, some aspects can be appropriately covered here based on quantitative findings of the pilot study.

One such aspect was the reply format on parent and child reports; 35.9% of trips from parental ATS report forms (all in paper) were missing at baseline compared to 20.6% in the remaining weeks. A likely reason for this discrepancy is the reply format at baseline; parents were required to circle yes or no as appropriate (from "YES/NO") but forms were returned blank in many cases. Also at baseline, a parent ATS report was returned to me with five ambiguous answers and was excluded from the analyses. This form was from the participant with a Chinese background, which may suggest the need for clearer instructions especially for non-native English speakers.

Asking children to take the form back home to be amended was impracticable and could lead to recall bias. Instead, after the first week, the yes / no format was replaced by 'yes' and 'no' followed by a box each, which parents were instructed to tick as appropriate. This seemed to have made a difference as missing responses were rarer thereafter. Response format was not problematic for children who completed their form under my verbal guidance, but for consistency with parental reports, the "tick the box" format was also adopted after baseline.

Written notes on ATS reports were infrequent. However, one parental ATS form where two 2min stops were reported had a written note "got dropped off a little away from school" in front of each of the two questions; it is unclear whether the child made a 2min stop whilst in the car, or it took the parent 2min to park and for the child get out of the car and walk to school, or the partway walk was 2min long (this parent reported ATS on each of these two days). Thus, it is possible that some parents were unsure about what times to report when requested, particularly related to partway active trips.

SMS replies (“Yes” or “No”) were almost always sent to me on the respective day, never included any additions, and yielded higher and timelier rates of response than paper forms. They were usually sent to me shortly after I had issued the SMS question. This may indicate a more contemporaneous and accurate recall of information than with paper forms which parents are less likely to carry with them at all times and fill in immediately after dropping their child at school.

The tardiness with which materials were returned was not a major problem per se in this study because the sample size was small and easy to manage. The number of accelerometers available to me was sufficient to proceed with assessments even if a few were only returned to me with much delay. Late paper forms were either handed to me on my next visit to school, or dropped at reception if brought to school on a different weekday. The main issue with belated parental forms was that tickets entering the draw had to be based on child report. In this study, this never became habitual with any specific child, possibly because each time it happened I stressed that the parental ATS form would need to be returned on the next draw.

Encouragingly, all accelerometers were returned to me, undamaged. It is unclear why one of the accelerometers failed to record on one of the weeks, but it is conceivable that the battery had not charged properly, as it functioned well when I tried it later. Although 78.7% of recordings during the pre-classes hour were valid, only 64.5% were so in respect of the times specified by the parent as corresponding to the journey to school, a value which lies below the 70% target. This can be explained by the fact that the latter required parental input, whereas the former could be calculated in the absence of the parental report. Even when the parental ATS report was available, the accelerometer could have been worn on a different time frame, making wear during parent-specified periods impossible to work out. Thus, a satisfactory number of recordings may be achievable during set periods but less so on participant-reported time frames.

Thank you vouchers did not seem to have caused significant trouble. This may have been due to the change made to the protocol which allowed participants to be rewarded as long as they provided me with the relevant materials, irrespective of the delay. Similarly, the intervention scheme run smoothly and required few adjustments. This is also likely to be in part thanks to the protocol amendment according to which those who failed to return the parental ATS report could still enter the draw based on

the child reports. No complaints about the study were ever made to me by parents, nor to the school so far as I am aware.

4.4.4 Integrity of the procedures

Altogether the procedures of the study seemed to have worked well, which speaks to the integrity of the protocol. Presentation, recruitment, randomisation, weekly collection of reports and accelerometers, intervention and issuing of rewards, were delivered without major obstacles. This allowed progress from one level of the study to the next (e.g. from recruitment to baseline assessment) and running activities which depended on other tasks (e.g. draws and return of parent ATS reports).

However, in most respects, the intervention school appears to have “done better” than the control school. These included: participant recruitment (37.5% vs 29.2%); retention (100% vs 85.7%); session attendance (97.3% vs 91.2%); timely return of parent ATS reports on the first accelerometer week (100% vs 71.4%) and on the second (73.3% vs 41.7%); timely return of accelerometer on the first assessment (100% vs 78.6%) and on the second (80.0% vs 66.7%); return of parent ATS report form (at all) at baseline (100% vs 78.6%) and after (88.7% vs 54.3%); return of child report after baseline (99.2% vs 95.9%); weeks on which at least 1 SMS was replied to (100% vs 96.2%); agreement between parent and child reports (substantial vs fair); number of valid accelerometer recordings during parent-specified times (73.7% vs 53.8%) and during the pre-classes hour (82.2% vs 74.6%); median time of accelerometer wear during the pre-classes hour (60 vs 54); accelerometer wear in full during both time frames; median overall accelerometer wear (10h49 vs 7h44) and percentage of children who met wear time requirements (90.0% vs 73.1%); and average minutes of total MVPA (37.2 vs 34.4). On very few aspects did the control group equate or surpass the intervention group (e.g. rate of participants who met PA guidelines, CG 15.0% vs IG 11.1%), and when it happened, the difference was usually very small. Sample sizes were small and the observed differences between the two schools could be due simply to chance.

However, at least three other explanations might account for the observed differences. The first has to do with the background of participants. When compared to the control school, the intervention school had lower pupil eligibility for free meals (10.6% vs 30.8%), parents reported greater availability of a car to drive the child to

(80.0% vs 69.2%) and from school (80.0% vs 61.5%), and were more likely to hold a degree or higher degree (40.0% vs 15.4%) or A Levels or equivalent (66.7% vs 23.1%). Overall this suggests a higher socioeconomic status (SES) amongst intervention parents, although schools were in areas of very similar IMD scores (CG 27.72 and IG 28.07). However, it is unclear how SES could favour parents' engagement with ATS research. A large body of data (mainly from outside the UK) suggest an negative association between SES and AST (table 2.2) and a UK study (n=2035, age 9-10) has found no association at all (Owen *et al.*, 2012). In my study, intervention pupils were also more likely to come from households with two parents/carers (66.7% vs 46.2%), suggesting potentially higher availability to fill in forms and support the child's participation in other ways (e.g. accelerometer wear, encouragement to carry on with the study).

A second possibility is that intervention participants were more enthusiastic about the study than their counterparts because they had been assigned to the intervention condition and this was an unblinded study, with those in the intervention group having the potential to receive additional rewards. This explanation, however, does not explain differences before and at baseline, since neither school had been randomised at that point, but it could have played a role in post-baseline weeks.

A third potential reason for the differences observed between intervention and control schools is the richer involvement of the former school in the trial processes. This school reminded individual parents to return materials to school on at least three occasions (compared to one occasion in the control school) and had at least one member of staff attending all of my study sessions (while this happened only once in the control school). Most of the times it was the same person, one of the Year 5 teachers. She used to collect the parental ATS forms prior to my arrival, send them to the office together with the register, and she then accompanied participants to the designated room. During the sessions, she helped me distribute and collect forms, would often reinforce any message I had for participants, pulled the ticket out of the bag, cheered the winner and encouraged non-winners to keep trying. Since she was more involved than teachers in the control school in delivery of the intervention, it is also likely that she prompted participants to return materials throughout the week more often, and reminded them of the joys of receiving a voucher. However, the frequency and intensity of these prompts is hard to quantify for me because I was not present. The teacher's involvement may have helped create an environment which

led more participants to comply with the procedures, for example through showing approval to those who did well and by giving unwanted attention to those who had failed to follow procedures. This may have boosted adherence from the start, and once most people had managed to comply with the requirements, those being assessed could have felt more compelled to meet the standards achieved in previous weeks. In the control group, forgetting materials was more frequent and therefore less likely to cause embarrassment to anyone. Nevertheless, it remains unclear how the teacher could have influenced parents in the study (e.g. return of parental forms, agreement between parent and child reports). There is the possibility of an indirect effect whereby children, if indeed they were more motivated thanks to the teacher, could have passed that motivation on to the parents, for example by asking them to complete their forms or SMSs more frequently or vehemently. Alternatively, children's 'pester power', due to the knowledge that their parents' actions could have implications for their chance of winning a reward, may have been greater in the intervention school, and this may have enhanced parental reporting.

Length of time is also a factor to consider in assessing the integrity of this study. Procedures and materials were relatively easy to administer during a single school term, but the enthusiasm may decrease over longer periods. This is suggested by a drop in the percentage of materials returned on time, in both schools, from first to second accelerometer assessment: accelerometers, from 89.7% to 74.1%; parental paper ATS reports, from 86.2% to 59.3%. The levels of any form of parental ATS reports returned also decreased in both schools from 89.7% at baseline to 75.2% in post-baseline weeks. Completion of the child ATS report remained always at 100% because it took place in my presence, and anyone who happened to be absent upon my visit was happy to complete the form when back to school (if he/she had been at school at all on that respective week). Thus, if the duration of the study is to be extended in a future trial, either the need for parental involvement and accelerometry should be minimised, or new motivational strategies would need to be put in place.

4.4.5 Fidelity of the procedures

The fidelity of the procedures is the extent to which they were delivered as intended. Further to arrangements made with head teachers, 11 sessions were scheduled for each school including initial presentation, one baseline session, one session at the

end of baseline, and eight post-randomisation sessions. All 11 sessions were delivered in each school. However in the intervention group one had to be re-scheduled due to a school trip which the teacher had informed me about with enough notice; instead of Tuesday, the session happened on Monday that week. This change in schedule resulted in a slight alteration to the parental ATS reports, and accelerometer assessment of two participants, only in the intervention group. That week, instead of five days (Wed, Thu, Fri, Mon and Tue), the parent ATS report included six school days (Tue, Wed, Thu, Fri, Mon and Tue); likewise, the two accelerometer users started wearing the accelerometer on the Monday of my visit until my next visit on Tuesday on the following week (data recorded on the day of receipt of the accelerometer was always disregarded for analysis, so these two particular children provided accelerometer data for Tue, Wed, Thu, Fri, Mon and Tue). Similarly, the parental ATS report on the previous week only comprised questions about four days, including three before half-term holidays (Wed, Thu and Fri) and one about the day immediately after the break (i.e. the Monday when the form was collected). As planned from the start, no accelerometer assessments were undertaken over the five school-day period before and after half-term.

Generally, the delivery of materials and procedures associated with the trial or intervention were consistent with the initial plan, and the possibility of changes being made to accommodate local preferences was pre-specified in the protocol (see section 3.2.11.3 for details about protocol amendments).

In addition to protocol amendments, a minor change was made to the response format of paper reports (see previous section), and the recruitment phase was extended by one week due to low response both at the school and individual level. Finally, consent forms were meant to be returned by the parent, by post or in person via the school office; however, although school staff was aware of this, the possibility that some forms were returned by the child cannot be ruled out.

4.4.6 Selection of an outcome measure

Based on parental report, the percentage of active trips at baseline was slightly higher in the intervention school (69.6%) than in the control school (58.6%) (Figure 4.4a). This is above the national rate of 48% (section 1.4.2) but may be explained by the fact that my participants lived nearer to school (0.5 miles) than the national

average (1.6 miles). However, as discussed in section 4.4.3, the number reports available at baseline was lower than thereafter and therefore the reported baseline rates may be at greater risk of bias.

On the baseline questionnaire (Table 4.13), parents had reported higher rates of ATS (intervention 80.0%; control 66.7%), but the comparison requires caution because parents could report various travel modes on the questionnaire. Besides, in the ATS reports, multi-mode trips could be counted as active trips which is less likely to have been the case on the questionnaire. Based on the parental ATS reports, in post-baseline weeks, ATS rates rose in both schools but dropped in the last weeks in the control school (76.5% to 58.6%) and remained high in the intervention school until the last week (82.1%). This difference could be due to chance but could also have resulted from the intervention.

Child reports suggest higher ATS rates than parental reports but this discrepancy is much greater in the control school (14.8% difference) than in the intervention school (4.1% difference). Data from child report also suggest a progressive increase from baseline to the last week, and higher ATS in the control school. However, the conclusion that ATS rates were higher in the control school requires caution, considering the poor inter-rater agreement found in that school.

There were 938 (24.4% missing) instances where both parent and child report were available, of which 356 were in respect of children in the control group (37.0% missing) and 582 related to the intervention group (13.8% missing). Chi-squared tests showed that the association between parent and child reports was highly significant in both schools ($p < 0.001$); crude rates of agreement were 79.0% in the control school, 93.2% in the intervention school, and 87.8% overall. However, inter-rater analysis (kappa scores) indicated that chance-corrected agreement was only fair in the control school, substantial in the intervention school, and moderate overall. Kappa scores are thought to be a more robust measure of agreement because they take into account agreement occurring by chance (Cohen, 1968). For research purposes, there seems to be general agreement that the kappa should be at least 0.60 or 0.70 (Wood, 2007). Together with a statistically significant confidence interval, this means that parent-child agreement was probably adequate in the intervention school, but not in the control school or overall.

Children whose parent was a paper-respondent was not “blind” to their parent’s replies, as children themselves returned the parental ATS forms. It is unknown how this affected, if at all, the agreement between parent and child.

Parents reported fewer active trips, but even assuming these numbers to be more realistic, the accuracy of their reports is still uncertain (i.e. a parent could have reported two ATS trips on a given week but not necessarily on the right days). This is particularly applicable to the paper reports which could have been completed retrospectively and been subject to recall bias, but less so to SMS replies which were almost invariably sent to me shortly after parents had received the question.

Unfortunately a MVPA comparison between ATS and non-ATS trips, broken down by parental report mode (paper or SMS), is not possible because only the paper version was used in accelerometer weeks, from which MVPA data were obtained.

When data are stratified by distance (Table 4.19), the increase in ATS rates from baseline to post-baseline remain, except for those living between 0.1-0.3 miles from school in the control group, for whom it is always 100%. This alerts to the risk of ceiling effects in AST research. Consistent with the literature (Davison *et al.*, 2008), ATS rates were generally lower at greater distances.

The question used to assess ATS “Today (day), did your child walk or cycle to school all or part of the journey? Please reply YES or NO” (in the case of children “did you...”) may also be problematic. Through classical conditioning, initially neutral verbal stimuli acquire an emotional connotation due their pairing with positive or negative events in our lifetime (section 2.3.2.2); thus, the word yes comes to evoke a more positive emotional reaction than no. It is possible that asking about car travel to school, using the same yes/no format, could have led to more yes responses (i.e. car trips). Alternatively, we could have asked parents how their child travelled to school and give them a range of travel modes to choose from. Although this would only have necessitated minor modification on the paper form, it could have made SMS questions and replies more complex and time-consuming for parents, especially in the case of partway active trips. A yes/no question type was in line with the advice by schools to simplify materials as much as possible, and was intended to make MVPA-related analyses more straightforward. Similarly, the logo chosen in this study could have constituted another source of bias by only portraying active travel modes and underrepresenting car users. It may be that these issues – emotional reaction to yes and to no, and an eco-friendly logo - are more influential for children than for parents,

whose lifetime could have already changed them to be more honest with researchers (e.g. by reporting car trips when they happened).

Reports of cycling trips in the control school markedly outnumbered those in the intervention group. These could rarely be verified, either because the reported trips happened when I was not at school or because parents had taken the bike back home (according to the child). However, it may be a fact that control participants do actually cycle more to school than their counterparts. A two mile-long cycle path crosses that part of the town and passes right outside the control school gate, whereas no cycle routes exist in the vicinity of the intervention school. Both schools had comparable bike parking infrastructure. However, at the time this study was carried out, the control school had greater involvement with Sustrans than the intervention school whose affiliation was stronger with Living Streets; this may be another explanation since Sustrans runs cycling and walking initiatives, whereas Living Streets has an exclusive focus on walking.

In terms of criterion-related validity, significant differences in minutes of MVPA were found between ATS and non-ATS trips during the times specified by the parents (based on parental report: $U=390.5$, $p<0.05$, 2.46 min vs 0.76 min; based on child report: $U=596.5$, $p<0.05$, 2.40min vs 0.81 min). Likewise, there were significant differences in the minutes of MVPA between ATS and non-ATS trips during the hour before the classes (based on parental report: $U=665.5$, $p<0.05$, 4.99 min vs 2.55 min); based on child report: $U=955.0$, $p<0.05$, 4.99 min vs 2.59 min). Values derived from parents and children are very similar and suggest that reports from both sources were generally valid. The fact that the inter-rater agreement was poorer in the control school probably had little effect on MVPA analyses because the majority of data used for MVPA analyses was provided by participants from the intervention school (see end of section 4.3.9).

The above differences in minutes of MVPA between ATS and non-ATS trips may look trivial compared to what is usually reported. In two systematic reviews, objectively-measured differences in daily MVPA between ATS and non-ATS children were 20 minutes (Faulkner *et al.*, 2009) and 17 minutes (Martin *et al.*, 2016), including trip to and from school, and adjusting analyses for confounders. If we only consider the journey to school (as in the current study) this would correspond roughly to 10 minutes and 8.5 minutes. However, the differences in MVPA reported in the

above reviews were found based on comparisons between total daily MVPA of ATS and non-ATS children.

In another, UK-based study (n=4688, age 11), the MVPA difference between children who walked and children who were driven to school was 2.90 minutes for trips within 0.5 mile (CI 95% 0.52; 5.28; n=1082), 4.75 minutes for trips between 0.5-1 miles (CI 95% 2.79; 6.71; n=1050) and 7.79 minutes for trips between 1-5 miles (CI 95% 5.70; 9.89; n=1568) (Van Sluijs *et al.*, 2009). Again, this difference was found comparing the total minutes of MVPA in weekdays between active and non-active travellers; it was not based on a shorter, self-reported timeframe corresponding to the school trip or hour before lessons.

The number of minutes of MVPA associated with times reported by the parent as corresponding to the journey to school, based on parent and child report – 2.46 minutes and 2.40 minutes respectively – may be explained by the use of a short, reported timeframe. This may seem a small amount of MVPA considering the average duration of the trip to school reported by parents (10 minutes), the average distance home-school of 0.5 miles, and the fact that children always wore the accelerometer belt during the whole period reported by the parent as pertaining to the trip to school. On the surface, it may suggest walking below the level of moderate intensity. However, the ratio of ‘walking time’ to MVPA observed here - 10 minutes to 2.46 minutes - may be consistent with other research. Few studies look at MVPA during parent-reported times of the journey, so I will illustrate this point with an example which focuses exclusively on the period of the journey to school using an objective measure.

In a UK study (n=141, age 11-12) which combined accelerometry and GPS, where the average duration of the trip to school was 20.3 minutes, children who walked to school accumulated on average 10.5 of MVPA during the journey to school; this could suggest that approximately half of the journey was spent on MVPA, which was also true for the afternoon trip (Southward *et al.*, 2012). By the same token, I would expect to obtain 5 minutes of MVPA in ATS trips because the average trip duration in my study was 10 minutes. However, my study relied on parent-reported times of the journey to school, not on GPS technology as in Southward *et al.*'s. Parents could have misreported the times of the journey to school and this could explain the relatively small difference in MVPA between ATS and non-ATS trips.

Southward et al also found that children who walked to school accumulated on average 14.5 minutes of MVPA in the hour before classes (8am-9am) (Southward *et al.*, 2012), whereas in my study the amount of MVPA of ATS trips was 4.99 minutes (based on both parental and child reports) in the hour before the class. In part, this is explained by the trip duration being on average 10 minute long in my study, whereas it was 20.3 minutes long in Southward et al's study. Another possible explanation for the smaller 'ATS vs non-ATS' differences in MVPA could be the partway active trips. They were an important element of my study, particularly in the intervention school where 'drop off and walk' trips were encouraged and allowed entry into the draw. Thus, the variability of MVPA values associated with a trip duration, e.g. 10 minutes, could be due to cases where children walked all of the way as well as to cases where children were driven and then dropped off before arriving at school. In both situations, parents could have reported the same trip start and end times, but the levels of MVPA could have been quite different. This could explain the wide range of MVPA values associated with some commonly reported trip durations in my study such as 5 minutes, 10 minutes and 15 minutes (see Figure 4.6), and the weak correlation between trip duration and MVPA levels (Spearman rho 0.27). Unfortunately, the YES/NO format of the question used to measure ATS in this study does not allow a breakdown of uni-mode and multi-mode trips. To the best of my knowledge, the issue of partway trips affecting the analysis of MVPA associated to ATS has not yet been investigated.

Another possible interpretation is that non-ATS children could also have been more likely to arrive earlier at school, and therefore have more time for energetic play before the start of the classes than ATS children, however this was not the case in my study. The median (IQR) times of arrival at school were similar for ATS and non-ATS trips, 8:50h (8:46h – 8:55h) and 8:50h (8:50h-8:52h) respectively.

In sum, it seems that the difficulties of validating ATS reports vis-à-vis accelerometry stem mainly from the use of ATS timeframes reported by the parents and from mixing uni-mode with multi-mode active trips, and to a lesser extent from the use of fixed timeframes (e.g. hour before the classes).

Two additional issues emerged during my data analysis. These issues were not pre-specified in the protocol but will be briefly addressed here due to their potential relevance for future report validation work. Overall, there were 41 parent ATS report

forms returned on accelerometer weeks (see Table 4.16); only on these did parents report times of departure from home and of arrival at school. I noticed that 17 forms (41.5%) had exactly the same departure/arrival times (e.g. 8:40 and 8:50) on each of the five days on the form. Though it is possible that children could leave home and arrive at school at roughly the same time every day, it seems implausible that this would always happen at exactly the same minute, as traffic and other circumstances impacting on journey time would likely vary from day to day. It occurred to me that parental reports with varied times, e.g. 8:40-8:50 one day, 8:42-8:53 on another day etc., could reflect greater accuracy than those where times never changed. When I looked at the differences in MVPA between ATS and non-ATS trips based on parental report, using exclusively those reports where at least one of the five days had a different departure/arrival time, the mean difference between ATS and non-ATS trips increased considerably.

The second issue is that parent-reported non-ATS trips (i.e. car trips) were less likely to have concurrent accelerometer data compared to ATS trips, 48.1% (13/27) vs 81.1% (99/122). It is possible that children were more likely to forget to wear the accelerometer belt when taking the car, or that they were less sure about whether they were expected to wear it on those situations, but it is also conceivable that they were less willing to do so to avoid appearing sedentary. In non-ATS trips, also reported by the parent, the chances of a parent ATS report being returned with incomplete responses was 39.1% (9/23) compared to 0.8% (1/122) in ATS trips. Because parents indicated whether the trip was active or not, it is unlikely that they forgot to complete the remaining sections of the question (about start and ending times of the journey); instead, parents could be unsure whether they were expected to report times when travelling by car, or could be more reluctant to provide data to validate non-ATS trips due to social desirability.

As to overall PA, the vast majority of participants managed to meet the minimum wear time required of at 6h/day on at least three days (control school 73.1%; intervention school 90%), resulting in 47 valid recordings from all accelerometer assessments. However, the average time per day spent in MVPA was only 34.4min amongst control participants, and 37.2min amongst intervention participants. This lies markedly below the 60min target recommended for this age group, which only three participants in each school achieved (overall 12.8%; five boys and one girl). This

finding is, however, in line with national data that suggest that 79% of boys and 84% of girls aged 5-15 fail to meet the above guidelines (Townsend N *et al.*, 2015).

4.4.7 Strengths and limitations

The RIGHT TRACKS study used a cluster RCT design which allowed the delivery of the intervention at a school level and test of materials and procedures in both control and intervention arms, without the potential for contamination that would have been inherent in an individually randomised design. A lottery-based incentive scheme has a strong theoretical basis (Chapter 2) and a number of advantages: it is a relatively novel approach in this area of research, inexpensive, can be run in short sessions, and does not require special expertise from the deliverer. Outcome measures were combined from three sources - parental and child reports of ATS, and accelerometry - adding to the robustness of measurement methods. In keeping with current trends in behaviour change research, another technological element of this study were the SMS parent ATS reports. These were easily manageable through an inexpensive online platform, were usually immediately answered, and reliably received. The availability of 45 days of report data allowed a better scrutiny of changes over time.

Nevertheless, this pilot study also has a number of limitations. Its small sample size imposes constraints to the generalisability of the findings. Contrary to undifferentiated PA, ATS is difficult to measure objectively because accelerometers cannot provide the type of contextual information accessible via other devices, such as GPS or wearable cameras. I was the only researcher directly involved in the study, which could have led to some bias in the delivery of procedures (e.g. more positive attention unconsciously given to intervention group), as well as increased chances of error in data entry and analysis. In addition, this being a student-led project may have contributed to lower school and individual uptake.

4.5 Conclusion

Overall this pilot study suggests that a lottery-based incentive scheme to promote ATS is feasible and acceptable in a sample predominantly constituted of White British families. However, additional feasibility work is recommended before proceeding to a definitive evaluation, particularly on the improvement of strategies to

recruit schools and families. Data from ATS reports vis-à-vis accelerometry suggest that the use of a fixed and larger timeframe such as the hour before the classes is better at identifying MVPA differences between active and non-active trips, than shorter time frame or one that varies with parental report. The combination of GPS and accelerometer is likely to provide more robust data on the validity of ATS reports because it allows an exclusive focus on the period of the journey to school. A greater involvement of the school, for example through the active participation of a staff member, may have a positive effect on recruitment, retention and adherence to study procedures, and should therefore be encouraged and further investigated.

Chapter 5 - Qualitative study

5.1 Introduction

The barriers and facilitators to intervention evaluation and implementation are key questions addressed in feasibility studies, often involving a mixture of quantitative and qualitative methods (Craig *et al.*, 2008a). Mixed-method studies contribute to a richer picture of behavioural phenomena by integrating multiple forms of data. There is some guidance, but no consensus, about what exactly constitutes a mixed-method approach, including, for example, the report of statistical results followed by qualitative themes that support or refute the quantitative result (Creswell *et al.*, 2011). However, behavioural researchers often use the term to refer to any type of research involving quantitative and qualitative methods, such as qualitative studies nested within larger trials (Bishop, 2015). A data merging approach will also be adopted in the overall discussion (Chapter 6).

A number of feasibility studies have employed mixed-methodologies in the context of health promotion in young populations (e.g. (Boniwell *et al.*, 2015) (Habib-Mourad *et al.*, 2014) (Chansavang *et al.*, 2015)). Typically, the use of qualitative techniques alongside pilot or feasibility trials seems to represent an additional source of feasibility and/or acceptability data. For example, Hunter *et al.* (2015) tested the feasibility of a competition to promote walking to school. At the end, focus groups were conducted with children, parents and teachers, which further explored the feasibility and acceptability of the intervention and data collection methods (Hunter *et al.*, 2015). Another study tested the feasibility of an intervention to promote physical fitness and PA amongst primary school children, who were also interviewed for more information on barriers and facilitators to participation (Eather *et al.*, 2013a).

'Process evaluations' are also often conducted alongside feasibility and evaluation trials. One of their core objectives is to explore issues with the implementation of materials and procedures (Moore *et al.*, 2015). In practice, in the context of feasibility studies, many process evaluations appear to focus on obtaining insights into feasibility/acceptability. Vanwollegem *et al.* (2014) reported the feasibility and effectiveness of drop-off spots to promote walking to school (Vanwollegem *et al.*, 2014). School staff and parents completed process evaluation questionnaires to assess how the implementation of the intervention was perceived (e.g. logistics of the drop-off spots). Similarly, Adab *et al.* (2014) assessed the feasibility and acceptability

of a multi-faceted and culturally-tailored intervention for preventing obesity in children of a South Asian background (Adab *et al.*, 2014). The process evaluation used a range of techniques such as observation, questionnaires with parents and children, and interviews with school staff, to highlight how delivery could be improved.

In sum, the combination of quantitative and qualitative methods has the potential to enrich feasibility assessments whilst meeting a central objective of process evaluations, namely the assessment of implementation issues.

This chapter is concerned with the qualitative component of the RIGHT TRACKS feasibility study, consisting of semi-structured interviews with participating children, parents/carers and school staff, as well as other stakeholders (Sustrans and Living Streets school officers). The aim of these interviews was to explore different perspectives associated with the proposed intervention and pilot trial procedures, thus providing further insights into their feasibility and acceptability. At the same time, this qualitative study may be appropriately defined as a process evaluation by exploring issues of implementation (Moore *et al.*, 2015). Its objectives reflected the contents of the interview topic guides, the development of which has already been described (Chapter 3). As a general orientation, I am following existing guidelines for the reporting of qualitative research, particularly with respect to aspects such as study design, analysis and findings (Tong *et al.*, 2007).

5.2 Methods

5.2.1 Participants

Participants in the qualitative study included children, respective parent, Year 5 teachers, head teachers and school receptionists, from both the control and intervention groups, as well as stakeholders.

5.2.1.1 Sample selection

Ideal criteria for selecting participants and for deciding when to stop collecting qualitative data were purposive sampling and data saturation respectively (Francis *et al.*, 2010). Through purposive sampling, specific people within the population are non-randomly selected by the researcher, for example to represent a variety of

participant characteristics. Data saturation occurs when new data emerging from ongoing interviews do not lead to more information related to the research questions.

However, the application of these two rules depends on the number of participants indicating an interest to be interviewed. Although there is no agreed threshold for establishing data saturation, a very small number of interviews (e.g. less than 10) is unlikely to capture less prevalent themes (Fugard and Potts, 2015). If sufficient numbers indicate an interest to be interviewed then purposive sampling rules can be applied. In this study, purposive sampling of parents and children was to be made on the basis of socio-demographic variables assessed in the parental baseline questionnaire, including ethnic background, socioeconomic status (indicated by parental qualifications and employment status) and usual travel mode to school. If low numbers of participants indicated an interest in taking part in interviews, then all of those doing so would be included.

5.2.2 Materials

Two forms were particularly important for enrolment in the RIGHT TRACKS study, including the interview components: the parental consent form and the child assent form; the development and administration of these have been described in Chapters 3 and 4. Vouchers were issued to thank interviewees, £10 for parents and £5 for the child (see section 3.2.11.3). A voice-recorder Olympus DM-20 was used during the interviews. Transcription was made in Microsoft Office Word 2013, and data analysis was supported by NVivo software, version 10.0.128.0, QSR International Pty Ltd 2015 (QSR International Pty Ltd, 2015).

5.2.3 Procedures

5.2.3.1 Ethical approval

Procedures and materials involved in this qualitative study were approved by the relevant ethics committee at Newcastle University (appendix D) as part of the approval of the overall study. Participants enrolled voluntarily and could withdraw at any time without needing to give a reason. Written informed consent and assent were obtained from parents and children respectively, while verbal consent was sought from school staff and stakeholders (see next sub-sections for details). Confirmation of

interest to take part and permission to voice-record the session was restated at the onset of each interview.

5.2.3.2 Timeline and timing of the interviews

All interviews were conducted at the end of the pilot trial, in December 2014 or January 2015. I chose to interview participants at the end of the trial as I felt they would be better placed to express their opinions on the whole process at that stage. If they had been interviewed earlier their views could have changed significantly during the course of the study. The only exception was one child who dropped out (control group) and his respective parent, who were interviewed in mid-November 2014. For dropout participants it was felt that shortening the wait between dropout and interview would allow more accurate recall of information.

All interviews at school were conducted during school hours or immediately after dismissal (9am – 4pm) while the school office was still open. Interviews at my workplace (Newcastle University) or via the phone took place on week days during working hours (9am-5pm).

5.2.3.3 Parental Interviews

An expression of interest to be interviewed could be indicated on the consent form completed by the parent before baseline, by ticking a box and providing an email address or phone number through which they could be contacted. Parents were then contacted to confirm their interest and availability, and to make arrangements for a suitable date/time/location. Verbal consent to have the interview voice-recorded was requested, with a reminder of the anonymous and confidential nature of the study. Parents were also informed that they would be thanked for taking part with a voucher (£10).

As discussed in Chapter 3, the head teacher consulted as part of PPI advised not to meet families in their homes. Thus, parents were given the possibility of choosing between the school and my workplace (Newcastle University) as a venue for the interviews. Parents were also free to choose the date and time of the interview, including the option of having the interview at the weekend. If interviews with parents were scheduled for weekends then the university was the default location. For all

university-based interviews, for safety reasons, I was to ensure that a colleague would be in the building at all times. In practice, all parents chose to be interviewed at their child's school.

After the phone conversation (or email exchange) with the parent, I contacted the school office to check room availability for the proposed interview date and time, and this was recorded in the school diary. I then sent a confirmation to the parent by email or SMS with the details of the interview meeting. At the scheduled date and time, I waited for parents at reception. Parental interviews were conducted individually with the exception of a parent who was interviewed with their child present, and another parent who was accompanied by her partner and her baby for some of the interview.

5.2.3.4 Child interviews

In accordance with the research protocol approved by the ethics committee, when contacted to confirm their interest in being interviewed, parents were also asked to verbally consent to their child's participation in this component of the study, to having the child's interview voice-recorded and to the issuing of a thank you voucher to the child (£5).

Upon recruitment to the trial, children had already completed an assent form in the classroom. In addition, children for whom I had (written and verbal) parental consent for interview were approached by me in school at play time or at lunch break, asked if they would agree to take part in a voice-recorded interview at school later that day, for which they would be thanked with a £5 voucher. All children approached responded positively.

Given the likely short duration of these interviews, children were interviewed at play time (10:20h-10:40h) or at lunch break, in a room in the school booked via the school office. Most rooms had a windowed door, but the door was left ajar slightly during interviews with children.

All children were interviewed individually with two exceptions: one parent asked for her son to be interviewed in the presence of a member of school staff (in this case the head teacher); another child requested to have her best friend in the room with her, and this was also facilitated.

5.2.3.5 School staff

Teachers, head teachers, and school receptionists were approached personally by me at school and invited to take part in an interview to share their views on the RIGHT TRACKS study, to which they consented orally. They could choose a place, date and time of their convenience, according to mutual availability. All opted to be interviewed at school, teachers and head teachers immediately after dismissal and receptionists during their lunch time breaks.

In both schools the head teacher was interviewed together with both Year 5 class teachers. After recruitment, head teachers had had little involvement in the study, and for that reason they requested to be interviewed together with the class teachers who had been more involved in the day to day implementation of the study. Receptionists were interviewed individually. All school staff members stated that they were happy for me to audio-record the interview. The possibility of accommodating local preferences in the conduction of interviews was pre-specified in the protocol and approved by the ethics committee.

5.2.3.6 Stakeholders

In the case of the participating stakeholders, one was a Sustrans officer with whom I had been in contact from an early stage of the study (section 3.2.5), and the other was a school officer working for Living Streets (Living Streets, 2012) who was introduced to me in one of the schools involved in the study (section 4.2.5). Both Sustrans and Living Streets are UK charities promoting active school travel, working in close partnership with schools. By email, I invited each of the stakeholders to be interviewed at a later date, and both accepted the invitation.

Stakeholders also had the freedom to choose a place, date and time that suited them. One of the stakeholders was interviewed at the university, while the other preferred to be interviewed over the phone due to other commitments. Both interviews were carried out individually and were voice-recorded with the prior consent of the stakeholders.

5.2.3.7 Data management and analysis

After the interview, voice files were uploaded on my computer (password-protected), in compliance with Newcastle University's Data Retention and Storage policy (NU, 2013). Interview recordings were transcribed verbatim and anonymised by removal of names and other material which would allow individuals to be identified. The six longest interviews were transcribed by professionals at UK Transcription (UK Transcription Ltd, 2014), while the other 19 were transcribed by me. I read all the transcripts, and coded the content of responses as nodes into an NVivo database following a data-driven approach. Hierarchical codes included lower-order codes. Text was retrieved and coded in the nodes, and data were interpreted and summarised. Owing to the limited resources available to this PhD project, no inter-rater analysis was carried out on this data.

5.3 Results

In total, I conducted 25 interviews involving 29 participants: children (n=9); parents (n=9); school receptionists (n=3); stakeholders (n=2); and the groups of head teachers and two Year 5 teachers interviewed together, one group in the control school and one in the intervention school (n=6). Two other parents, both from the control group, had expressed interest in being interviewed upon recruitment, but stated that they were no longer willing to take part when contacted by phone. No other justification was given. Thus, 11 parents out of 29 (37.9%) expressed interest in the interview, and nine out of 29 (31.0%) were actually interviewed. The duration of interviews was on average 40 min (25.0-44.5) with parents, 21 min (18.5-24.5) with children, 30-36min with teachers and head teacher, 5-10 min with receptionists, and 46-72 min with the stakeholders.

Due to the small sample of parents (n=9) and children (n=9) who confirmed their interest in being interviewed, a purposive sampling procedure was ruled out. A pragmatic approach was adopted and all willing participants were invited for interview irrespective of their background, and interview data was checked for saturation. Table 5.1 shows the main individual characteristics of interview participants.

	School	Gender	Ethic background	Highest qualification	Child's travel mode to school on a typical day (based on parental questionnaire)	Child dropped out or remained until the end	Child won draw once (for int. school only)
Child 1	Cont.	Male	Wh. British		Car	Remained	
Child 2	Cont.	Female	Wh. British		Walking	Remained	
Child 3	Cont.	Male	Wh. British		Car + walking	Remained	
Child 4	Cont.	Male	Black Affric.		Walking	Dropout	
Child 5	Interv.	Female	Wh. British		Car	Remained	Yes
Child 6	Interv.	Male	Chinese		Car + walking	Remained	Yes
Child 7	Interv.	Female	Wh. British		Car + walking	Remained	No
Child 8	Interv.	Male	Wh. British		Walking	Remained	No
Child 9	Interv.	Male	Wh. British		Walking	Remained	No
Parent 1	Cont.	Female	Wh. British	A Levels	Car	Remained	
Parent 2	Cont.	Female	Wh. British	GCSE	Walking	Remained	
Parent 3	Cont.	Female	Wh. British	Degree/Higher	Car + walking	Remained	
Parent 4	Cont.	Male	Black Affric.	Degree/Higher	Walking	Dropout	
Parent 5	Interv.	Female	Wh. British	A Levels	Car	Remained	Yes
Parent 6	Interv.	Female	Chinese	None	Car + walking	Remained	Yes
Parent 7	Interv.	Female	Wh. British	Degree/Higher	Car + walking	Remained	No
Parent 8	Interv.	Female	Wh. British	GCSE	Walking	Remained	No
Parent 9	Interv.	Female	Wh. British	GCSE	Walking	Remained	No
Head teacher 1	Cont.	Female	Wh. British				
Head teacher 2	Interv.	Female	Wh. British				
Teacher 1	Cont.	Female	Wh. British				
Teacher 2	Cont.	Female	Wh. British				
Teacher 3	Interv.	Female	Wh. British				
Teacher 4	Interv.	Male	Wh. British				
Receptionist 1	Cont.	Female	Wh. British				
Receptionist 2	Interv.	Female	Wh. British				
Receptionist 3	Interv.	Male	Wh. British				
Stakeholder 1		Male	Wh. British				
Stakeholder 2		Male	Wh. British				

Table 5.1 - Main characteristics of interview participants, per individual. Information on the qualifications of school staff and stakeholders was not collected.

Parents and the respective child are identified with the same number (e.g. parent 3 is the mother of child 3). Four parent-child pairs were from the control group and five from the intervention group. A higher proportion of boys took part in this component of the study than in the pilot trial (66.7% vs 44.8%), fewer parents with A Levels as highest qualification (22.2% vs 46.4%), and more parents who, in the baseline parental questionnaire, had reported chauffeuring their child to school on a typical day on the questionnaire (55.6% vs 37.0%). The only two non-British families taking part in the RIGHT TRACKS study expressed interest and agreed to be interviewed.

In the intervention school, two of the children interviewed had won the draw, once each.

5.3.1 Thematic analysis

Five main sets of nodes were created in NVivo, one for each class of participants: parents, children, head teachers and teachers, receptionists, and stakeholders. Each of these sets of nodes was divided in themes which reflected a number of aspects of the intervention and trial procedures. These themes included, among others, presentation session, recruitment procedures, randomisation, wearing the accelerometer and the reward scheme. Although driven by the data, these themes mainly reflected the questions asked in the various interview topic guides to which participants' answers were usually confined (e.g. asking about parent ATS reports led to answers wholly related to this topic). Dimensions assessed were relevant from a feasibility perspective.

There was a considerable overlap between themes across the different classes of participants. For example, any issues associated with wearing an accelerometer were explored from the viewpoint of children themselves, parents, teachers, and stakeholders. Themes, in turn, were divided in sub-themes, which were nodes with a more specific focus. For instance, the theme "accelerometer" included a large number of sub-themes, such as "good things about the accelerometer", "problems with the accelerometer" or "how parents helped with accelerometer wear". Some quotes were assigned to more than one node. For example, participants' views about using vouchers to engage youth in research were often indistinguishable from views on using vouchers to promote active travel or PA in youth. For analytical purposes, all nodes were grouped in seven themes: (1) recruitment; (2) randomisation; (3) measurement procedures; (4) incentives; (5) more general views about the study; (6) ATS behaviour and contextual factors; (7) school involvement.

5.3.2 Recruitment

The first aspects covered by the interviews were related to the recruitment process. In the case of parents and children, the focus was exclusively on the recruitment of individual participants (i.e. parents and children). For teachers, head teachers and

stakeholders, questions were about recruitment of schools as well as of individual participants.

5.3.2.1 Recruitment at the school level

Head teachers found the way that schools were recruited (emails followed by a phone call) to be acceptable and indicated that they had decided to take part because of their commitment to encouraging healthy lifestyles amongst their pupils.

“Because we’ve got a history of promoting cycling to school, and doing exercise in general, and (...) children’s PA levels is high in our agenda. That was the reason it caught my eye” (Head teacher 1, control)

Both head teachers seemed unsurprised by the low uptake amongst schools due to the amount of correspondence that schools receive and are, therefore, forced to ignore.

“(...) each school is bombarded with lots and lots of emails every day. You can’t do everything that’s offered, you’ve got to pick and choose” (...) “We get even more rubbish on the mail than we do on the email to be honest...” (Head teacher 1, control)

This was consistent with the view of both stakeholders who stressed that schools are often under pressure to undertake many activities at the same time and meet performance targets. One of them said that it is particularly challenging to get the information beyond the school secretary to the Head teacher who is able to make decisions.

“... Not surprised in the way that schools are just... They’re just so busy. And a lot of the time we struggle because we come along and say, “We’re going to do this for you”, and they just go, “We just haven’t got the time to do it” (...) (Stakeholder 1)

“We found it quite difficult recruiting schools as well (...) Getting the information past the secretary is a very, very difficult task. If they don’t pass the information on to the relevant teachers, then you really, really struggle” (Stakeholder 2)

A number of suggestions were made by school staff and stakeholders to boost uptake by schools in the future.

“Maybe looking at the schools’ websites and seeing whether that’s something they got” (Teacher 2, control)

Personally visiting the school was viewed in a different light by some of the interviewees.

“A personal visit perhaps. I know that’s time consuming, but to come out and meet people face-to-face (...) I suppose once you’ve done it in one school, word of mouth goes around and passes to other schools, that might get them interested” (Head teacher 1, control)

“How long would it take you to visit 123 schools? You wouldn’t be able to do it. And the chances are that most of them would say no, and if you did get more uptake (...) when you go away they probably won’t do it anyway” (Stakeholder 1)

Another recommendation was to contact schools and promote the project through closer partnership with third parties, such as AST organisations already working in schools (e.g. Sustrans or Living Streets) or via local authorities.

“[Partnering with AST organisations] could have been a really good way in, to get them to promote alongside (...) if they’re busy working in schools, they could just “oh, we’ve got this good project”, and then you’ve the links with Living streets, and the Go Smarter, and things like that. So they’re all in schools, so that could be a way of really getting people on board and sign up for it” (Head teacher 2, intervention)

“Potentially, with yours being an active travel project, you could have approached the Road Safety Officers or Active Travel team at the local authority (...) What they would have been able to do was given you an overview of what projects were happening in which schools, and potentially, been able to give you some good contact details to recruit (...) [and] narrow down which schools you could have approached” (Stakeholder 2)

5.3.2.2 Recruitment at the individual level

Participant recruitment started with a presentation of the study. Most children enjoyed the presentation and were willing to take part from that moment.

“Good presentation, I liked it (...) because you were really explaining it, because some people just come in, tell you what’s about and leave” (Child 1, control)

Reasons given by children for wanting to take part included a will to be more active, to be part of a study, to wear an accelerometer, to get a voucher, because it sounded exciting, because others were doing it, or because the parents wanted them to.

“I always thought it would be good to wear a pedometer” (Child 1, control)

“I felt like I really wanted to do it because it sounded really good and exciting” (Child 7, intervention)

“I wanted to take part because I want to know how many miles I'm walking and that. And I thought it was good that we were getting a £5 voucher” (Child 2, control)

“When I heard about it I was thinking like should I do it or should I not, because my mum was saying I should do it, because it will help me with fitness and that” (Child 3, control)

Some, however, found it less interesting or clear and were unsure about whether to participate or not.

“Child 6 (intervention) - [I found the presentation] quite complicated at first (...), like, signing in the forms, wearing the belt, (...) but when I started the RIGHT TRACKS, then I started to understand it

Me - What do you think was complicated?

Child 6 - Like... signing in the forms, wearing the belt ... That's all”

“You were talking to us and I wasn't actually sure that I wanted to do it. But then I had everyone else to do it and I thought maybe I should because I don't take part in that many clubs” (Child 5, intervention)

Some children explicitly stated that they were not doing it for the prize.

“It wasn't just about the voucher, because I'm not that type of person” (Child 1, control)

One suggestion was made to make the presentation more dynamic.

“Child 8 (intervention) - I found [the presentation] long, and also at the time, boring.

Me- Were there some things in particular that you found boring?

Child 8 - Just, I had to sit there. That's why I found it boring.

Me- Do you think I could have made something to make it more interesting?

Child 8- Put a little game, to show how the RIGHT TRACKS was.

Me - Any idea how I could do that?

Child 8 - A race. You put the accelerometer on and you have a race, and see who was the most active for that race"

Teachers held favourable views about the presentation session. They spent more time in the session and with children immediately afterwards and were therefore best placed to express their views than head teachers.

"I thought it was really good, I think they all understood what it was" (Teacher 3, intervention)

"I thought it was delivered well and clear, you explained what was behind your study" (Teacher 1, control)

Unlike children, teachers highlighted the effect that vouchers exerted on the audience at the presentation.

"They were all keen to take part at that point (...) especially with the rewards and things" (Teacher 3, intervention)

"I think they were really initially enthusiastic about it, especially when you mentioned the incentive. That seemed to get everybody" (Teacher 1, control)

"When they first saw the vouchers they all wanted to take part" (Teacher 2, control)

All children expressed satisfaction with the recruitment process, which consisted of taking a questionnaire pack home and parents returning the relevant documents to me. None of the children interviewed made suggestions for improvement in the process or the child information leaflet.

"That was fine. My mum just signed it, there was quite a lot of papers but she just kept reading through them and signed them, handed it in the next day, and then that was fine" (Child 2, control)

"[Leaflet for child] was easy to read, it's not that complicated, and there's pictures to show you how to do it, and it tells you step-by-step what to do" (Child 6, intervention)

The assent form was generally felt to be easy to understand.

"The questions were alright yeah... I wasn't struggling with it. It was just straightforward answers, so I could read it and I could know it straight away" (Child 3, control)

However, one child stated that he was unsure about how to answer some of the questions on the assent form (although he was unable to recall exactly which ones) but found the assistance of the teacher helpful.

“I found it alright, then some parts of it I crossed it off because I wasn’t really sure about it. Then when Mrs S came back in she explained me that part of it. Then I got and I checked down” (Child 4, control)

Most parents found the questionnaire, consent form and information leaflet easy to understand. In particular, the recruitment approach adopted gave parents a greater sense of involvement.

“I thought it was very good, there was a lot of information, and I like that. I like to know everything that he is doing in school” (Parent 3, control)

“[The questionnaire] was just quite easy to fill out and easy to read. Well laid out. It’s fine” (Parent 8, intervention)

“You can more or less say yes or no before the child gets involved, which is a good thing, rather than them just being told or asked at school to do something. I think it’s quite good that adults are involved in it” (Parent 5, intervention)

The length of the questionnaire was mentioned by at least two parents, but it did not seem to have posed a major problem.

“It was long, I don’t think I had any difficulties with it though (reads through) I think that was pretty straightforward, it’s pretty clear” (Parent 2, control)

One parent was unclear about the response mode options (paper form or SMS) listed on the consent form, another parent was not sure about what an accelerometer was (despite the information provided in the parent pack), and another one would have preferred more bullet points in the participant information sheet. A preference for an online system (e.g. by email), as opposed to paper forms, was evident in some cases.

“Perhaps if you could do [the questionnaire] online would be good. Just in terms of accessing it because then I wouldn’t have to carry a piece of paper out, depending where I filled it in” (Parent 3, control)

The opinion of school staff and stakeholders was largely consistent with parents’. Teachers and head teachers mentioned the difficulties of getting parents to respond

to similar invitations, and recommended a further simplification of the paper work in the future.

“Head teacher 1 (control) – I would have hoped a bit more, but I think there was a lot to read, wasn't it? If I remember well...

Me - Possibly...

Teacher 1 (control) - I know you went through this a bit in the session, but...

Head teacher 1 - We do have a history here of (...) parents not responding to things in writing”

However, both school staff and stakeholders thought that the number of positive responses obtained (around 30%) was good, considering the requirements of the study. Consistent with some parents, one stakeholder suggested increasing the options for completing the questionnaire.

“Teacher 1 (control) - That was quite a good uptake then.

Head teacher 1 (control) - It was. When you (looking at me) first came in and showed me what you wanted parents to fill out, I said “what!”

“That's pretty good. You'd be looking at about a third, I would think. I think a third is a good number” (Stakeholder 1)

“Rather than just sending one out, a hard copy, we've potentially sent a couple of versions out. If they want to fill it in online, they have got that option. If they want to return the hard copy, that is great. If you want them to send it back via post, what we have also done is sent pre-stamped envelopes, so there's no cost to them, or asked them to just return it to the school” (Stakeholder 2)

5.3.3 Randomisation

The flip of a coin to decide allocation to intervention or control condition was described as fair by almost everyone in both schools. Children in the intervention school were glad to have the incentive scheme. One child expressed some regret for not having the scheme in her school but appeared to be understanding of that outcome.

“It’s alright, because it’s the flip of a coin. I don’t find it unfair. If the other school has got the reward scheme, that will be it. You can’t have everything in life” (Child 1, control)

“You couldn’t have done it in any fairer way. If you flip a coin, it’s fair” (Child 5, intervention)

“Well, I think it would be better with the prize draw, but you wouldn’t do it here so” (Child 2, control)

“Fair and square. You flipped the coin and the other school got it, so that was fair” (Child 3, control)

Parents and teachers accepted the fact that their school could be allocated to either group and saw no signs of sadness or disappointment amongst children.

“I think she did say, oh the other school are doing something else, but I don’t think she was that bothered. She wasn’t sad” (Parent 2, control)

“You just have to accept that sometimes, don’t you...you just have to know that’s what going to happen... There was still some reward from it” (Teacher 1, control)

Nothing was asked about possible alternatives to randomisation in a future study but three ideas were put forward by children: my research team and I voting on who should host the intervention; picking the group with the largest number of “Yes’s” reported by the parent (i.e. active trips to school); and delivering half of the scheme in each school. In the same line, two parents wondered if both schools could have received the intervention scheme.

“I think you should do a vote with the people in your team, because sometimes the coin always lands on heads” (Child 8, intervention)

“To be fair, if every school can have this scheme it would be good” (Parent 6, intervention)

5.3.4 Measurement procedures

Data were collected from three outcome measures: parental ATS reports (in paper or optionally, and more usually, by SMS); child ATS report forms; and accelerometers.

5.3.4.1 Parent ATS report

Children whose parents had opted for the paper report form were asked to return it completed to the classroom every week; those whose parents were SMS respondents were also asked to return paper forms on two weeks (when their child wore the accelerometer). Most children felt this was an easy task, but many reported to have forgotten the form at least once. One child suggested leaving the form in a strategic place in the house, so as to increase its noticeability. Some of the difficulties had to do with parents having little time to complete the form.

“We just really put them in our bags and give them to the teachers, then they would hand them to the office and then I think the office would hand it to you” (Child 7, intervention)

“Me - Did you forget it any time?”

Child 9 (intervention) - Yes, the second time I forgot (...) because my mum was always at work and then couldn't fill it in and then she got a day off and she filled it in, and then... [I returned it]”

“I found it ok, then every week you asked me to fill forms, then sometimes my mum or my dad don't have time to fill in forms” (Child 4, control)

Another issue raised by two children was the possibility that some children may have completed the forms, incorrectly, themselves rather than the parents completing them as requested.

“My mom filled the form, but it might not have been the same for everybody else. Some people might have cheated and put that they walked to school” (Child 9, intervention)

In the weeks that the child wore the accelerometer, parents were asked to report travel times in addition to travel mode. For most of the parents this was straightforward because the departure and arrival times were virtually the same every day.

“It was ok because we live only about... it's not even half-mile, which is about 5-6 minute walk every day... so it wasn't a problem...” (Parent 4, control)

“Fine, for me personally, I just live here so it's just 3-4 min walk, so it wasn't difficult for me to do” (Parent 5, intervention)

However, other parents found it difficult to recall this information, and in some cases it was unclear which times needed to be reported (e.g. for partway active trips parents were not clear if they needed to report times for the whole journey or just for the active part of the trip).

“So I was trying to think – the times were weird because the time that I leave home, I drive three-quarters of the way – so did you want me to start recording from the time I got out of the car at [supermarket]? Do you know what I mean?” (Parent 1, control)

Parents found returning this form to the classroom via their child to be acceptable, but on the downside, forms were often forgotten. One parent would have preferred to be handed the form by the teacher when dropping the child at school, and said she used to leave the form by the door to increase chances of remembering it. Consistent with what some children had suggested, at least two parents were unfamiliar with the parental ATS report.

“I don’t remember it (looks at the form), it possibly could have been [child] who did it” (Parent 2, control)

Parents who had opted for SMS reports, but who completed paper forms when the child wore the accelerometer, stated that they had found the SMS texts more convenient. There was a mix of opinions about the response mode chosen amongst regular paper and SMS-respondents.

“A lot easier, because I think it was about two or three minutes past nine every morning. It was so precise, every morning, so precise; I knew straight away when I was coming away from school and I would hear the 'ding'. I would go, “Oh, there it is”. Whereas if you'd have given me a sheet of paper with Monday, Tuesday, Wednesday, Thursday, Friday – what happens sometimes is, because I'm so busy, I would get to Thursday and then go, “What happened on Monday?” (Parent 1, control)

“I just like to have something in front of me. If I'd have it on my phone, I'd forget to do it. Doing it that way, [child] needs to return it to school, so I know that I would do it. I just personally find... cause I'm older, its old school (laughs)” (Parent 5, intervention)

5.3.4.2 Child ATS report

In the classroom, children completed their own ATS report form on a weekly basis. The vast majority found this form easy and could not think of ways to improve it.

“Me – How did you find completing that form in the classroom?”

Child 6 (intervention) - Quite simple.

Me - Is there anything that I could have done to make it even easier for you?

Child 6 - (head shake after a very long pause)”

Only one child said he had found it hard to recall the information required at times.

“Like, some days you couldn’t remember, so it would just be hard” (Child 4, control)

Amongst the interviewees was a child who regularly cycled to school. He was asked to show me his bike after being dismissed from school for the day, and suggested that he found this acceptable.

“Me - I also asked you to circle when you had cycled and to show me your bike after school. How did you find that?”

Child 9 (intervention) - Ok because you could have thought that I was lying. So you had to make sure.

Me - So were you happy with that?

Child 9 – Yes”

5.3.4.3 Accelerometer belt wear

Wearing the accelerometer belt was mostly described as a positive and non-intrusive experience by children. They had been instructed to take it off at night, during aquatic activities and any sports where it could be feel uncomfortable, and seemed to have managed to follow these instructions well.

“It felt really comfy, and it didn't annoy us. Nobody noticed it. All the other people like it, so I was fine about that” (Child 9, intervention)

“I do like technical sports, like judo and that... I wasn't allowed to wear it for judo, because it was on the side and we throw each other on the ground and that, and it would break. It was good that way” (Child 3, control)

A common strategy reported was for children to leave the belt next to the bed to remind themselves to put it on in the morning. However, most children reported

having forgotten to wear the belt on some days, for example when hurrying to go to school in the morning, or on the weekend.

“I had it on the end of my bed, I missed it out on about Saturday because I was going to my nana's and I forgot to put it on” (Child 2, control)

“Me - How many days did you manage to wear the accelerometer?”

Child 1 (control) - I think most of the days apart from two, I forgot. But that's when I was really in a hurry”

One child found it distracting in the classroom, while another child felt the same but only on the first day.

“It was really distracting us, but I just didn't focus where it was and just ignored it. I thought it's there for a reason, just leave it. I couldn't focus the first day I had it, but then the second day I was used to it and I just ignored it” (Child 5, intervention)

Assistance received from parents was mentioned by some children, but reports suggested a high level of independence with the belt wear.

“Me - Were there other people helping you remember the accelerometer?”

Child 8 (intervention) - I did

Me - Did your mum help you?

Child 8 - I put it on by myself”

Some children placed the monitor upside down a few times, but soon realised and corrected the mistake.

“One week I put it down by accident half the day, and then I looked at the sheet and... do I have it like downwards... and it says just copy what it says on the sheet... the arrow” (Child 3, control)

One child reported feeling discomfort when wearing the accelerometer, but when I asked him what he liked about it, he gave the opposite account.

“Child 6 (intervention) - It was not that comfortable and it was quite itchy.

Me - What did you do when it was itchy?

Child 6 - I just kept on pulling it.

Me - Did that make any difference?

Child 6 - It only made it even more uncomfortable.

Me - So did you take it off when it felt uncomfortable?

Child 6 – Yes”

“Me - And the things that you liked about the accelerometer?

Child 6 - It was like really really smooth... and it was really really comfortable... and it wouldn't fall off easily”

All parents had a favourable opinion about the child's accelerometer assessment, and none reported major issues.

“She would have gone to bed with it on. She got herself in a routine where she would religiously put it on in the morning until she would put it off last thing at night. Some nights I had to remind her to take it off at night time, because it used to go underneath her pyjamas. So I had absolutely no problems with her using that”
(Parent 7, intervention)

Teachers were positively surprised by the fact that the belt wear did not interfere with the classroom activities.

“There were no problems at all. I think the ones in my class were very keen. In fact I think, so keen that it stopped becoming a novelty, it was just part of them. There was no fuss about it at all” *(Teacher 4, intervention)*

A frequently cited effect of wearing the accelerometer was a rise in PA, apparently independent of any rewards, by both parents and children.

“Me - Would you wear the accelerometer again in the future?

Child 7 (intervention) - Yes

Me - Why is that?

Child 7 – (...) I just like the idea of being a bit more fit. Because some people these days aren't really that fit”

“[Child] wanted to walk, because he had the thing on. His little brother hates walking, and would rather get in the car every day. But because [child] had this on, it encouraged him to join in even though he didn't have the accelerometer on” *(Parent 3, control)*

“On the weekend, when she was wearing it, she wanted to do more activity. So it was increasing the level of PA that she would normally do on the weekend. Because on the weekend she normally does... her iPad... she normally doesn't want to do much, whereas when she had that on she wanted to get out a bit more, she wanted to do

more exercise, I really noticed an improvement. And she was a bit more alert as well, rather than just being comatose with the iPad” (Parent 7, intervention)

Children also liked the feeling of having their PA recorded, even though this recorded information was inaccessible to them.

“I liked the feeling that my activity was getting recorded. So when I was doing something good, it could get recorded” (Child 1, control)

“They're fun to have because you know how many steps you took, even in the night, and when you stopped or were walking around” (Child 5, intervention)

Similarly, parents were happy with the measurement and aware of the importance of this type of research.

“This programme told me that you can count a child’s activity with this belt, I think it’s quite intelligent yes... knowing what kind of activity, I think it’s quite good” (Parent 6, intervention)

“I don’t mind, it’s a good thing. It’s all about research, isn’t it” (Parent 2, control)

Participants suggested that there was little difference between the first and the second accelerometer wear, other than the child being more used to the procedure or less excited the second time. Children seemed to have taken the responsibility of wearing and taking care of the accelerometer, but some parents mentioned that they often helped with reminders. There were no social occasions or times during the day where wearing the accelerometer was particularly difficult or problematic according to the interviewees.

“Once I was aware that he had it – I think the first day that he came home, I wasn’t aware that he was wearing it and he took it off when he got changed out of his uniform and he didn’t put it back on, and I didn’t realise until bedtime, I think it was, or the next day, or something like that. I went, “Oh, if I’d known I would have told you to put it straight back on”. Aside from that, though, he was quite good at remembering it most of the time” (Parent 1, control)

As to improving the use of accelerometers in the future, children and parents made a number of suggestions. These were either ideas which users themselves could put in practice, or which I could myself apply as a researcher.

“You could have the accelerometer, and change it so [that children] could have it three times (...) So that is gives them a bit more exercise” (Child 8, intervention)

“Maybe put it somewhere that I'm going to look past and see it, and think 'accelerometer!', I need it!” (Child 1, control)

“Something like a calendar on my wall, a schedule or something, just write it on” (Child 2, control)

“You could let the people who are wearing it, wearing it for a little bit longer” (Child 9, intervention)

“Just make it in different sizes, so that it could feel comfortable” (Child 4, control)

“The father, or the mother, can do exactly the same thing with the kids. They could encourage the children to know how important, how activity is needed every day for them, for a healthy system” (Parent 6, intervention)

“Texting in the morning just to say ‘is your child wearing the equipment’? Because parents in the morning, I think that would be the last thing on their mind. Especially my children cause I'm ‘hurry up hurry up’, you know, busy in the morning” (Parent 2, control)

“Maybe you could have called the parents in and meet the parents before that, explain to them... like I thought you were maybe asking him to wear it when he comes to school, and he comes back home he takes it off” (Parent 4, control)

“If he had been out in the summer months, you would have got an accurate measure and the right tracking” (Parent 9, intervention)

“[Child] had [my pedometer] on a few times because you can see your steps so maybe something like that where they can see how much more active they are by looking themselves” (Parent 8, intervention)

In the control school, data were collected at play time and children interviewed stated that they were happy with this.

“I didn't really mind, because it's play time, you have 15min” (Child 1, control)

“Play time instead because during school hours you're missing out lessons, and at play time you're got all the time” (Child 2, control)

5.3.5 Incentives

5.3.5.1 Incentive scheme

The incentive scheme was only experienced by those in the intervention school, therefore only parents and children in the intervention group were asked questions about this. Overall, children expressed positive (or very positive) views and experiences associated with the draws, whether they ever won any or not.

“It was really funny, because I had a couple of other friends there. And it didn't really matter who won it, the important (thing) was to take part” (Child 5, intervention)

The uncertainty of who was going to win, the transparency of the process, and the fact that everybody could take part as long as they had at least one ticket in, were some of the strengths highlighted.

“Me: What did you think went well with the draws, with the scheme?”

Child 9 (intervention): That it was fair, because you were showing us the bag in case there was anything in

Me: What else you think went well?

Child 9 - You got the teacher to pick the paper ticket”

“It was fair, there wasn't just one person getting picked, like over and over” (Child 8, intervention)

“Child 7 (intervention) - I found it quite tense, but still good and exciting

Me - What do you mean by tense?

Child 7 - A bit tense on who is going to win it.

Me - Is that a good thing, or a bad thing?

Child 7 - Good thing”

The only limitation of the scheme brought up was the fact that some people never won any draw, but although some children admitted feeling a little disappointed they did not seem particularly troubled.

“Me - So how did you feel about [not winning the draw]?”

Child 8 (intervention) - I just felt the excitement

Me - Did you also feel sad?

Child 8 - When I didn't get I felt I bit, ohh..

“(...) Me - What do you think went less well?”

Child 8 - When people didn't get a voucher. Like I never got a voucher in any draw"

Parents in the intervention group also saw the incentive scheme in a positive light, regardless of whether their child had won a draw or not, and none reported problems.

"I don't think it's a bad thing. If each child did and enjoyed doing it, I think it would probably make them walk more to school. I know that [child] definitely wanted to walk more, because she knew she was achieving something" (Parent 5, intervention)

"On these days where she was able to walk either part or all of the way, she was like "yeah, I might be in with the chance". So sped her on a bit more. She never once came home and said "oh, I haven't won the draw". I think she just thought "oh, it's a game and I haven't got it". It didn't distract from her enthusiasm for the accelerometer or for walking to school" (Parent 7, intervention)

Children could not think of ways to improve the incentive scheme but a number of ideas were proposed by the parents, some of which provided further support for the acceptability of an incentive approach.

"Maybe the rewards, instead of vouchers, could be more age group related? I don't know (...) Just toys or something... Activities! (...) If someone wins a football, they're going to go out and play football, aren't they?" (Parent 8, intervention)

"A different period, the summer time" (Parent 9, intervention)

"Rather than using the reward system for actually doing the project, actually incentivising them to do more exercise. Like, give them a target to work towards. And make it a bit more competitive, so that, yes still use the reward vouchers, but incentive that by saying "if you do... I don't know... seven hours of exercise..." (Parent 7, intervention)

"Just involve the parents (...) maybe doing it together, or other siblings, if you've got brothers and sisters. If you've got two then they're competing. The prize system, doing it that way" (Parent 9, control)

Teachers' views were aligned with those held by intervention participants. Of particular interest were the views of the teacher who attended the weekly draw sessions (teacher 3). She used to collect the parental report forms in advance for me, and was the one who picked the ticket out of the bag in the draws. According to her,

children knew what to do and enjoyed taking part in the scheme, without detriment to their learning.

“All of the children understood, I think they got a routine of what they had to do as well. They were coming in, give out the pencils, filling that form... I think it was really clear (...) And I think that encouraged to walk a little bit more cause they wanted more tickets in the bag. But I thought the reward scheme worked really well”
(Teacher 3, intervention)

*“Me: Did the sessions influence their behaviour, for example right after the draws?
Teacher 3 (intervention): No, they knew that they had to go back to the class and get on with their work*

Teacher 4 (intervention): That’s right, they take everything, and that’s right they came back in and get straight back on. Yeah, they’re very good”

“They might have missed grammar some weeks, or reading some weeks, but they weren’t the main afternoon lessons. And if they did miss grammar it was something that they could catch up on. And they were only out for a short space, 15min most weeks. By the time they came in and got “sorted” they were fine, they didn’t miss much” (Teacher 3, intervention)

Limitations included the difficulty of attesting the accuracy of reports and possible “self-policing” attitudes in the classroom.

“I think this whole honesty thing, how honest they have been, if they had walked or cycled, we just have to take their word for it. I know the parents have sent things in as well but I don’t know” (Teacher 3, intervention)

*“Head teacher 2 (intervention) - It’s like any of those schemes, where they walk once a week... (...) sometimes you can say “no you didn’t, you came by car or whatever”
Teacher 3 (intervention) - I think in our class as well they are more than willing to tell on each other”*

Both stakeholders were generally supportive of the use of lotteries, a common practice in their work.

“I’ve done that lots of times, where, like, in the summer term you’ll have the badge scheme, and if money allowed, we’d buy a bike on top. So the kids would all get the badge at the level that they did, and then for every fifth time they came to school on a

bike, then they'd get a raffle ticket (...) then the more times they come, the more chances they've got, and then there'd be a bike at the end of it. (...) That definitely seemed to generate a lot of excitement" (Stakeholder 1)

"I think that's absolutely fine. That's something that we've done with work in secondary schools, for example. People who have returned things, they go into a draw, and it's pulled out of the hat" (Stakeholder 2)

A poster in the corridor's wall explained the rules of the RIGHT TRACKS, which children could call upon in case of doubt. Next to the poster was a bar chart displaying the total number of active trips to school in the classroom, week-by-week. After each session, I would glue a new bar based on the number of tickets entered into the draw. Teachers found these materials to be a useful addition to the scheme.

"I thought that was good because the children could see what you were measuring, and see all together how much they had walked, how many days. Then I did say 'make sure you have a look each week' to see what the difference is (...) you could maybe talk about it in the session, then they could go and look at it on their own. But obviously you want to get through things quickly" (Teacher 3, intervention)

5.3.5.2 General views about the use of incentives

Some questions in the interview guides explored more general views about the use of incentives, without focusing on the incentive scheme. In the RIGHT TRACKS study, in addition to the weekly draws, vouchers were issued to thank children who returned materials as requested, in both arms of trial, therefore all participants answered questions about these. The aim of this reward was to enhance recruitment, retention and adherence to procedures. Some of the questions asked to parents and children regarded the importance of vouchers in this and other similar studies, where 'vouchers' could mean both thank you vouchers and incentive or reward scheme vouchers. For clarity, all answers to these questions will be discussed in the remainder of this section, unless the participant made explicit mention to the incentive scheme.

As discussed in section 5.3.2.2, some children emphasised that they had other motivations to participate beside the voucher. Others, however, openly said that vouchers encouraged them to join and remain in the study.

*“Me - How important were the vouchers for you in encouraging you to take part?
Child 2 (control) - The vouchers were quite important, how we got them like as a
reward for doing the RIGHT TRACKS and doing the pedometer”*

*“[Vouchers] were quite encouraging, to some of my friends and me” (Child 7,
intervention)*

The possibility of spending the high street vouchers as one pleased was clearly an advantage, and the amount chosen (£5) was judged appropriate by everybody, children and adults.

“I liked the voucher idea because you can use it all the different shops. So it wasn't that you got to use like just there, it can be anywhere” (Child 3, control)

“Really really good, because I can get the vouchers and buy more books and other things” (Child 6, intervention)

“I think £5 is the best amount you can give to children like me” (Child 1, control)

“I think £5 was a reasonable amount... any more than that, it would probably be a bit too much, but £5 was a token amount that is probably suitable” (Parent 7, intervention)

Other justifications for remaining in the study, beside the incentives, were to finish what one had started, to help with physical fitness, and to have something to do.

“I'm not the type of person that starts something and drops out. I want to stay for as long as I can, unless I really can't stand it anymore” (Child 1, control)

“(...) the way you told us about walking to school and fitness and that... I always do fitness because I do judo and swimming. So that just kept us going” (Child 3, control)

“(...) because there's something to do” (Child 8, intervention)

Parents were not motivated by the vouchers, but suggested that these were influential to the child more than the child reports implied.

“For [child], money is a big incentive to a child, so that would be her incentive to take part because she can go and spend it on nail varnish or whatever. For me, I wouldn't be bothered about a gift voucher or not” (Parent 2, control)

“I wasn't really bothered about rewards or not (laughs). I thought the rewards were more a nicer thought for the children than for the parents” (Parent 7, intervention)

The primary reason for parents to join the study was their child's willingness to do so, but encouraging their child to be more active and collaborating with research were also motives.

"I didn't even know there were rewards really (...) He wanted to do it, I said, "Fine, not a problem"" (Parent 9, intervention)

"It's a study on getting him walking more and moving more so... Which is what every parent wants, I suppose" (Parent 8, intervention)

"I was going to do it, and I will do it, and will continue to do it, because what you are doing is a valuable research" (Parent 4, control)

Some parents considered that ideally people should be disposed to engage in research without the need of using incentives. However, given the current society trends, there was a consensus that it was appropriate to reward children of this age group for taking part in research studies.

"Of course this world is turning into a mind with money (...) and nowadays our kids always think of money, money (...) We know that he gets the incentives, but it's not always. He should do some of the things because they have to be done (...) It's a good idea for the kids... and (...) for the parents... (...) because of parents only think about money... but with me, it's not about that" (Parent 4, control)

"I think it's a good idea, so they know they're getting a reward for doing it" (Parent 5, intervention)

"I think children of his age probably, it's a good idea. It's a good incentive. Older children though, I suppose, would have to learn that they don't always get a reward for doing things" (Parent 2, control)

"I think if it's something that they wouldn't normally do, and if it's for somebody else, I think that's good to reward them (...) Vouchers were an excellent idea, because they have a monetary value and I think they are at this age aware of the value of money. I think they were a good idea because it's in his hand and he can go and spend it, and he knows that he got that because he has done something" (Parent 3, control)

When asked about what prizes could be used, many parents and children reiterated that vouchers were a good choice.

"Me - What type of prizes do you think are best for young people like you?"

Child 9 (intervention) - Vouchers

Me - Why is that?

Child 9 - Because that's basically the same without using my mum's and dad's money"

"Me - Other types of prizes that could be used?

Child 3 (control) - I liked the voucher idea because you can use it all the different shops"

"(...) Vouchers because he is aware they are money. Yes, he is. I couldn't think what else" (Parent 9, intervention)

Although vouchers included a congratulations note, one child suggested the addition of certificates.

"(...) a certificate (...) so that parents can like understand that you won something" (Child 6, intervention)

Other ways to promote ATS or PA in general suggested by children included organising walks, the mere use of the accelerometer (which would naturally make people more active), and putting in other prizes.

"You could take them on a trip as well, just to get more kids. Like a short trip to the park" (Child 1, control)

"If they take part in the pedometer and that, that's a good way to get active" (Child 2, control)

"Put in different prizes, so like... a bike helmet, then if they have a bike they can have a new bike helmet, and they can cycle to school" (Child 4, control)

All parental suggestions revolved around rewarding behaviour by accumulating points, but activities, little prizes or praise were seen as viable alternatives to vouchers.

"They can have a trampoline session, or their nails done or something. So they can save points for some things, to get something that they want" (Parent 5, intervention)

"Maybe the group of children who got more PA got a treat at school, or have someone external coming in" (Parent 7, intervention)

“I think children his age are quite happy with little things, you know? They're quite happy with little stickers and badges and things like that” (Parent 1, control)

“[Child] has got a lot of medals and he's proud of his medals (...) He likes to get up in assembly and get them and that. They do, yes, they feel proud” (Parent 9, intervention)

Head teachers and teachers supported the use of incentives and gave examples of similar ongoing ATS programmes in schools. One of the head teachers also suggested resorting to badges and other smaller prizes, which could be easy to obtain through Sustrans and other organisations. One teacher considered that high street vouchers were particularly attractive because they were different from the rewards that children were used to. Another teacher defended a moderate use of rewards.

(Showing materials) “Sustrans has lots like this, and little badges like that, they're lovely (...) These are the badges they get, plastic, but they love them (...) If you would want to make things like that, you'd be thinking that's far too much. But if you can tap into resources and work alongside another project, then that would work really well. So you worked with your rewards things along the lines of that, that would be fine” (Head teacher 2, intervention)

“They were all really excited cause they knew they could use them in the shops they wanted to. And it was something different from what they usually get, because they usually get badges and prizes in school” (Teacher 3, intervention)

“Do it whatever works. Whatever makes them more active, do it. Anything. We try to promote cycling to school, we've got cycling courses on today, we've got bike racks, we run competitions, we have a partnership with Sustrans. Just anything we do to promote activity” (Head teacher 1, control)

“It's like any motivation, as long as it's not overly used so they don't lose their value. We have house points but we don't give them out, they have to be earned” (Teacher 4, intervention)

For stakeholders, incentivising behaviour is a habitual technique and potentially effective, but is usually done in the context of certain organised activities (e.g. children go on bike rides and receive badges).

“Things we've seen in the past that have worked are if you can link in with a local leisure centre, or a local movie theatre, and be able to offer tickets for something. You take part. You've got a chance to win a free cinema ticket, which is a different version of the monetary value, a swim, or a gym session, or something” (Stakeholder 2)

Vouchers are also common but they are directed at a specific end (e.g. cinema, baseball match).

“That's something we've done (...) with cinema vouchers or vouchers to see the basketball, the Newcastle Eagles. That's worked” (Stakeholder 1)

The weekly frequency of the draws was viewed as an advantage, compared to monthly programmes where there is a longer delay between the performance of the behaviour and the reward.

“With your scheme as well, you had the weekly incentive, so it was a lot sooner where they were going to be reaping the benefits. Whereas with our scheme, it's a monthly based scheme, so they have to wait till the end of every month to be able to get the reward” (Stakeholder 2)

Five pounds was regarded as an appropriate amount, but in some cases, it might be excessive, or on the contrary, insignificant, depending on the family.

“As a weekly draw, I think your £5 per week was adequate” (Stakeholder 2)

“It depends where you are. It depends on the parents (...) It's funny because five pounds is a lot of money to some children, and it's nothing to others (...) And that's not necessarily based on demographics from what I've seen as well (...) I've worked with some schools where they're in really nice areas, and mum and dad have nice things and nice clothes and nice cars, but they don't have a lot of things” (Stakeholder 1)

One stakeholder would have preferred something that other people can see, for example in assembly, in order to motivate peers. Other possible strategies to promote ATS included teaching relevant skills, and using didactic materials. Working together with another organisation may be advantageous.

“My personal preference is something that people can see, so then when... Let’s say a cool kid at school has a badge on, then the other kids will be like, “I want to be like that kid. I want to have a badge” (Stakeholder 1)

“Giving skills and trying to break down barriers. So, one of the barriers is the kids will say, “Well, my bike’s got a puncture” or “The brakes don’t work.” So we fix the bikes. “I don’t know how to get to school, it’s a busy road.” So we show them a quieter road, or off road” (Stakeholder 1)

“They could have a termly booklet or a half term booklet. Each month, there are different activities that they take part in, as part of that booklet, and there’s a different theme, and it is quite engaging, and there are things for them to do with parents” (Stakeholder 2)

“Children could log on to a safe website where there may be games, and things that they could do interactively, which is all linked into your project, for example” (Stakeholder 2)

“Trying to build some corporate partnerships with local businesses, maybe that you then would be able to get your rewards for free, if they can become a partner of your project” (Stakeholder 2)

5.3.6 More general views about the study

One of the questions asked participants about their overall experience and opinion about the study, whether they were in the control or intervention group. All participants described their participation as enjoyable and beneficial.

“Me - Anything else that you enjoyed?”

Child 1 (control) - Well, to cut a long story short, just about all of it”

The only exception was the child who dropped out. However, child and parent gave different accounts when asked about the reasons for the dropout.

“I found the accelerometer uncomfortable, and quite a lot of forms” (Child 4, control, dropout)

“He tried to say “no, it’s kind of uncomfortable”, which I think it wasn’t. It was maybe his friends were not participating and then he felt that pressure” (Parent 4, control, dropout)

In a few cases, children spontaneously started talking about the importance of the study to promote their “fitness” or to reduce pollution, even though I had rarely, if ever, mentioned these reasons to them.

“Me – Do you think I should try again this reward scheme in the future?”

Child 8 (intervention) - Yeah

Me - Why is that?

Child 8 - Because I think it's good and it keeps people healthy”

“You were trying to keep us healthy and that because it wouldn't be as good if you just went in the car. Because you explained that you went in the car the smoke and that would come out at the back and hurt everyone” (Child 3, control)

Likewise, parents thought this was a good study (even the parent of the child who dropped out), and many appealed to the need to encourage healthier lifestyles at an early age.

“Overall, I thought it was a good study. Really, I think it's a good study. To see how we can help our kids to be more active, and knowing their physical fitness is a good thing” (Parent 4, control, dropout)

“To be honest, I did kind of forget that it was happening, case it was so easy to fill the form in and (child) was happy that he knew everything that was going on in school, and I just sent a text everyday” (Parent 3, control)

“It was fine, no problem. Everything was easy, quite straightforward” (Parent 9, intervention)

Generally parents thought the duration of the study was appropriate, but some reported being willing to participate for longer. However, one SMS respondent felt that sending texts every day for any longer period could be excessive.

“You should do it half year time. Especially when you compare on the winter time and the summer time” (Parent 6, intervention)

“How would it be for you, texting us every day [during half a year]?”

Parent 1 (control): Bit much”

Teachers and head teachers expressed satisfaction with the way the study was run, with the enjoyment of children in taking part, and with the little impact that the study had on their work.

“Head teacher 1 (control) - To be part of a study, to work with yourself from the university... I think that’s all well and good. We like to do things like that. We have been part of research projects before with other universities. I think it’s a benefit to both of us.

Teacher 1 (control) – It’s good for the children as well. To have you come in from university.

Head teacher 1– And they can voice their opinions about things, the pupils... and involve parents”

Both schools saw the duration of the study as appropriate and one suggested running it for a longer period, as a lunch time club where the paper work could be supplemented with some energiser games. Links between schools and universities were described as mutually beneficial.

“Yeah, you could have made it like a little club, and you could have run it at lunch time. Just 15-20min, might even be 30min. So you could do the paper work bit, then do the 15-20 min (...) ball, activities in the hall, something like that. So it’s like we do this, and we do this, so filling forms but we also get that little extra session because they do like when it is put on for them. That again might have increased your participation” (Head teacher 2, intervention)

5.3.7 ATS behaviour and contextual factors

Some children in the intervention school reported a higher frequency of active trips to school as a result of the scheme, others said that nothing changed, and others felt more motivated but already used to walk anyway.

“I wanted to try to earn more, like more vouchers. So I just kept on walking” (Child 6, intervention)

“With the draws, did anything change about how you travel to school?

Child 5 (intervention) - No, I usually walk twice a week”

“Me - Do you think the draws can make young people like you walk more to school?

Child 8 (intervention) - (nods)

Me - Did that happen to you?

Child 8 - It didn’t happen to me, because I always walked to school”

The variable impact of the scheme on ATS was echoed by parents, some of whom described the routine of partial active trips in detail. Sometimes, grandparents played an important role in the process, by escorting their grandchild to school.

“Me - Were there any changes in [child] motivation to walk to school after this scheme started?”

Parent 9 (intervention): No because with [child] (...) it was his year to walk by himself and come home by himself”

“It definitely motivates them more to walk, when she had that she wanted to walk every day, whereas now she maybe once or twice wants to walk to school. But she would have walked every day when she was doing the study (...) Sometimes I would take her to my mum's because she would want to walk every day. So she would have been driven half of the way and then walked in, cause she wanted to walk but I couldn't because I was starting work early (...) I just left at the same time I would normally leave, and I just dropped her off on the way. So it was alright for me”
(Parent 5, intervention)

“She realised that she would get in a better position to get pulled out of the draws if she was walking to school five days a week. But she was very much aware that she wasn't able to do it, that it wasn't feasible, because where her grandparents live (...) So what they did, they drove part of the way and walked the rest (...) She resigned herself to the fact that she was only able to walk to school perhaps once or twice a week. She was quite happy with that (...) Granddad was the driver, and grandma got the job of walking. And I think they quite enjoyed it, these couple of days that they did it.” *(Parent 7)*

“(...) He got a taxi from his dad's once and he actually asked his dad to stop the taxi so he could walk from the end of the long road to say he had walked. I said, “It doesn't work like that.” So he was constantly thinking about it and it was on his mind”
(Parent 8, intervention)

However, changes in school travel behaviour were also described by one parent in the control group, apparently due to the simple fact of being assessed.

“(...) It would be a very boring research because every morning I would have been ticking, “Did your child walk?” “Nope, nope, nope, nope, nope, nope” (...) But at least if on Monday – if the weather was nice and we left the house a little bit earlier, I can

park in [supermarket], walk up to school, he's got his scooter, and I would come back to the car (...) So basically that's why I did it; just for a little bit of variety, and I thought, "At the end of the day, he's benefiting – well, me as well – benefiting from it because we're getting a little bit of exercise that we wouldn't have normally had". So I saw that as a positive thing as well" (Parent 1, control)

In both cases, changes appeared to have ceased with the end of the study.

"But they fell back into the way of coming back into the car park now" (Parent 7, intervention)

On a number of occasions, parents highlighted factors underlying school travel mode choices, which are therefore relevant to the success of ATS interventions. The most common reason for car use given by parents was lack of time due to work commitments.

"I would anticipate a lot of people walk. But then again you have parents like myself who do work and sometimes you have just to drop and run" (Parent 3, control)

"Some mums have got a school run to do with three children so it would be better to drop their child off in the car and then go to the next school. I'm lucky, I've got one" (Parent 9, intervention)

Bad weather and having children to drop off at various schools were other obstacles to ATS mentioned by parents.

"[Talking about partway active trips during the scheme] On some days, whether it was because of the weather or circumstances, they weren't able to do that every day (...) (Parent 7, intervention)

5.3.8 School involvement

The involvement of school staff, and their acceptability of what and how much was asked from them, were aspects explored in the interviews. Head teachers played a particularly important role during the school recruitment phase, and for arranging initial sessions with participants. One head teacher volunteered to assist with the distribution and trial of the accelerometer belts in the classroom and with the completion of assent forms by children.

"Me - You helped me with the tasks of adjusting the belts and with the assent forms

(...) can you remember how you found this?

Head teacher 1 (control) - Absolutely fine yeah... Great (...) it was straightforward"

At the end of baseline week, one of the teachers in the control group offered to have a chat with one of the pupils who had expressed an intention to drop out (which he eventually did), and helped him complete the assent form at the time.

"Me - I remember at the beginning you had a word with [dropout child] and that was really helpful. Do you think it's ok to ask that from teachers?

Teacher 1 (control) – I think so, sometimes you need a bit of encouragement.

Head teacher 1 (control) – We pretty much think that if you sign up for something we follow it through, we don't let somebody down"

The involvement of the four Year 5 teachers was minimal, with the exception of one teacher in the intervention school. This teacher (teacher 3) attended most weekly sessions, took the group of participants to the computer room where the sessions happened, stayed in the room for the whole duration of the session, helped distribute and collect forms, and picked the winning ticket out of the bag in the draw. On one occasion, a session had to be re-arranged for another time and she agreed to collect and distribute forms and accelerometers in my absence.

"Me - How did you find [the level of assistance you provided me]?

Teacher 3 (intervention) - That was fine because the children just gave it to me when I did the register in the morning. I'd send it to the office with the register and then [receptionist] would put the things in the box for me. The children all know that, even [teacher 4] came and gave it to me while I was sorting them out. Children were very good on it, very organised"

"It was just great that you came, you just get on and you didn't put any demands on us to do anything for you" (Teacher 3, intervention)

All teachers and head teachers stated that they were happy to help, and considered that it is reasonable to expect a similar level of assistance from other schools in future studies.

"In a way probably other schools, quite a lot of other schools, may have other staff so it wouldn't have necessarily to be one of the teachers. There might be a teaching assistant or admin that could actually do that bit that [teacher 3] was doing. But I think it's just trying to get it all sorted initially then it just becomes a routine" (Head

teacher 2, intervention)

“Teacher 1 (control) - (...) It hasn't impacted on us teachers...

Head teacher 1 (control) - It hasn't, really... just a few emails from you... it has been easy, no trouble...”

Also relevant were the school receptionists, who collected materials at recruitment, and late forms and accelerometers throughout the study. These were kept in a cardboard box that I had provided to them for that purpose. Receptionists handed envelopes containing vouchers to children and to parents as appropriate (the rightful recipient was specified on the envelope). They also answered phone calls and emails about study-related matters, such as me running late because of the traffic, arranging a time and place for interviews with parents and children, re-scheduling a session, or queries about pupil absences. For that reason, they had a significant face-to-face contact with many of the participants, but stated that they were never asked anything that they did not know, or heard any complaints. They found the study workload easy to manage and saw it as a natural part of their roles.

“I did have to remind a couple of them to collect [the vouchers], but it had to be an adult to come and collect them, cause they were there a few days and they had forgotten that it was there, but that was all (...) Parents were fine” (Receptionist 1, control)

“Me - How much time did my study take from you?”

Receptionist 2 (intervention) - Not an awful lot. It was more routine, it was more as your things came in, things get sorted in pigeon holes whatever, it just blended in with everything else. I think probably the biggest task was the registers, but once I showed you how to do it, you did that. But no, it's been fine”

However, a few suggestions for improvement were made: providing receptionists with more background information about the study and the researcher(s) going to school, including a schedule of the expected visits and respective dates which they can post on the wall; making sure that children have had their lunches before being interviewed at lunch time; greater flexibility on the venue for interviews, including the possibility of conducting them in the corridor when necessary.

“I think it would have been better if that information would have been disseminated so that we knew what study you were doing, who was participating, and perhaps a

schedule of when you planned to be in school. That would have been helpful”
(Receptionist 3, intervention)

“It was at lunch time, you have to be careful to make sure that children get enough time for their lunch” (Receptionist 1, control)

“Even if you wanted to record, I think you could still be in the corridor to record it (...) It makes it easier, we can be more flexible for times and things, if you can do things like that. If you need an actual room (...) it would be harder for you to book in somewhere” (Receptionist 1, control)

Finally, stakeholders underlined the role that schools have in the successful delivery of this type of project, particularly the head teacher and the staff in the school office. Given the pressure that schools are subject to, it is fundamental to help them recognise the pertinence of the research being undertaken and give them as little extra workload as possible.

“If they see an intervention come to the school and it’s not going to be that beneficial to what they’re trying to achieve in the school, then they’re not going to support. If they can say, “Oh, yes, I can see that’s going to work for the kids because of this”, then you’re going to get the head teacher on board. And then if the head teacher is on board they’ll say to a staff member, “You’re going to have to do that.” That’s their job” (Stakeholder 1)

“Try to keep it as low a work rate for the teachers as possible. We’ve found that’s a big way of keeping schools engaged, and keeping them involved” (Stakeholder 2)

One suggestion was to create a group who runs the activities, or to assign this responsibility to a particular staff member.

“You need to have their support for it to be able to run, but once it starts running, what we’ve encouraged schools to do is to get the school councils, or set up groups who go into school, who can then look after the scheme and keep it running. You may only have one staff member that’s involved then (Stakeholder 2)

5.4 Discussion

This study employed individual interviews to investigate the views of children, parents and school staff about the procedures and materials associated with the trial and intervention of the RIGHT TRACKS pilot trial, described in Chapter 4. The aim was to

provide further data on the feasibility and acceptability of what was proposed.

5.4.1 Feasibility and acceptability

5.4.1.1 School recruitment

The rate of school recruitment was very low (3.3%). An important factor that became evident in my interviews was the workload and pressure that schools are subject to, which forces them to be selective in terms of collaborations with research and other type of projects. Although both participating schools reported liking the contact modes used (email and phone), little is known about the opinion of all other schools.

One head teacher suggested personally visiting schools, but as one stakeholder pointed out this is likely to be unfeasible in a large study. Instead, contacting schools via local authorities might be a better alternative, as suggested by both stakeholders. None of those interviewed mentioned the possibility of liaising with head teacher associations but this was the advice of the head teacher interviewed during the development stage (Chapter 3). I tried to gain a letter of support from Newcastle City Council, and finding the contact details of a head teacher association, but both pursuits were unsuccessful. Although greater efforts could be made in the future to create these links, a third suggestion by a head teacher was to partner with organisations such as Sustrans or Living Streets, who already have an established basis in many schools. In this study, this partnership only consisted in the provision of contact details of schools. However, in a future trial, it may be advantageous to deliver the intervention together with AST organisations already working in schools.

5.4.1.2 Individual recruitment

All participants held favourable views about the materials and procedures associated with individual recruitment. An interesting suggestion to improve the presentation session was to include a little game whereby children would run in the room and thus could see how levels of PA would be recorded by the accelerometer. Alternatively, children could be taken for a walk outside whilst wearing the belt, for a reasonable distance and at a brisk pace, to show them the levels of MVPA amassed.

While children attributed relatively little importance to the vouchers, teachers and some parents reported that these were a crucial element for recruitment. It is possible

that this discrepancy arose due to social desirability, and can be understood in the context of the theoretical framework discussed in Chapter 2, in terms of contingencies of social punishment and reinforcement. A child who is “greedy” and only motivated by material goods is likely to face negative and disapproving reactions from parents, teachers and significant others. Behaviours that show a desire to contribute to scientific knowledge and to help others irrespective of material rewards are more likely to receive approval and affection. However, there appears to be a lack of experimental studies investigating the origins of social desirability, possibly due to difficulties in manipulating such contingencies in the child’s natural context.

Teachers and stakeholders found the participant recruitment rate (33%) positive and typical. However, parents suggested that a shorter questionnaire, the option of completing it online, and more bullet points in the participation sheet, could have made recruitment materials more acceptable and procedures easier to implement. Parental interviews also suggested that an active consent (opt-in) procedure is more acceptable to them than passive consent (opt-out). However, in this case, active consent was the only possibility as parents needed to engage actively in the study by filling in report forms or sending SMS texts on a daily basis.

5.4.1.3 Randomisation

Random allocation to control or intervention group was clearly acceptable to everyone, which might in part be attributable to the provision of thank you vouchers in both arms. Nevertheless, some wondered if both schools could receive the intervention. Although some of the ideas suggested by children would be difficult to achieve, a waiting list control group design could be a possibility in a future trial.

5.4.1.4 Measurement procedures and materials

A number of issues were reported about the parental ATS report: times of the commute were difficult to estimate, which might hinder the analysis of PA associated with the journey to school; paper forms were often forgotten, either by the child or by the parent; two parents were unfamiliar with the form, which suggests that children might have completed them in some cases although it is difficult to know exactly how many. The mother whose child had returned a parent ATS report form with

ambiguous answers at baseline (section 4.3.5) was also interviewed and her spoken English suggested that she could have had difficulties in understanding the instructions on the form; regrettably, I forgot to address this issue during the interview.

These are important points as one objective of this feasibility study was to select an outcome measure for evaluation, which included comparing reports from both parents and children, and vis-à-vis accelerometer data. On the contrary, no issues were reported about replying by SMS. Thus, a potential solution could be to limit the options of reply mode to SMS texts, as this would give guarantee of a reply coming from the parent. This would probably mean a need to exclude information on times of departure and arrival, to keep the parent's task as easy and quick as possible. Parents who are less used to technologies could be put off, but an emphasis on the simplicity of the participation requirements – replying yes or no, nothing else – could make the study more attractive. Without data about times, reports would not be comparable against accelerometry, but PA levels during set periods (e.g. 1h before the start of the classes) could still be assessed.

Children found their own ATS report generally easy but one found it difficult to remember the information at times. An alternative, which would need to be negotiated with schools beforehand, would be for children to keep the form in the classroom and tick the respective box every morning.

All participants in interviews suggested that accelerometer assessments are generally feasible and acceptable, even in the classroom, with the exception of the child who dropped out. Initially, this child explained his decision based on the fact that the parent had no time to complete the forms, but at the time of the interview he only mentioned the discomfort of wearing the belt. On the contrary, the father believed his son's decision was likely to be due to the fact that his closer friends were not taking part in the study. Other children also mentioned feeling some discomfort, but only in the first days or until the belt was readjusted. Although discomfort caused by accelerometer wearing on the hip is rarely reported, extra attention may need to be paid to ensure that the belt is adjusted and worn properly. This could consist, for example, in issuing a note on information materials asking for parental involvement in the process (e.g. checking belt at home).

Interestingly, many children and parents reported an increase in PA during the accelerometer assessment. Children often receive approval and rewards for being physically active, and are often criticised for being sedentary (e.g. called “lazy”), which makes the accelerometer assessment and the researcher’s presence an opportunity to exhibit socially reinforced behaviours, or to avoid appearing sedentary. According to operant conditioning, these contingencies of reinforcement and punishment are the key mechanisms of behaviour change. However, the distinction between contingency-shaped and rule-governed behaviour is relevant here (Kudadjie-Gyamfi and Rachlin, 2002). Behaviour can change due to direct exposure to the above contingencies, as when people feel better, control their weight more effectively, or are socially approved, when they exercise. Another process consists in changing behaviour by imitating other people or following social rules, because doing as others do, or what others say, has led to reinforcement in other circumstances. This could explain why people behave in some ways even when their behaviours have no obvious consequences. In the present case, past experiences of both sorts, contingency-shaped and rule-governed, could have predisposed participants to be more physically active whilst being assessed, even though I gave them no signs of approval if they were active, or any form of criticism if they were not. In fact, most behaviour is only reinforced or punished on an intermittent basis. Nevertheless, this is only an interpretation consistent with the theoretical model described in Chapter 2. Again, despite some recognition of the contextual origins of social desirability (Kaminska and Foulsham, 2013), there seems to be, at present, a lack of experimental evidence to support this link.

Some parents expressed a will to be more involved in the accelerometer assessment and even to wear one themselves. Assuming this not to be another instance of social desirability, parents suggested that they were also concerned about their PA, or would welcome more opportunities to engage in research studies. One parent would like to have seen the researcher showing what an accelerometer is, and how to handle it. In this study, head teachers discouraged me from attending parent gatherings, which are often poorly attended. However, in a future study, it might be beneficial to explore the possibility of presenting the study face-to-face to those parents who wish and can attend the meeting, or providing them with a link to a YouTube video showing the accelerometer (and the study) procedures, alongside other approaches (e.g. information pack via pupil’s bag). Two additional suggestions

made by parents might also be easily feasible at little extra cost: sending an SMS reminder to the parent when the child is wearing the accelerometer so that they support the child in using the device; and providing participants with some basic information, numeric or graphic, on their accelerometer-assessed PA (also suggested by children). The latter suggestion may be easier to achieve with a pedometer which could provide immediate feedback on number of steps.

5.4.1.5 Incentive scheme

A central element of RIGHT TRACKS was the incentive scheme. The feedback received indicates that it is feasible and acceptable, to both children, families, stakeholders and schools. An encouraging finding was the increase in the motivation of the child to walk to school reported by some parents, which suggests that the intervention has potential to change behaviour. Two parents in the intervention school described the routine of her child being driven to school part of the way and walking the remainder, while the intervention was running, something that they had not done previously. This also supports the feasibility of a “park and stride” approach to promote ATS. Another mother from the intervention school explained how her child once asked their parent if the taxi driver could drop them off and they could walk the rest of the way to school, an indication that the intervention might have caused an impact on the child at least and that the child understood the concept of part-ATS trips. However, the interpretation of this particular mother (“It doesn’t work like that”) is ambiguous. She may not have understood that multi-mode trips could be entered into the draw, or she could have meant that it was impracticable for the taxi to drop off a child half-way to school. This latter interpretation would point to limited scope for partway active trips in the case of children who happen to travel to school by taxi. These examples may give some indication of children’s ‘pester power’, although this was not further explored in this study. Considering the evidence that school travel mode is most often decided by parents, a shift to ATS could occur due to children’s ability to persuade them, for example to let them enter a draw.

An increase in ATS reported by two parents seemed to have ceased with the end of the study. Whether the effects of an incentive scheme would last can be better answered in longer-term follow-up assessment in an evaluation trial. My qualitative data suggest that strategies to increase extrinsic motivation may be insufficient to

achieve sustained behaviour change, and therefore, that targeting intrinsic motivation (e.g. benefits of ATS to health and environment) may also be necessary.

Although described as an enjoyable experience, not all children reported feeling more motivated to travel actively to school than before. The reinforcing value of a voucher depends on a number of variables, particularly the immediacy of reinforcers associated with driving to school (Chapter 2). An analysis of antecedents and consequents of behaviour is important to describe its mechanisms of change, and may help explain why some children prefer being chauffeured to receiving a voucher. This has implications for promotional efforts, when children and parents are resistant to shifting to ATS. Withdrawing some of the reinforcers for car use (e.g. lower speed limits) may be necessary, in addition to making ATS more reinforcing.

Parents also reported that full or partway active trips were not always possible due to work commitments or unavailability of an escort. It is important to consider these contextual factors as much as possible, as simply increasing the reinforcing value of ATS with more vouchers might result in stronger opposition from parents and schools. Parents, stakeholders and teachers suggested that reinforcers such as accumulating points towards a final reward, medals and certificates might also be effective, as well as compliments and applauses during assembly. Interviews clearly indicated that the possibility of spending vouchers as one pleases was an advantage, but stakeholders' advice of using tickets for specific activities such as cinema or a sports match might also be worth considering. Perhaps a variety of incentives, as opposed to having the same week after week, could be a good addition to a future application of this scheme. One stakeholder also highlighted the advantages of offering the reward shortly after engagement in ATS, for example at the weekly draw (as in my case) as opposed to a scheme where children would only be rewarded monthly, which fits with the framework presented on Table 4.3.

5.4.1.6 Thank you vouchers

Interviews of participants from both arms of the trial expressed favourable opinions about the thank you vouchers. Some parents explicitly stated that it is appropriate to reward children for something that they would not do otherwise. Another reason, mentioned by parents in the control group, had to do with making the study fairer,

which might have made participation more acceptable among those who did not receive the intervention, or those who never won any draw in the intervention group.

5.4.1.7 General views about the study

Overall, the vast majority of reports supported the integrity of intervention and trial procedures. Both schools found the duration of the study appropriate and the intervention school considered that running it for a longer period would not cause special trouble. However, although parents generally agreed that a school term was an appropriate length, there was a mix of opinions about taking part in the study for a longer period such as six months. Thus, it is important to attest the validity of child reports, which could, if valid, make parents' daily or weekly involvement less necessary.

5.4.1.8 School involvement

School staff, including head teacher, teachers and receptionists, found the level of assistance they were required to provide acceptable. However, this could be due in part to the relatively short duration of the study. Head teachers, teachers and stakeholders clearly suggested that running a similar scheme as a lunch time club would have a number of advantages. It could be managed by other school employees and not necessarily teachers, would not take time from classes, and could therefore, be run over a longer period of time. Thus, these characteristics could make the scheme more acceptable and potentially contribute to a better school recruitment rate at the start.

5.4.2 Strengths and limitations

A strength of this qualitative study was the holistic approach taken to exploring the views associated with the various materials and procedures used from the perspective of children, parents, school staff and stakeholders. This gave a more complete picture of the feasibility and acceptability of each aspect of the study, and gave everybody the chance to have a say about their private feelings and thoughts. Most interviews, including children's, were conducted individually which might have contributed to the honesty of the reports. All interviews were conducted shortly after

participation in the pilot trial (including the dropout child) which might have helped towards a more accurate information recall.

However, this study had a number of limitations. The generalisability of the views expressed is questionable, since schools, school staff and parents who declined my invitation to take part could have very different opinions about the approach and procedures used. The two parents who initially expressed, but later withdrew, their interest in being interviewed did not provide any explanation for their change of heart. As far as data saturation is concerned, I felt that a wide range of views were covered and topics of discussion were often repeated across participants. Nevertheless, it is plausible that new issues and themes would have emerged had the sample been larger.

Children had had a weekly contact with me over almost three months, and despite the formal nature of these contacts, could have felt more inclined to share only positive views about the study when I interviewed them. Moreover, one child was interviewed in the presence of the head teacher at the parent's request, another child asked to be interviewed together with her best friend, and one parent had to be interviewed with her child in the room. These constraints could have contributed to the bias of opinions expressed. As child interviews were conducted during the morning break or at lunch time, children were often visibly looking forward to go outside and enjoy their remaining free time (e.g. looks at the clock), possibly rushing their answers to leave sooner. No inter-rater analysis was undertaken whilst entering or analysing data due to the limited resources.

5.5 Conclusion

The findings of this qualitative study suggest that the approach taken here to promote ATS is generally feasible and acceptable, but some reports and suggestions made indicate the need for additional piloting work. This is particularly true of recruitment strategies at the school level, and of ATS report validity. Schools and stakeholders suggested that a greater involvement with local authorities or other school-based organisations of ATS promotion might improve recruitment rates. Parents described fewer problems with the use of SMS reports than with paper reports (e.g. forgetting the form). Even less problematic seemed to have been the administration of child ATS reports. Children in both schools were generally curious about how active they

were during the accelerometer assessments, and giving them access to a graphic or numeric representation of their physical activity levels may further promote their engagement with the study. Interviewees also suggested that using a range of prizes (material and non-material such as activities) might help boost motivation, and that delivering this incentive scheme as a lunch club, run by school staff, might be beneficial.

Chapter 6 – Overall discussion and conclusion

6.1 Summary of results

This chapter integrates the main findings of the pilot trial (Chapter 4) and those of the qualitative study (Chapter 5), discussing these in the context of wider, related literature. A possible way of integrating quantitative and qualitative data consists in presenting data from both components together and considering whether findings from each method agree, complement or contradict each other (O’Cathain *et al.*, 2010). For example, the report of statistical results may be followed by qualitative themes that support or refute the quantitative result (Creswell *et al.*, 2011). Including qualitative research alongside a pilot trial, as part of a mixed-methods feasibility study, can maximise the value of that study in preparation for a future main trial (O’Cathain *et al.*, 2014). As a general reference, the above approach will be followed in the present discussion. Before, a summary of the main findings from the pilot trial, based on published guidance for reporting feasibility outcomes (Shanyinde *et al.*, 2011) (Bugge *et al.*, 2013), is presented in Table 6.1.

Methodological issues	Findings	Evidence
1. Did the feasibility/pilot study allow a sample size calculation for the main trial?	Yes, a total sample size of 80 to 170 would be required depending on cluster size (section 4.4.2)	MVPA during pre-classes hour: Standard deviation=3.26 Dropout rate: 7% Cluster size: 15 (two Year 5 classrooms per school) Estimated design effect=6.2
2. What factors influenced eligibility and what proportion of those approached were eligible?	Ineligibility was primarily due to participant refusal, both at the school and family levels.	- All 123 schools approached were eligible, and so were the 88 children (and respective parent) approached. - 2 participants could not take part because they returned their consent form after the deadline set
3. Was recruitment successful?	There were a number of problems with recruitment, particularly at the school level.	- 55.2% of schools failed to provide a definite answer - School recruitment needed to be extended by two weeks - Participant recruitment needed to be extended by one week
4. Did eligible participants consent?	Very low response from schools; better response from families.	- 3.3% of schools approached replied positively - 33.0% of families approached replied positively
5. Were participants successfully randomised and did randomisation yield equality in groups?	Generally worked well, but some of the differences between the two schools were known about before randomisation, and randomisation could not change that due to being at school level.	- The two schools were successfully randomised to control or intervention group. The number of children consenting was roughly equal in the two schools (14 and 15). - Control vs intervention: Free meals (school level) - 30.8 vs 10.6% Parents holding a degree (participant level data from questionnaire) – 15.4% vs 40.0%
6. Were blinding procedures adequate?	Not used in this study.	NA

7. Did participants adhere to the intervention?	Adherence to intervention was excellent	Intervention group (only): Retention 100% Session attendance 97.3% Return rates: Accelerometer 100% Parent ATS reports 94.4% Child ATS reports 98.9%
8. Was the intervention acceptable to the participants?	Low numbers recruited, but adherence suggests that it was acceptable	As above (evidence from qualitative data is provided later in this chapter)
9. Was it possible to calculate intervention costs and duration?	Data suggest that a full trial, run for roughly one school term, would cost from £10,960 to £12,480 depending on cluster size.	<p>Costs of the intervention (cluster RCT)= £603 including:</p> <ul style="list-style-type: none"> - Total cost per child: £190, including: <ul style="list-style-type: none"> - accelerometer (£175) - thank you vouchers (£10) - paper leaflets/forms/SMS (£5) - Total cost in intervention school (roughly one school term)= £413, including: <ul style="list-style-type: none"> - draws over eight weeks (£40) - transport (20 bus return trips, £78) - printing materials (£5) - biscuits & thank you card (£10) - approximately 35h of work (preparation and running intervention, at £8/hour rate*) (£280) <p>Cost of process evaluation per school=£550 including:</p> <ul style="list-style-type: none"> - interviews and average length, assuming 5 parents (40min), 5 children (21min), 1 interview with teachers (30min) and 1 stakeholder (60min): total transcription costs £395 (£1/minute) <ul style="list-style-type: none"> - costs of interviewer (approx. 10h), £80 - thank you vouchers for parents (£10/each) and children (£5/each), £75 <p>Per school: Intervention (£413) + process evaluation (£550) = £963</p> <p>Total costs in a study with a cluster size of 7, 10 or 15 and 10 schools: $(£190 \times 7) + (£963 \times 10) = £10,960$ $(£190 \times 10) + (£963 \times 10) = £11,530$ $(£190 \times 15) + (£963 \times 10) = £12,480$</p> <p>*The £8/h rate is for a teacher assistant which was comparable to mine as a PhD student</p>
10. Were outcome assessments completed?	Outcome measures used did assess main areas of interest pertaining to feasibility. Report validation data was quite incomplete.	Feasibility outcomes (overall in both schools): Recruitment 33.0% Retention 93.1% Session attendance 97% Return rates: Accelerometer 100% Parent ATS reports 82.5 % Child ATS reports 98.9% Report validation Trips where parent & child reports available 76.0% Trips with concurrent accelerometer data available varied from 40.8% to 58.9%
11. Were outcomes measured those that were the most appropriate outcomes?	Outcome measures generally yielded useful data from a feasibility viewpoint. No suggestion from	Report validation: Parental report availability Paper 82.5% SMS 98.2%

	interviews that there were other important outcomes not measured here.	Trips with concurrent accelerometer data available varied from 39.7% to 58.9% N and % of non-ATS trips available for MVPA comparisons varied between 13 and 20 and between 11.6% and 12.0% Information on stops on the way to school could not be used
12. Was retention to the study good?	Retention was excellent.	Both schools retained for the entire study period Overall participant retention 93.1% Control school 85.7% (2 dropouts) Intervention 100%
13. Were the logistics of running a multicentre trial assessed?	Yes, though actual arrangements varied between the two schools.	Time of the sessions Control – play time Intervention – class time Presence and involvement of teacher Control - No Intervention – Yes See section 3 (Chapter 4) for control vs intervention outcomes
14. Did all components of the protocol work together?	Components had strong synergy.	In general, I was able to implement and proceed with the study procedures. However, two protocol amendments were required, mainly around simplification of recruitment materials and greater flexibility in the provision of vouchers (see section 3.2.11.3). Sessions in the control school were noisier but did not cause trouble to data collection.

Table 6.1 - Summary of findings against 14 methodological issues for feasibility research

6.1.1 School recruitment

A total of 123 primary schools were approached to take part in this study. Compared to the average English primary school, these 123 schools had a larger school size (239.5 vs 220) (Bolton, 2013), higher eligibility for free meals (19.7% vs 15.2%), higher proportion of state-funded schools (99.2% vs 90.3), lower percentage of faith schools (25.2% vs 37.0%), and considerably fewer pupils for whom English was not the first language (3.8% vs 15.0%) (DfE, 2015). However, the schools approached reflect the characteristics of schools in the North East (DfE, 2015), which is one of the most deprived regions of the country (DCLG, 2011) and where people are the least likely to report a main language other than English (ONS, 2013). This consistency between the characteristics of my sample and those of all primary/junior schools in the North East suggests that the involvement with Sustrans, present or past, did not affect the representativeness of the schools in the region. (As explained earlier, contact details of the schools approached were provided by Sustrans, and therefore these were all schools which were currently or had been involved with Sustrans).

Out of 123 schools contacted, four (3.3%) replied positively. This is a very small number, considering the likely requirements of an evaluation trial using a cluster

randomised controlled design to evaluate intervention effectiveness and cost-effectiveness. My interview data, as well as brief justifications provided by schools who declined the invitation, strongly suggested that the busy schedule of schools was a major cause of this low recruitment rate. Yet previous school-based studies involving accelerometer assessments with similar age groups conducted in the UK have reported as many as 140 (70%) (Owen *et al.*, 2009), 92 (58.6%) (Van Sluijs *et al.*, 2008) and 8 (72.7%) (Lloyd *et al.*, 2012) primary schools recruited. In all these cases, school representatives were approached personally, either at school (Van Sluijs *et al.*, 2008; Owen *et al.*, 2009) or through a head teacher network (Lloyd *et al.*, 2012). As discussed earlier (section 3.2.4), the head teacher consulted during the development of this intervention also advised resorting to a head teacher association, but the relevant contact details for such an organisation in the study area could not be obtained. Consistently, head teachers and stakeholders interviewed as part of the RIGHT TRACKS study suggested that accessing schools via local authorities could have been a more viable recruitment strategy. Unfortunately, attempts to gain official support by the City Council were also unsuccessful (section 3.2.5), but in this study, this was only tried with one local authority (Newcastle), not with the other three into which the 123 schools could have fallen (23 schools (18.7%) were covered by Newcastle LA). Further efforts to liaise with schools through these means might be warranted, as well as the investment in resources for a more personalised recruitment process. However, better recruitment results have been reported elsewhere with the contact methods adopted in my study, email and phone (Kipping *et al.*, 2014; Jago *et al.*, 2015). In these two studies and in the other sources cited in this paragraph, it is either unclear who approached schools or whether the approach came from the chief investigator, who was a senior researcher in all cases. It is also unknown whether schools were paid for hosting the study, but the funding bodies stated on the above publications suggest a likely level of financial resource way above the one enjoyed by my study. Thus, it is possible that a student-led project as in my case could have made it less appealing to schools. This possibility was not raised in my interviews with school staff and it only occurred to me in subsequent discussions with my research team. On this issue, in the context of sexual education, recruiting schools by directly approaching staff attending training events was found to be far more successful than recruiting via a steering/advisory group member or through cold-call invitation (8 secondary schools recruited, number of pupils=831, age 14-16) (Aventin, 2016).

Selecting schools 'in need' of an ATS intervention (because of currently low levels of ATS) would likely maximise scope for change, and possibly willingness to participate. For this purpose, updated and accurate data on current ATS rates is needed. Paradoxically, those data may be less available or accessible for schools with low ATS, since they may be less likely to be already engaged with an organisation such as Sustrans or Living Streets. If the necessary data are not already available, a two-stage approach may be required: schools could first be surveyed as to current ATS levels, upon which eligibility for going into the trial would be based.

6.1.2 Participant recruitment and retention

The child participant recruitment rate of 33.0% (n=29) is below what has been reported in many AST studies conducted in the UK using an active consent (or opt-in) procedure, where it has ranged from 49% to 95% (Goodman *et al.*, 2012; McMinn *et al.*, 2012; Owen *et al.*, 2012; Hunter *et al.*, 2015). My qualitative data suggested that the requirements of the study, namely the completion of daily reports by the parent over a long period of time and the paperwork at recruitment, might have deterred some parents from taking part, despite efforts to simplify materials and procedures. Excessive paperwork and/or parental involvement have previously been identified as potential barriers to child recruitment in other school-based studies of health promotion (Drews *et al.*, 2009; Keightley *et al.*, 2014). In addition to reducing paperwork and parental involvement, a passive consent (or opt-out) strategy is likely to generate higher recruitment rates amongst pupils (Breslin *et al.*, 2012; Spence *et al.*, 2015).

The retention rate was 93.1% (n=27). This is comparable to that reported in two other ATS interventions of similar sample size and study duration (Kong *et al.*, 2009) (Coombes and Jones, 2016), both of which reported the use of incentives to boost adherence to procedures. It is possible that receipt of a reward – thank you vouchers and draw vouchers - could also have increased motivation to remain in my study, in accordance with findings from an international study on strategies for high retention rates among low-income families (McDonald *et al.*, 2012).

The fact that parents generally perceived their local areas as walkable and were available to travel with their child to school also may have favoured participant recruitment and retention, as well as parents' self-efficacy about their child's ability to

travel to school (section 4.3.4). This may also be related with the short distances that participants had to travel to get to school in this study (0.5 miles on average). Nevertheless, some parents (20 to 30%) reported the existence of major obstacles on the way to school, and relatively few (12% to 40%) were confident about their child crossing busy roads. This suggests that a more 'holistic' intervention to encourage ATS may be warranted, such as starting out by equipping children with skills around safe road crossing and choice of a safe route to school. According to the theoretical approach presented in section 2.3.2.4, environmental antecedents, social and non-social, determine the likelihood of ATS, and so do the consequences of behaviour. Training involving contingencies of reinforcement (e.g. 'stop and look' when crossing → receiving approval from an instructor or from parents) could help strengthen appropriate behaviours in children and also contribute to stronger feelings of (parental and child) self-efficacy. Self-efficacy and other psychological variables assessed in a behaviour-analytical intervention could be regarded as behaviour too, and therefore provide a richer picture of the ATS repertoire of participants, and be predictors of other forms of behaviour (e.g. walking/cycling behaviours).

6.1.3 Adherence to study procedures

Adherence to classroom-based activities was excellent. Session attendance and availability of children ATS reports (completed in the classroom) were always above 90%. Parental SMS reports of ATS were at similar levels. Compliance with other procedures not exclusive to the classroom was less satisfactory. Overall return of paper parental ATS reports was 78.1%, but only 60.0% in the control school. This overall rate is lower than the 92%-100% return rate of assessment tools in one previous AST study (McKee *et al.*, 2007) but higher than the return rates of 27%-54% reported in another (Hunter *et al.*, 2015). Unlike these two studies, however, my study involved the collection of parental ATS forms on a weekly basis, not just at baseline and end of study. In the interviews with parents, forgetfulness or risk of losing the parental form (at home or via the child) was only brought up by paper respondents, which could explain the difference in response rates between paper forms and SMSs. This is in keeping with the results of a pilot study on the monitoring of health behaviours in children (n=58, age 5-13), which found SMS reports (both by children and parents) to have somewhat lower attrition (28%) than paper diaries

(61%) and significantly greater adherence to intervention than paper diaries (43% vs 19%, $P < .02$) (Shapiro *et al.*, 2008).

Another issue raised in the parental interviews was the unfamiliarity with the paper parental ATS report. It must be noted that the two parents in question were SMS respondents, which is perhaps less concerning than if they had been regular paper respondents. That is because there were only two weeks, out of the nine, when they were expected to complete the paper forms, i.e. when the child wore the accelerometer (once at baseline and once over the course of the post-randomisation phase). However, the risk exists among all participants and deserves investigation, but I am not aware of studies where it has been discussed.

Accelerometer losses or breakages are common in objectively-measured PA research; for example, as many 13.3% (Basterfield *et al.*, 2011) or 2.5% (Cooper *et al.*, 2010) have been reported as lost or damaged. Encouragingly, all of the devices were returned undamaged in my study. This positive outcome may be thanks to the small sample size and also to the close contact that I had with participants, which allowed me to chase up those who failed to return the accelerometer on time. In total, 17.9% of accelerometers were returned late (usually collected upon my next visit, one week later) and one was only returned to me after the end of the pilot trial, further to an SMS reminder which the school issued to the family in question. Another potential reason for the excellent accelerometer return rate (independent of delay) was the provision of thank you vouchers. This was not explicitly mentioned by children or parents in the interviews, despite their recognition that thank you vouchers were a source of motivation to stay in the study.

The potential role of vouchers in a similar context has been investigated in a two-phased study by Audrey *et al.* (2012) with English adolescents (aged 12-13) (Audrey *et al.*, 2013). After the loss of 21% of accelerometers in phase I ($n=76$, no incentive), participants were rewarded with a £10 voucher in phase II ($n=234$) if they returned their accelerometer on time, resulting in an improved average loss rate of 12%. During focus group discussions, some students in that study said they would have worn and returned the accelerometer without the incentive, although others suggested they would not have done so. In the previous study, informing participants of the price of the accelerometer (£200) at the start of the wear period did not affect return rates, and participants reported wishing to have had access to graphs

depicting their levels of PA (Audrey *et al.*, 2013), similar to what some parents and children suggested in my interviews.

The rate of valid accelerometer recordings was 64.4% during the times specified by the parent as corresponding to the journey to school, and 78.7% during the hour before the classes, which did not require the parental report to be worked out. Usually, studies investigating PA during specific time-segments throughout the day report the proportion of participants who achieved the minimum wear requirements to calculate overall PA (e.g. 6h/day on at least three days), but not the percentage of those who provided sufficient wear time during the specific time segments (e.g. (Dessing *et al.*, 2013; Brooke *et al.*, 2016)).

In my study, the availability of recordings during the two above time frames, 64.4% and 78.7%, was below that of participants who met accelerometer overall wear time requirements of 6h/day on at least three days, which was 83.9%. It is possible that children who forgot to wear the accelerometer in the morning were able to catch up on wear time after school or over the weekend. One child and one parent in my interviews suggested that the departure from home to school was often hurried and therefore particularly prone to forgetfulness. This issue makes it more difficult to collect sufficient data for validation of ATS reports; it would have been less of a problem had the aim been simply to validate a self-report of general PA which could take place at any time of the day.

The percentage of those who, for purposes of overall PA, wore the accelerometer long enough in my study (83.9%) is consistent with what is commonly reported in the literature where a similar criterion has been applied (6h/day on at least 3 days) (King *et al.*, 2011; Basterfield *et al.*, 2014). The choice of this rather generous wear time criterion was suggested by Basterfield *et al.* (2011) who found that children (n=291, age 6-8) who wore the accelerometer for 6h/day on at least three days provided reliable data, irrespective of the days of the week, as no significant differences were observed in MVPA across the week (Basterfield *et al.*, 2011). In order to boost accelerometer wear, it has been recommended that instead of a single voucher to incentivise the return of the accelerometer (e.g. £10), two vouchers of lower value would be preferable: one (£5) upon return of the device, and one (£5) after data have been downloaded and checked for compliance with wear time requirements (Audrey *et al.*, 2013).

Most feasibility outcomes were more favourable in the intervention school than in the control school (see Chapter 4 for details). Tentative explanations for this difference include chance, true baseline differences, greater enthusiasm due to the receipt of the intervention, and the richer involvement of the school (section 4.4.4). My interview data can say little about the first two possibilities, but few differences were found between the demographics of a nationally representative cohort sample (n=6497) and those of the whole cohort sample (n=13,681) in the provision of valid accelerometer data (Griffiths *et al.*, 2013). However, in a large-scale family-based weight management intervention for childhood overweight and obesity (n=18,289), children were relatively less likely to complete it if they were from lone parent families or lived in less favourable socioeconomic circumstances (Fagg *et al.*, 2014). Both of these were more likely in my control group compared to my intervention group, although the low number of participants do not allow robust conclusions.

Regarding the third possibility, potential differences in enthusiasm and satisfaction between the intervention and control schools were unclear in my interviews. Like their intervention counterparts, control participants reported being generally pleased with their participation in the study, although some level of social desirability in responses from both groups cannot be dismissed. The novelty of an intervention has previously been identified as a potential motivator for participation in PA programmes (Withall *et al.*, 2012). This could explain why both groups were happy to take part in my study since engaging in research, wearing accelerometers and earning vouchers were unusual in their school routines; nonetheless, the novelty effect could have been greater in the intervention group who also received the incentive scheme. However, inter-group differences in satisfaction due to receipt of the intervention could not explain differences in adherence to procedures at the pre-randomisation stage.

A fourth possible explanation has to do with the involvement of the school staff, which was greater in my intervention school. In my qualitative study, stakeholders highlighted this factor in the successful delivery of an intervention, particularly the role of the head teacher and school office. Although these staff members were in fact essential in my study, particularly at an early phase, their level of involvement was comparable in both of my schools. A more marked difference was the continuous involvement of the Year 5 teacher in the intervention school, compared to the minimal participation of teachers in the control school. This aligns with findings from

cluster RCT evaluating a school-based PA programme for children (n=213, mean age 10.7 ± 0.6 years), whose PA levels were shown to be mediated by the social support provided by their classroom teacher (Eather *et al.*, 2013b).

6.1.4 Selection of an outcome measure

The validity of ATS reports was tested primarily by ascertaining the agreement between parental and child reports, and MVPA differences between reported ATS and non-ATS trips. Overall, parent and child agreed on 87.8% of reports and the chance-corrected agreement was moderate ($k=0.53$, CI 95% 0.45; 0.60).

MVPA differences between parent-reported ATS and non-ATS trips were significant, during parent-reported times as corresponding to the school journey ($U=390.5$, $p<0.05$) and in the pre-classes hour ($U=665.5$, $p<0.05$). MVPA differences between child-reported ATS trips and non-ATS trips were also significant, both during parent-reported trip times ($U=596.5$, $p<0.05$) and the pre-classes hour ($U=955.0$, $p<0.05$). Inter-rater reliability between parent and child reports was considerably higher in the intervention school ($k=0.716$) compared to control school ($k=0.264$), which raises the question of why one school yielded more favourable outcomes on so many aspects than the other. MVPA differences between ATS and non-ATS trips may be more easily detected in a fixed and wider timeframe (e.g. hour before the classes), as opposed to during times reported, possibly inaccurately, by participants, and by including only fully active trips. Further details on each of these topics are provided in section 4.4.6.

In the interviews, one child mentioned some difficulty in recalling school travel modes on some occasions, which gives some support to the hypothesis of recall difficulties. One parent reported being unsure what times to report in the case of partway active trips. This misunderstanding could have impacted on what some parents and children reported, and therefore complicated analyses of inter-rater agreement and accelerometer-related validity. Risks of misreporting mixed-mode trips should be addressed in future research.

6.2 Conclusion

The RIGHT TRACKS study suggested that a lottery-based incentive scheme to promote ATS is feasible but some trial procedures are not. Once enrolled, all participants in the intervention school remained for the whole duration of the study, attendance at draw sessions was always excellent, as well as the provision of materials for the draws. During interviews, participants from the intervention school provided further support for my approach and methods, but also some suggestions for modifications, such as the use of other rewards and the possibility of a similar scheme being delivered as a 'lunch club' run by school staff.

As to overall trial procedures in both schools, data collection procedures and materials showed to be feasible, session attendance was high, ATS reports showed to be valid compared to accelerometry, few adjustments were made to the study protocol, and retention was excellent. Recruitment of parents and children was relatively low and the school recruitment strategy stood out as not being feasible.

Most materials were returned and on time, but parental reports were less likely to be returned than the child report, which was always completed in the classroom. Parental reports by SMS were more likely to be returned than by paper, and were sent more quickly.

Validation of ATS reports was consistent with the wider literature: parent and child-reported ATS trips involved significantly higher levels of MVPA than non-ATS trips. However, the provision of accelerometer data associated with the journey to school was not optimal and there was a disproportionately low number of non-active trips with concurrent accelerometer output. MVPA differences between ATS and non-ATS trips were clearer when during a larger and fixed timeframe (hour before the class), than when during times reported by the parent, possibly inaccurately, as pertaining to the journey to school.

Total accelerometer wear (over a 24h period) was more satisfactory overall than when time-segmented (e.g. during times of the commute to school). The low levels of overall PA observed in this study reflect current national figures, highlighting the urgent need for effective PA promotion.

Differences between the two schools were observed in terms of retention, adherence and parent-child agreement. Although it is unclear why this happened, possible

explanations include: baseline differences (namely level of parental education and family composition); degree of satisfaction with the study (due to receipt of the intervention or not); and degree of involvement of the school in the study.

Based on the above data, a number of recommendations for future research can be made:

- More effective strategies to recruit schools and families are required. As examples, my data suggested recruiting through local authorities and existing organisations already working with the schools, in line with findings from previous research (Aventin, 2016). At the individual level, showing children the impact of a relatively short walk (i.e. a length achievable as a full or part ATS trip) on levels of MVPA may provide them with a better understanding of the study procedures and increase motivation to enrol in the study.
- An ATS incentive scheme should consider the use of a range of rewards in addition to vouchers, and also rewarding participants based on their levels of physical activity to which they would, ideally, have immediate access (e.g. pedometer that tells number of steps). It may also be possible for this scheme to be run as a 'lunch club' by school staff.
- Considering the widespread usage of technologies, further work should test the possibility of parental SMS-only reports or reports via the Internet (e.g. website, email), or at least explore ways of improving the use of paper reports.
- For validation of parental reports of ATS, the selection of a fixed and wider timeframe is likely to facilitate the detection of MVPA differences between ATS and non-ATS trips (or children). The combination of GPS and accelerometer may provide even more robust data on the validity of reports, as it allows an exclusive focus on the period of the journey to school.
- Additional work should investigate the potential role of factors such as parental education and family composition, excitement for receiving the intervention, and school involvement, in the assessment of feasibility outcomes.
- Whether any changes in ATS behaviour are maintained once the scheme is discontinued is another question for future research. Running this scheme for longer may contribute to more sustained behaviour change, as well as its implementation within broader intervention efforts (e.g. changes to physical environment). Data on the (potential) cost-effectiveness of this scheme may

also make it more appealing to funders and policy makers, even in the absence of evidence for sustained behaviour change.

Appendices

Appendix A – Parental questionnaire

Appendix B – Parent ATS report form (version used in accelerometer weeks)

Appendix C – Child ATS report form

Appendix D – First letter of ethical approval

Appendix E – Bar charts, child's walking and cycling to other destinations (questions 21-22 on parental questionnaire)

Appendix F – Bar charts, parental perceptions and attitudes about active travel (question 23 on parental questionnaire)

Appendix G – Bar charts, parental perceptions about local area (question 24 on parental questionnaire)

Appendix H – Bar charts, parental self-efficacy about child's ability to walk and cycle to school (questions 25-26 on parental questionnaire)

Questionnaire ID



Newcastle
University

Institute of
Health & Society

Parent/Carer Questionnaire



- The questions in this questionnaire relate to you or your Year 5 child.
- Completing this questionnaire will take approximately 30 minutes. If you prefer, you can stop part-way through and come back to it later.
- Please answer the questions as honestly and accurately as you can.
- If you make a mistake, please cross out the incorrect answer and give a new answer.
- Your answers will be treated as confidential.
- If you have any questions, please contact the RIGHT TRACKS study team:

Researcher's name: Mr Samuel Ginja

Institute of Health & Society, Newcastle University
Baddiley-Clark Building, Richardson Road,
Newcastle upon Tyne, NE2 4AX

Telephone: 0191 208 6459

Section 1: Parental travel and physical activity

The following set of questions is about the parent(s)/carer(s) who **live with the Year 5** child most time. If applicable, please ask your partner to answer these questions where appropriate or discuss the answers with him/her.

PARENT/CARER'S ACTIVITIES

1. This questionnaire is being completed by: *Please tick the box that applies.*
- a. Mother
 - b. Father
 - c. Other (c.g. grandparent, male carer, please describe):

2. Are you currently employed? *Please tick the box that applies.*
- a. Yes – **Go to question 3**
 - b. No – **Go to question 4**

3. How do **you** normally travel to work? *Please tick the option that applies, or options that apply if more than one, and write in the time spent (in minutes) for each travel mode used.*

<i>Travel mode</i>	<i>Time spent on average (min)</i>
<input type="checkbox"/> a. By car	_____
<input type="checkbox"/> b. By public transport	_____
<input type="checkbox"/> c. On foot	_____
<input type="checkbox"/> d. By bicycle	_____
<input type="checkbox"/> e. Work from home	

4. In a typical week during the past 4 weeks, how many hours did **you** spend on each of the following activities? *Please tick an option for each item.*

	0h	0-2h	2-4h	>4h
a. Walking, including walking to work, shopping and leisure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Cycling, including cycling to work and during leisure time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Other physical exercise (such as keeping fit, aerobics, swimming, jogging).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Do you live with a partner? *Please tick the box that applies.*

- a. Yes - **Go to question 6**
- b. No - **Go to question 10**

OTHER PARENT/CARER'S ACTIVITIES

6. What is **your partner's relationship** to the Year 5 child? *Please tick the box that applies.*

- a. Mother
- b. Father
- c. Other (e.g. male carer), please describe:

7. Is your partner currently employed? *Please tick the box that applies.*

- a. Yes – **Please go to question 8**
- b. No – **Please go to question 9**

8. How does **your partner** normally travel to work? *Please tick the option that applies (or options that apply) and write in the time spent (in minutes) for each travel mode used.*

- | <i>Travel mode</i> | <i>Time spent on average (min)</i> |
|---|------------------------------------|
| <input type="checkbox"/> a. By car | _____ |
| <input type="checkbox"/> b. By public transport | _____ |
| <input type="checkbox"/> c. On foot | _____ |
| <input type="checkbox"/> d. By bicycle | _____ |
| <input type="checkbox"/> e. Work from home | |

9. In a typical week during the past 4 weeks, how many hours did your partner spend on each of the following activities? *Please tick an option for each item.*

0h 0-2h 2-4h >4h

- | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| a. Walking, including walking to work, shopping and leisure | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Cycling, including cycling to work and during leisure time | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Other physical exercise (such as keeping fit, aerobics, swimming, jogging). | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Section 2 – Your Year 5 child’s travel modes

10. What is the gender of your Year 5 child? *Please tick the box that applies.*

- a. Boy
 b. Girl

11. How old is your Year 5 child? *Please write number in the box.*

Years

12. Does your child have a condition that affects his/her ability to be physically active?
Please tick the box that applies.

- a. No
 b. Yes. Please describe: _____

13. Can your child ride a bike? *Please tick the box that applies.*

- a. Yes
 b. No

14. Does your child have regular access to a bike? *Please tick the box that applies.*

- a. Yes
 b. No

15. How far does your child need to travel to get to school? *Please tick the box that applies.*

- a. Less than 1 mile
- b. 1-2 miles
- c. 2-3 miles
- d. Over 3 miles

16. How does your child travel to school on a typical day?
Please tick the option that applies, or options that apply, and write in the time spent (in minutes) for each travel mode used.

<i>Travel mode</i>	<i>Time spent on average (min)</i>
<input type="checkbox"/> a. By car	_____
<input type="checkbox"/> b. By school bus	_____
<input type="checkbox"/> c. By public transport	_____
<input type="checkbox"/> d. By bicycle	_____
<input type="checkbox"/> e. By walking	_____
<input type="checkbox"/> f. Other: _____	_____

17. Who does your Year 5 child go to school with on most days? *Please tick all the options that apply*

- a. My child goes alone.
- b. With me or my partner.
- c. With an older sibling (brother or sister).
- d. With other children (e.g. friends, neighbours).
- e. With other adult(s) (e.g. carer, other parents).
- f. Other. Please describe: _____

18. How does your child travel from school on a typical day?
Please tick the option that applies, or options that apply, and write in the time spent (in minutes) for each travel mode used until arrival at home.

<i>Travel mode</i>	<i>Time spent on average (min)</i>
<input type="checkbox"/> a. By car	_____
<input type="checkbox"/> b. By school bus	_____
<input type="checkbox"/> c. By public transport	_____
<input type="checkbox"/> d. By bicycle	_____
<input type="checkbox"/> e. By walking	_____
<input type="checkbox"/> f. Other: _____	_____

19. Who does your Year 5 child return from school with on most days? *Please tick all the options that apply*

- a. My child returns from school alone.
- b. With me or my partner.
- c. With an older sibling (brother or sister).
- d. With other children (e.g. friends, neighbours).
- e. With other adult(s) (e.g. carer, other parents).
- f. Other. Please describe: _____

20. Who decides whether your child walks (or cycles) to school or not? *Please tick the box that applies*

- c. Parent(s)/carer(s)
- d. Child
- e. Other. Please describe: _____

21. How often does your Year 5 child walk to the following places? *Please tick one box on each line*

	<i>Never</i>	<i>None within walking distance</i>	<i>Less than once a week</i>	<i>1 to 3 times per week</i>	<i>4 to 5 times per week</i>	<i>6 or more times per week</i>
a. Friend's house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Parks or playgrounds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Sports venue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22. How often does your Year 5 child ride a bike to the following places? *Please tick one box on each line*

	<i>Never</i>	<i>None within walking distance</i>	<i>Less than once a week</i>	<i>1 to 3 times per week</i>	<i>4 to 5 times per week</i>	<i>6 or more times per week</i>
a. Friend's house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Parks or playgrounds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Sports venue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section 3 – Your perceptions and attitudes towards active travel

23. Below are a number of statements that might be made about your child's journey to school. Please circle the number that best indicates your agreement or disagreement with *each statement*.

	1	2	3	4	5
	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
a. The traffic makes it too dangerous for my child to walk to school.	1	2	3	4	5
b. The traffic makes it too dangerous for my child to cycle to school.	1	2	3	4	5

	1	2	3	4	5
	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
c. My child cannot walk to school as it's too far away.	1	2	3	4	5
d. My child cannot cycle to school as it's too far away.	1	2	3	4	5
e. It is more convenient to take my child to school by car.	1	2	3	4	5
f. I am worried that something will happen to my child on the way to school.	1	2	3	4	5
g. I'm usually around to take my child to school.	1	2	3	4	5
h. I take my child to school on the way to somewhere (e.g. work).	1	2	3	4	5
i. There are no safe cycle paths on the way to school.	1	2	3	4	5
j. There are no safe pavements on the way to school.	1	2	3	4	5
k. I like or would like my child to walk to school.	1	2	3	4	5
l. I like or would like my child to cycle to school.	1	2	3	4	5
m. If walking or cycling, my child may walk past convenience stores and buy unhealthy snacks or drinks.	1	2	3	4	5
n. If walking or cycling, my child is more likely to engage in harmful or anti-social behaviours (e.g. smoking, vandalism or bullying others).	1	2	3	4	5
o. If walking or cycling, my child is more likely to be bullied by others.	1	2	3	4	5

24. Below are a number of statements that might be made about your local area. Where mentioned 'within easy walking distance' means within a 10-15 minute walk from your home. *Please circle the number that best indicates your agreement or disagreement with each statement.*

	1 Strongly disagree	2 Somewhat disagree	3 Somewhat agree	4 Strongly agree
a. There are shops to visit within easy walking distance of my home.	1	2	3	4
b. There is a park or open space to visit within easy walking distance of my home.	1	2	3	4
c. There is a sports or leisure centre within easy walking distance of my home.	1	2	3	4
d. It is pleasant to walk in my local area.	1	2	3	4
e. There are pedestrian crossings to help walkers cross busy streets in my local area.	1	2	3	4
f. I feel generally safe walking in my local area.	1	2	3	4
g. The crime rate in my local area makes it unsafe to go on walks at night.	1	2	3	4
h. It is easy to walk to a bus stop from my home.	1	2	3	4
e. There are few cul-de-sacs (dead-end streets) in my local area.	1	2	3	4
j. There are a lot of busy junctions in my local area.	1	2	3	4
k. There are major barriers to walking in my local area that make it hard to get from place to place (for example, busy roads, railway lines, rivers, hills).	1	2	3	4
l. There are many alternative routes for getting from place to place in my local area. (I don't have to go the same way every time).	1	2	3	4

	1 Strongly disagree	2 Somewhat disagree	3 Somewhat agree	4 Strongly agree
m. There are pavements on most of the streets in my local area.	1	2	3	4
n. There are cycle paths in or near my local area that are easy to get to.	1	2	3	4
o. There is a verge that separates the streets from the pavements in my local area.	1	2	3	4
p. There are trees along the streets in my local area.	1	2	3	4
q. There are diverse and interesting things to look at in my local area (e.g. buildings and views).	1	2	3	4
r. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my local area.	1	2	3	4
s. There is so much traffic along nearby streets that it makes it difficult or unpleasant to cycle in my local area.	1	2	3	4
t. The speed of traffic on most nearby streets is usually slow (30 mph or less).	1	2	3	4
u. Most drivers exceed the posted speed limits while driving in my local area.	1	2	3	4
v. My local area streets are well lit at night.	1	2	3	4
w. Walkers and cyclists on the streets in my local area can be easily seen by people in their homes.	1	2	3	4
x. There is a high crime rate in my local area.	1	2	3	4

25. How confident are you that your child can...

Please circle the number that best indicates your agreement or disagreement with each statement.

	1 Not at all Confident	2 Not Particularly Confident	3 Somewhat Confident	4 Quite Confident	5 Very Confident
a. Walk to school	1	2	3	4	5
b. Ask a parent or other adult to walk to school with them	1	2	3	4	5
c. Ask a friend to walk to school with them	1	2	3	4	5
d. Walk to school even if their friends don't walk	1	2	3	4	5
e. Walk to school in bad weather	1	2	3	4	5
f. Cross difficult roads when walking to school	1	2	3	4	5
g. Cope with busy traffic when walking to school	1	2	3	4	5
h. Walk to school even if there are many cars near the school entrance	1	2	3	4	5

	1 Not at all Confident	2 Not Particularly Confident	3 Somewhat Confident	4 Quite Confident	5 Very Confident
i. Walk to school even if there are not enough lollipop people	1	2	3	4	5
j. Walk to school even if they are frightened of meeting strangers	1	2	3	4	5
k. Walk to school even if they are frightened of being bullied	1	2	3	4	5
l. Walk to school even if there is poor lighting	1	2	3	4	5
m. Walk to school even if it takes a long time	1	2	3	4	5
n. Find a route to walk to school	1	2	3	4	5

If your child is unable to ride a bike or does not have a bike, please skip to question 27.

26. How confident are you that your child can...

Please circle the number that best indicates your agreement or disagreement with each statement.

	1 Not at all Confident	2 Not Particularly Confident	3 Somewhat Confident	4 Quite Confident	5 Very Confident
a. Cycle to school	1	2	3	4	5
b. Ask a parent or other adult to cycle to school with them	1	2	3	4	5
c. Ask a friend to cycle to school with them	1	2	3	4	5
d. Cycle to school even if their friends don't cycle	1	2	3	4	5
e. Cycle to school in bad weather	1	2	3	4	5
f. Cross difficult roads when cycling to school	1	2	3	4	5
g. Cope with busy traffic when cycling to school	1	2	3	4	5
h. Cycle to school even if there are many cars near the school entrance	1	2	3	4	5

	1 Not at all Confident	2 Not Particularly Confident	3 Somewhat Confident	4 Quite Confident	5 Very Confident
i. Cycle to school even if there are not enough lollipop people	1	2	3	4	5
j. Cycle to school even if they are frightened of meeting strangers	1	2	3	4	5
k. Cycle to school even if they are frightened of being bullied	1	2	3	4	5
l. Cycle to school even if there is poor lighting	1	2	3	4	5
m. Cycle to school even if it takes a long time	1	2	3	4	5
n. Find a route to cycle to school	1	2	3	4	5

Section 4: About your family and your household

This section will allow us to describe the families in our study. Questions are about the parents or carers of your Year 5 son/daughter now. If applicable, please ask your partner to answer these questions where appropriate or discuss the answers with him or her.

Question 27 can help us study important factors of the environment around your child's home and route to school, such as busy roads, quality of pavement and air quality. We would appreciate if you could provide us with the full postcode of the address, and remind you that all data are confidential and will only be accessed by the research team.

27. What is the postcode for the home address where your Year 5 child spends most time?

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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28. How many people live in the household in total? *Please write number in the box.*

<input type="text"/>

29. How many young people in each of the age bands are there in the household (including young person taking part in the study)? *Please write a number in each box.*

<input type="text"/>	0-3 years
<input type="text"/>	4-6 years
<input type="text"/>	7-11 years
<input type="text"/>	12-16 years

30. Is there a car available to drive your child to school? *Please tick only one option.*

<input type="checkbox"/>	a. Yes
<input type="checkbox"/>	b. No

31. Is there a car available to drive your child from school? *Please tick only one option.*

<input type="checkbox"/>	a. Yes
<input type="checkbox"/>	b. No

32. Do you have any of the following qualifications? Please tick all that apply.

- a. Degree or Higher Degree
- b. A Levels, professional qualification or equivalent
- c. GCSE's, CSE's, O Levels or equivalent
- d. None of the above

33. What is the ethnic group of the parents/carers of your Year 5 son/daughter? Please write the appropriate letter in the boxes below.

White

- A – British
- B – Irish
- C – Any other white background

Mixed

- D – White & Black Caribbean
- E – White & Black African
- F – White & Asian
- G – Any other mixed background

Asian

- H – Indian
- J – Pakistani
- K – Bangladeshi
- L – Any other Asian background

Black or Black British

- M – Black Caribbean
- N – Black African
- O – Other Black

Chinese or other ethnic group

- P – Chinese
- Q – Other ethnic group

Ethnic group of parent/carer 1:

Ethnic group of parent/carer 2 (*if applicable*):

This is the end of the questionnaire. Please check that you have answered all the questions.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE. PLEASE SEAL IN THE ENVELOPE PROVIDED AND RETURN TO THE CLASSROOM ON, OR BY POST BY MONDAY 15th SEPTEMBER

Appendix B – Parent ATS report form (version used in accelerometer weeks)

ID No:

Active School Travel - Parent Report for the seven day period starting on: Tuesday 14th October

Please select the appropriate option, YES or NO, and indicate the times for each question below as the week goes by.

On Tuesday 14th October did your child walk or cycle to school, all or part of the journey?

YES NO (please put a cross (X) in one box only)

- At what time did your child leave home? _____
 - At what time did your child arrive at school? _____
 - Did your child stop anywhere on the way? YES NO
- Only if YES - how long was the stop for? _____ minutes

On Wednesday 15th October did your child walk or cycle to school, all or part of the journey?

YES NO (please put a cross (X) in one box only)

- At what time did your child leave home? _____
 - At what time did your child arrive at school? _____
 - Did your child stop anywhere on the way? YES NO
- Only if YES - how long was the stop for? _____ minutes

On Thursday 16th October did your child walk or cycle to school, all or part of the journey?

YES NO (please put a cross (X) in one box only)

- At what time did your child leave home? _____
 - At what time did your child arrive at school? _____
 - Did your child stop anywhere on the way? YES NO
- Only if YES - how long was the stop for? _____ minutes

On Friday 17th October did your child walk or cycle to school, all or part of the journey?

YES NO (please put a cross (X) in one box only)

- At what time did your child leave home? _____
 - At what time did your child arrive at school? _____
 - Did your child stop anywhere on the way? YES NO
- Only if YES - how long was the stop for? _____ minutes

On Monday 20th October did your child walk or cycle to school, all or part of the journey?

YES NO (please put a cross (X) in one box only)

- At what time did your child leave home? _____
 - At what time did your child arrive at school? _____
 - Did your child stop anywhere on the way? YES NO
- Only if YES - how long was the stop for? _____ minutes

*Thank you for your time in completing this form. Please ensure that you have answered all of the questions and return to the classroom **on Monday 20th October**. Note that this form can be returned by your child.*

Note: The parent ATS report form used in all other weeks (non-accelerometer weeks) was similar to this one, but only the first question was asked followed by the YES or NO response options.

Appendix C – Child ATS report form

ID No:

**Active school travel - Young person report for the week starting on
Tuesday 7th October**

Please answer YES or NO (only one), for each question. Try to remember the best you can.

1. **On Tuesday did you walk or cycle to school, all or part of the journey?** YES NO (put a cross (X) in one box only)

2. **On Wednesday did you walk or cycle to school, all or part of the journey?** YES NO (put a cross (X) in one box only)

3. **On Thursday did you walk or cycle to school, all or part of the journey?** YES NO (put a cross (X) in one box only)

4. **On Friday did you walk or cycle to school, all or part of the journey?** YES NO (put a cross (X) in one box only)

5. **On Monday did you walk or cycle to school, all or part of the journey?** YES NO (put a cross (X) in one box only)

Make sure you have answered all of the questions. Return the completed form to the researcher. Thank you!

Appendix D – First letter of ethical approval



27 May 2014

Samuel Ginja
PhD student
Institute of Health & Society

Faculty of Medical Sciences
Newcastle University
The Medical School
Framlington Place
Newcastle upon Tyne
NE2 4HH United Kingdom

FACULTY OF MEDICAL SCIENCES: ETHICS COMMITTEE

Dear Samuel

Title: The RIGHT TRACKS study - development and feasibility of a reward programme to promote active school in Year 5 children

Application No: 00759/2014

Start date to end date: 01 May 2014 to 31 August 2015

On behalf of the Faculty of Medical Sciences Ethics Committee, I am writing to confirm that the ethical aspects of your proposal have been considered and your study has been given ethical approval.

The approval is limited to this project: **00759/2014**. If you wish for a further approval to extend this project, please submit a re-application to the FMS Ethics Committee and this will be considered.

During the course of your research project you may find it necessary to revise your protocol. Substantial changes in methodology, or changes that impact on the interface between the researcher and the participants must be considered by the FMS Ethics Committee, prior to implementation.*

At the close of your research project, please report any adverse events that have occurred and the actions that were taken to the FMS Ethics Committee.*

Best wishes,

Yours sincerely

A handwritten signature in black ink, appearing to read "M. Holbrough".

Marjorie Holbrough
On behalf of Faculty Ethics Committee

cc.
Professor Andy Hall, Chair of FMS Ethics Committee
Ms Lois Neal, Assistant Registrar (Research Strategy)

*Please refer to the latest guidance available on the internal Newcastle web-site.

tel: +44 (0) 191 222 6000
fax: +44 (0) 191 222 6621

www.ncl.ac.uk

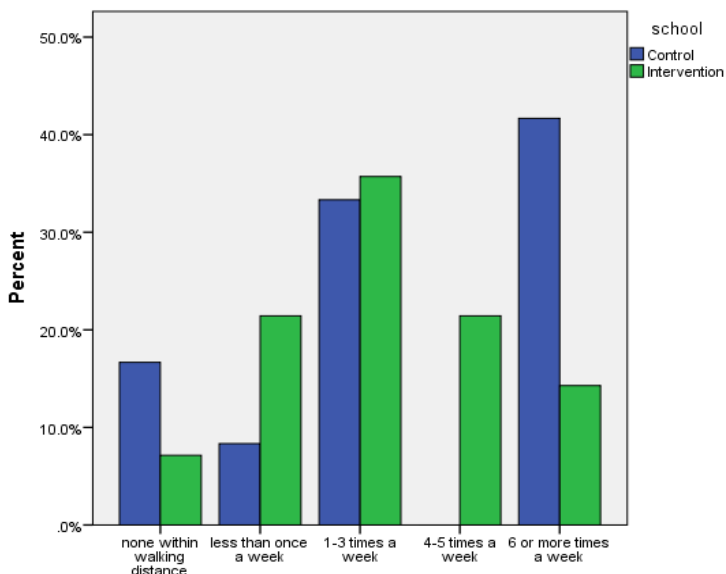
The University of Newcastle upon Tyne trading as Newcastle University



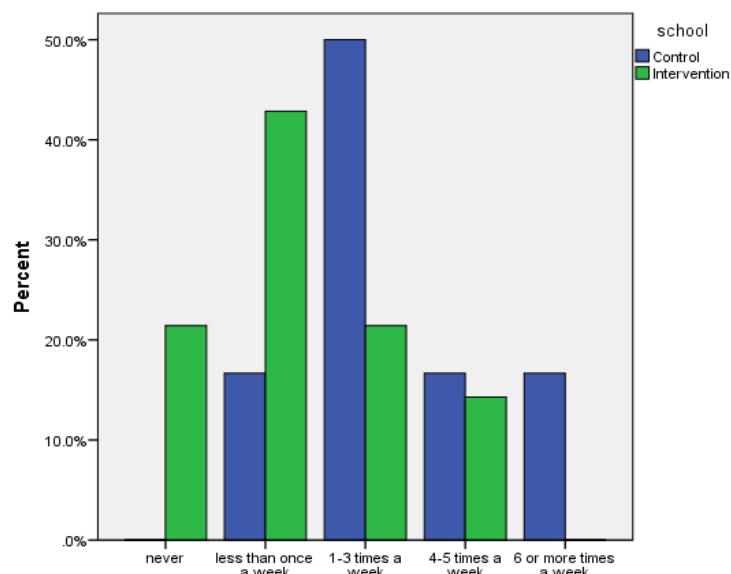
THE QUEEN'S
ANNIVERSARY PRIZES
FOR 1954 AND POSTER EDUCATION

2009

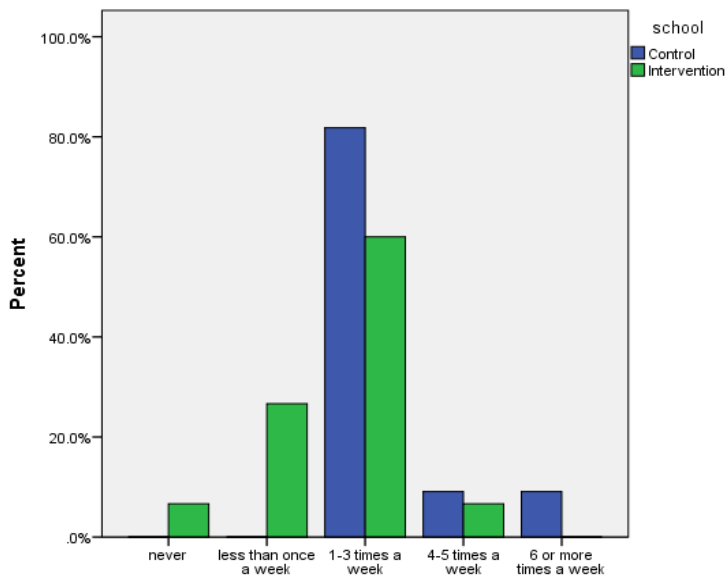
Appendix E – Bar charts, child’s walking and cycling to other destinations (questions 21-22 on parental questionnaire)



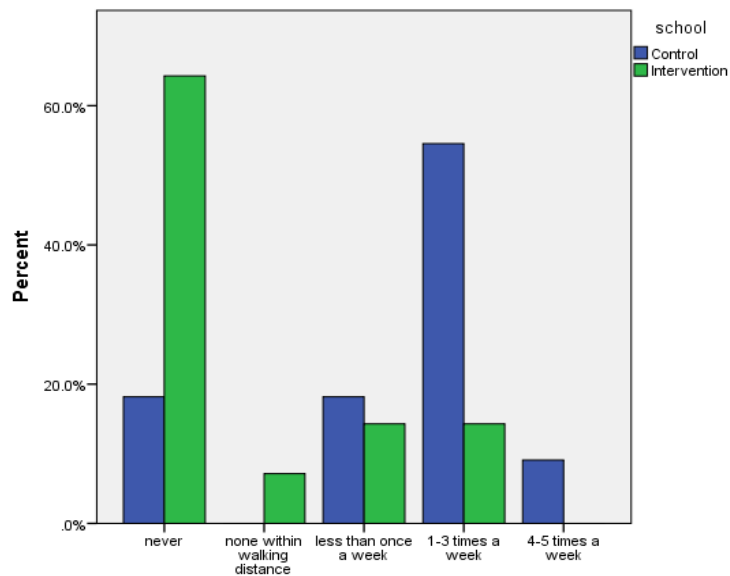
21a. How often does your Year 5 child walk to: Friend's house



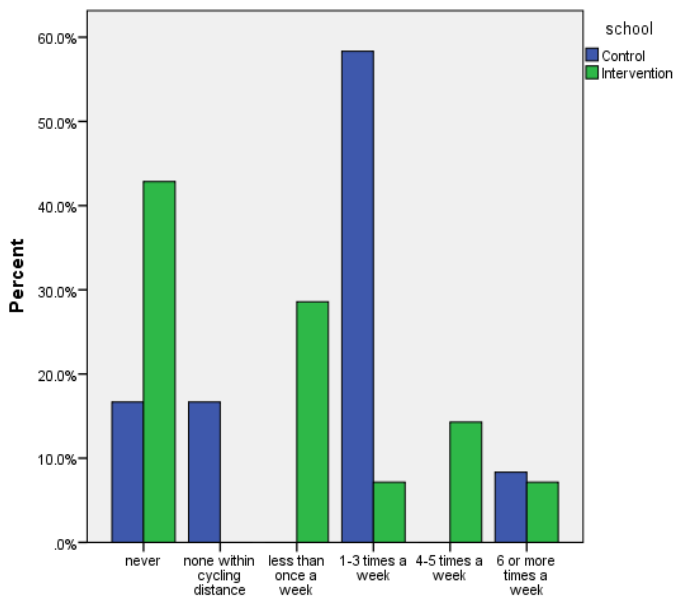
21b. How often does your Year 5 child walk to: Parks or playgrounds



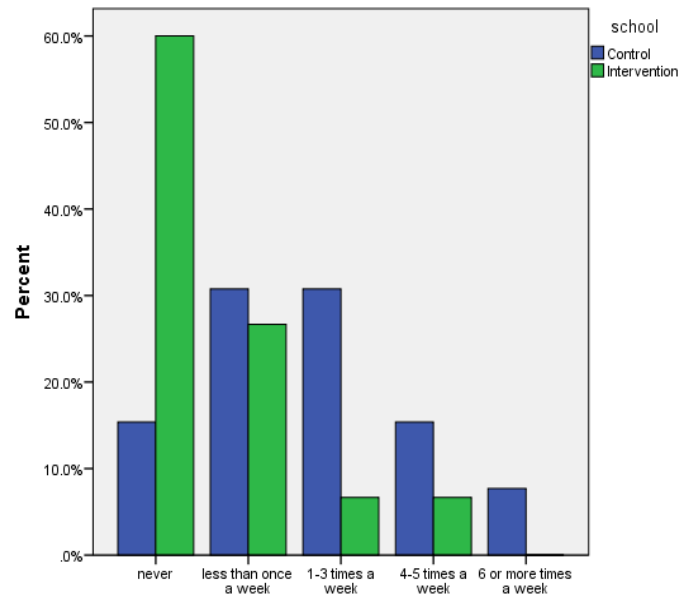
21c. How often does your Year 5 child walk to: Shops



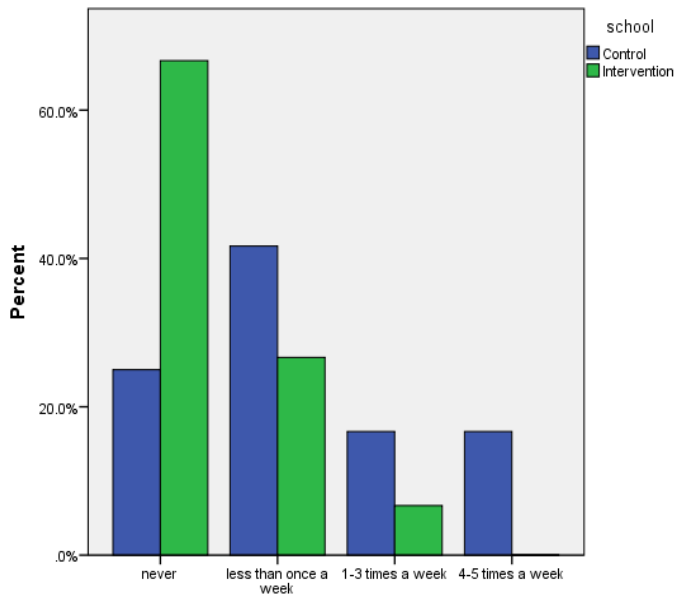
21d. How often does your Year 5 child walk to: Sports venue



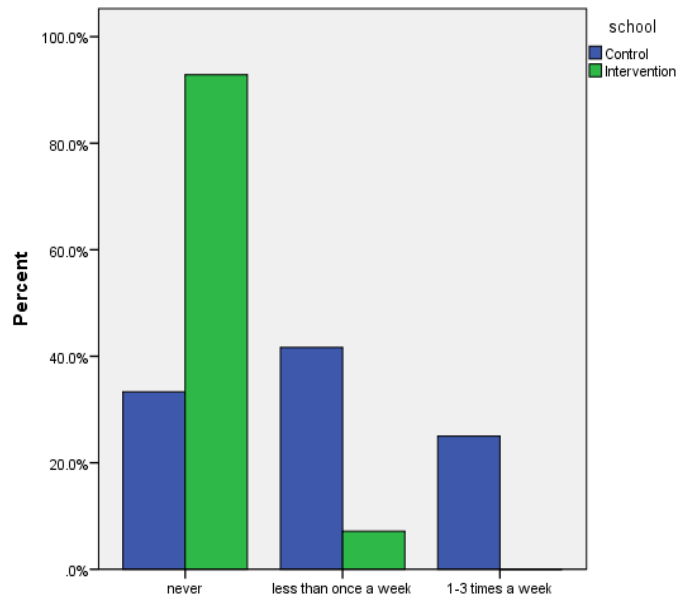
22a. How often does your Year 5 child ride a bike to: friend's house



22b. How often does your Year 5 child ride a bike to: parks or playgrounds

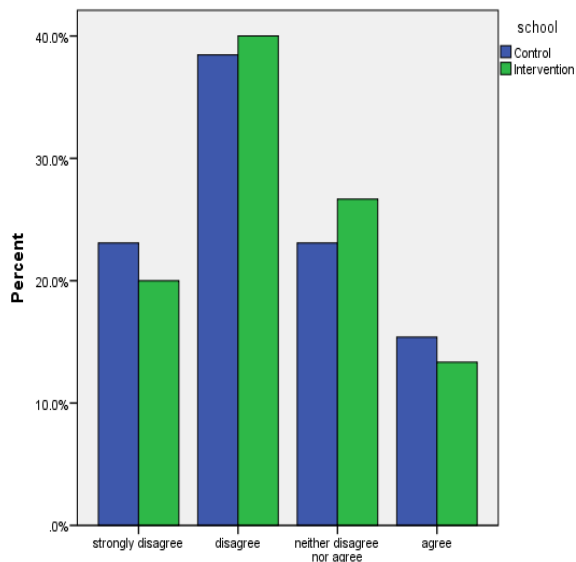


22c. How often does your Year 5 child ride a bike to: Shops

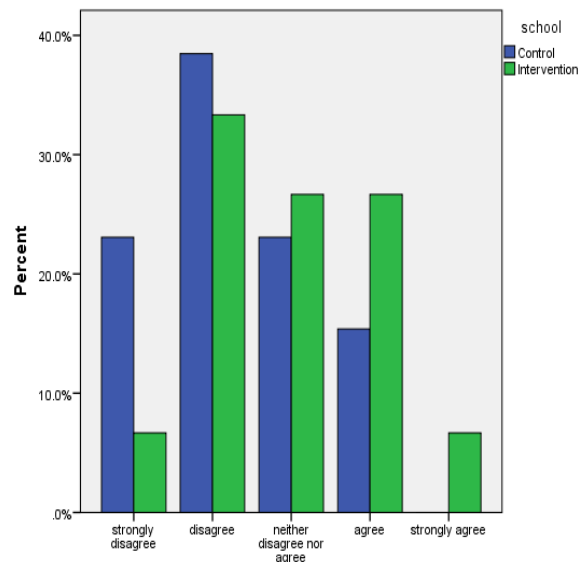


22d. How often does your Year 5 child ride a bike to: sports venue

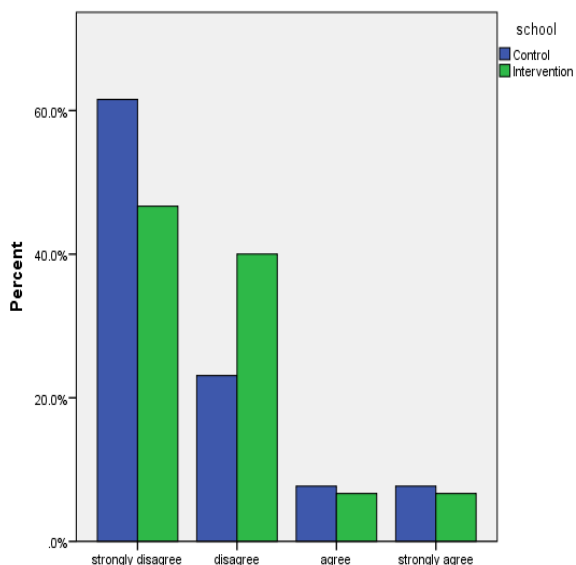
Appendix F – Bar charts, parental perceptions and attitudes about active travel
(question 23 on parental questionnaire)



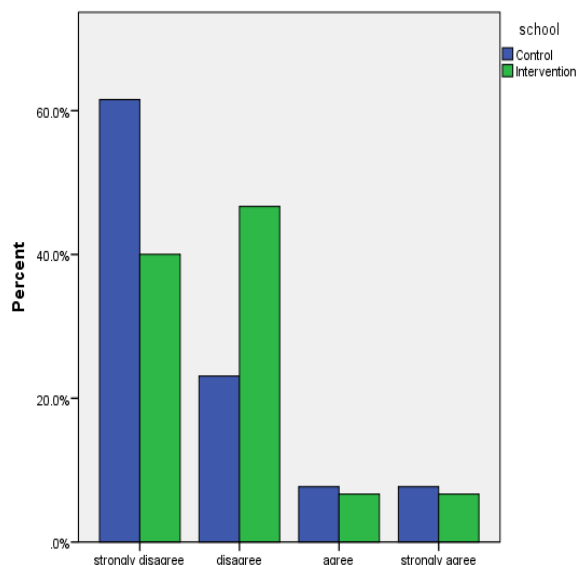
23a. The traffic makes it too dangerous for my child to walk to school.



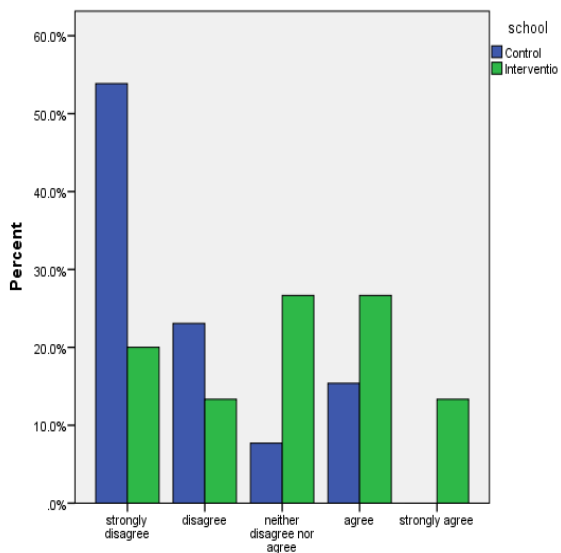
23b. The traffic makes it too dangerous for my child to cycle to school.



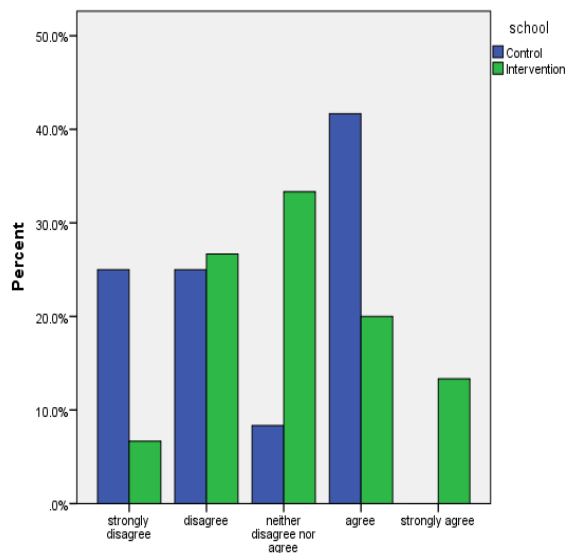
23c. My child cannot walk to school as it's too far away.



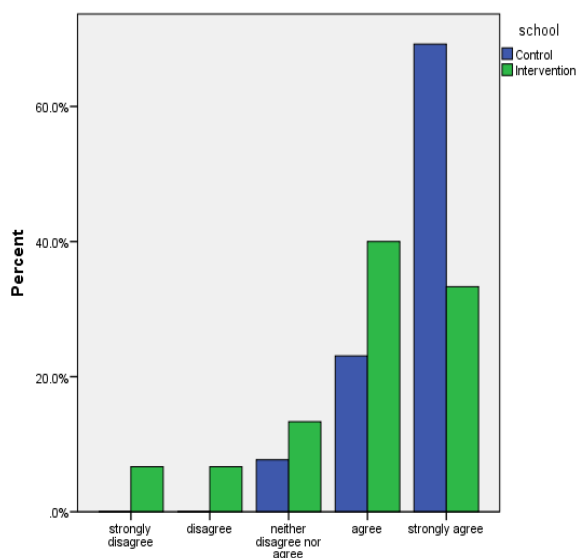
23d. My child cannot cycle to school as it's too far away.



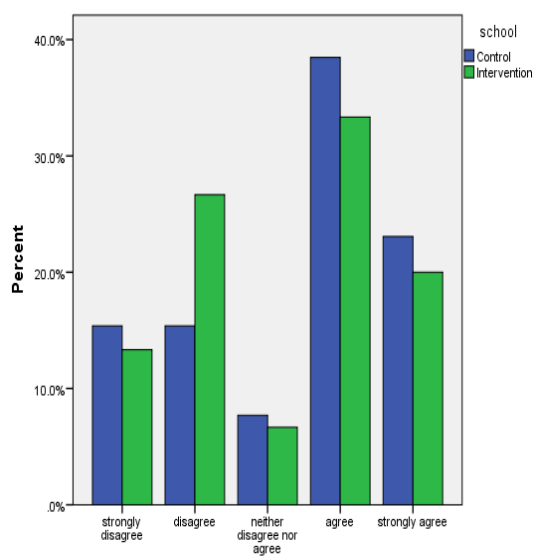
23e. It is more convenient to take my child to school by car.



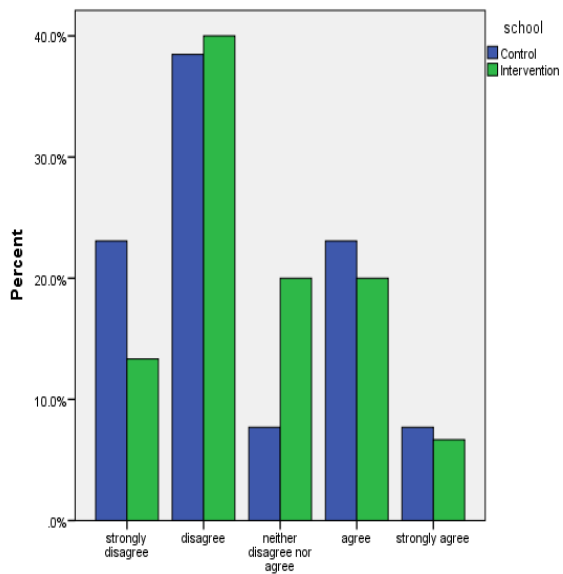
23f. I am worried that something will happen to my child on the way to school.



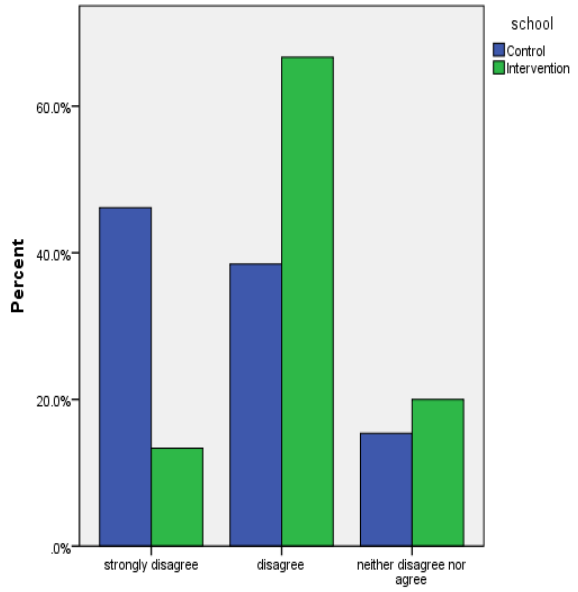
23g. I'm usually around to take my child to school.



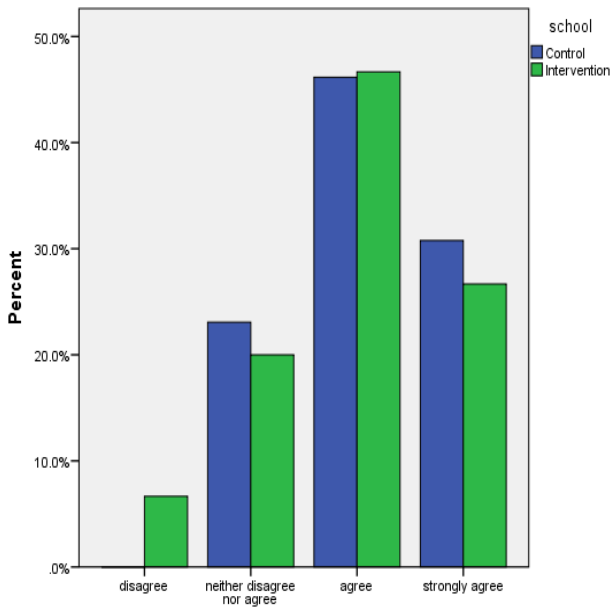
23h. I take my child to school on the way to somewhere (e.g. work).



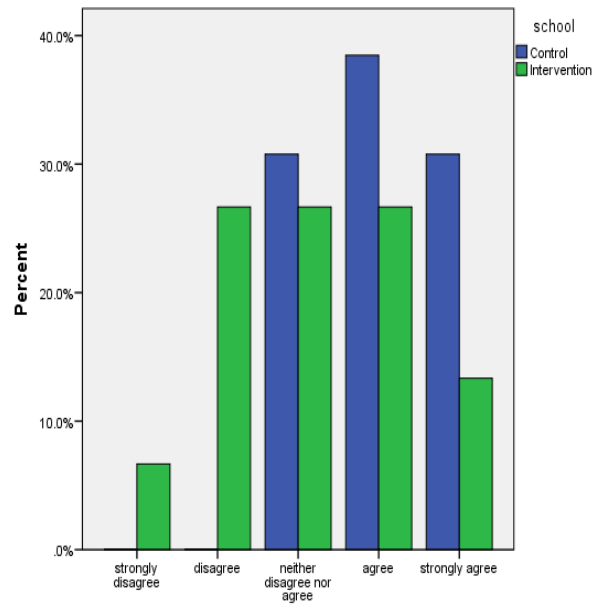
23i. There are no safe cycle paths on the way to school.



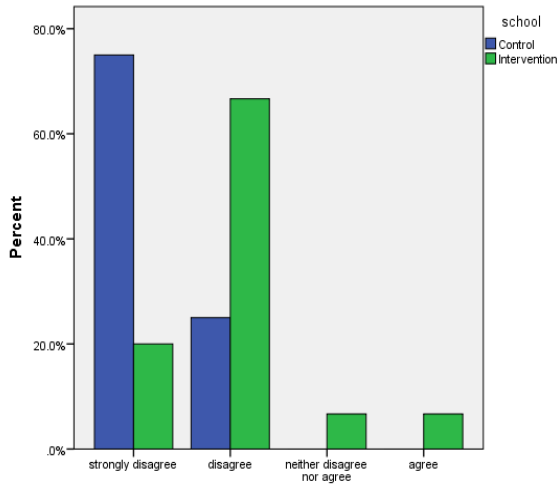
23j. There are no safe pavements on the way to school.



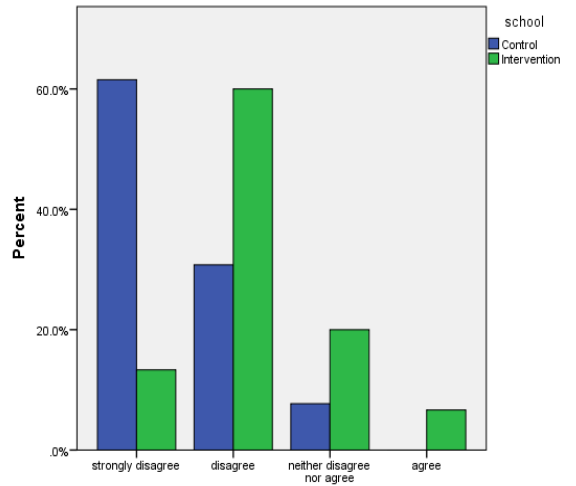
23k. I like or would like my child to walk to school.



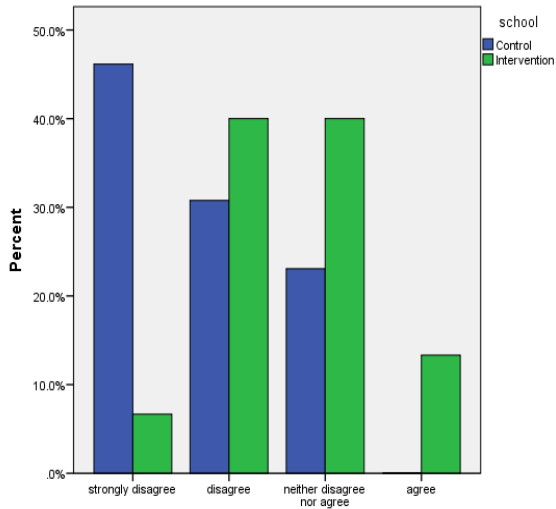
23L. I like or would like my child to cycle to school.



23m. If walking or cycling, my child may walk past convenience stores and buy unhealthy snacks or drinks.

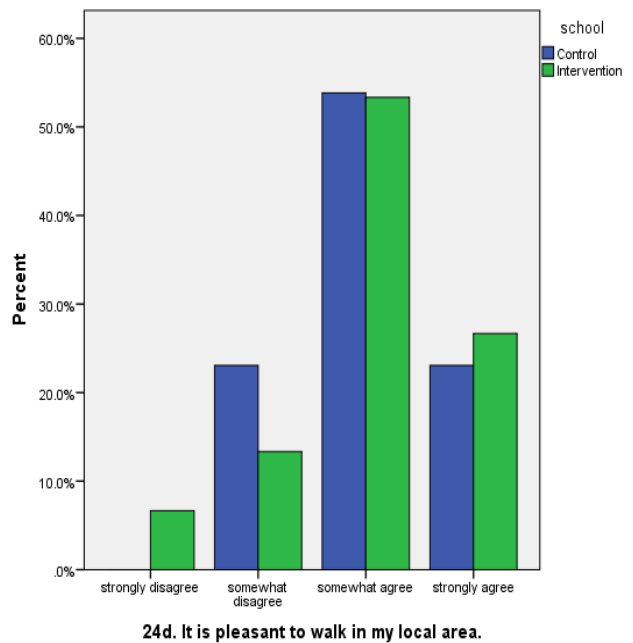
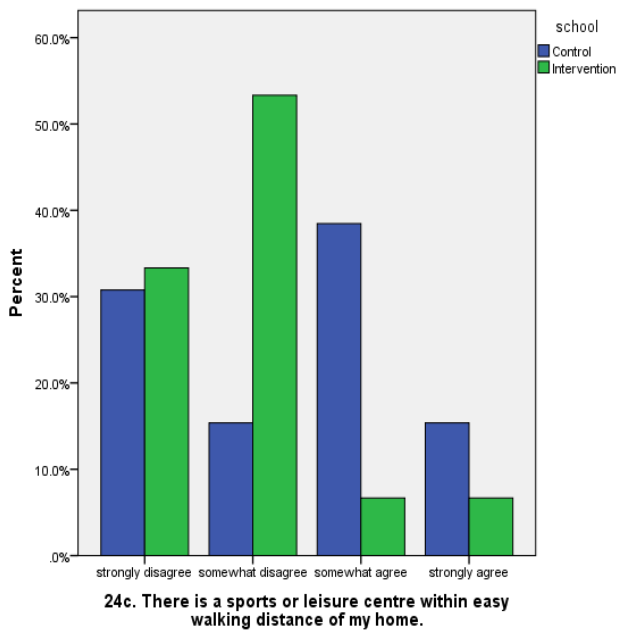
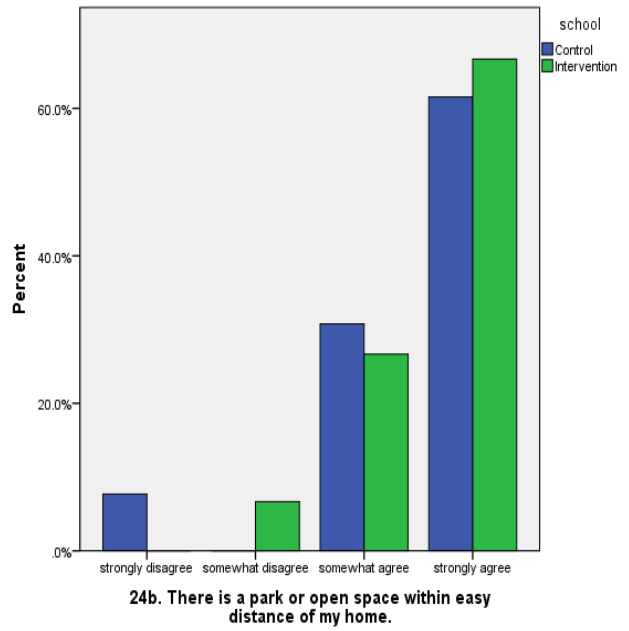
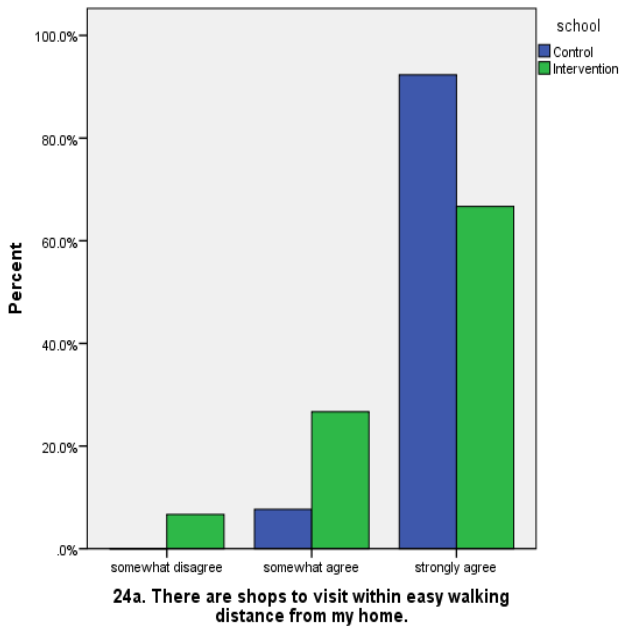


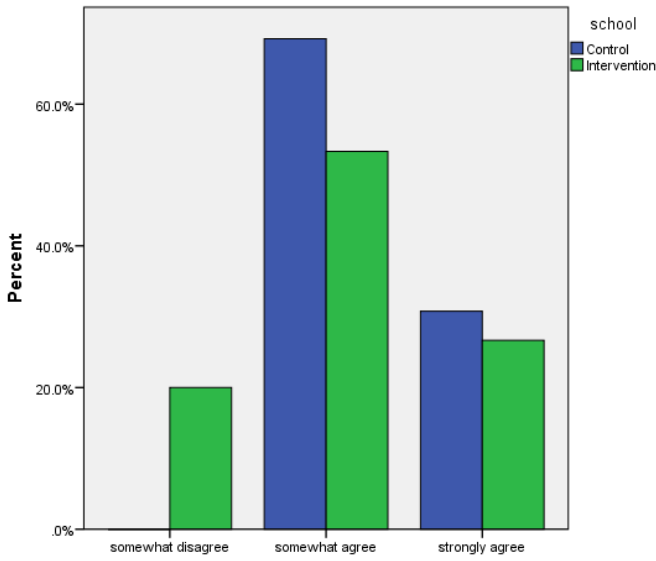
23n. If walking or cycling, my child is more likely to engage in harmful or anti-social behaviours (e.g. smoking, vandalism or bullying others).



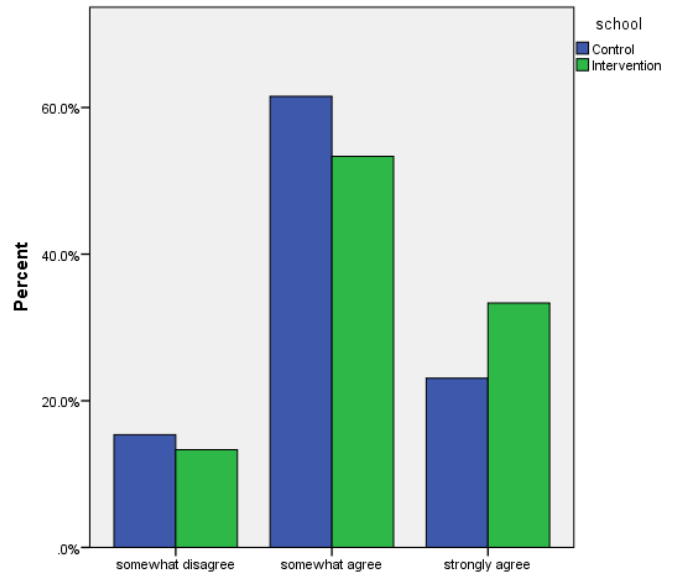
23o. If walking or cycling, my child is more likely to be bullied by others.

Appendix G – Bar charts, parental perceptions about local area (question 24 on parental questionnaire)

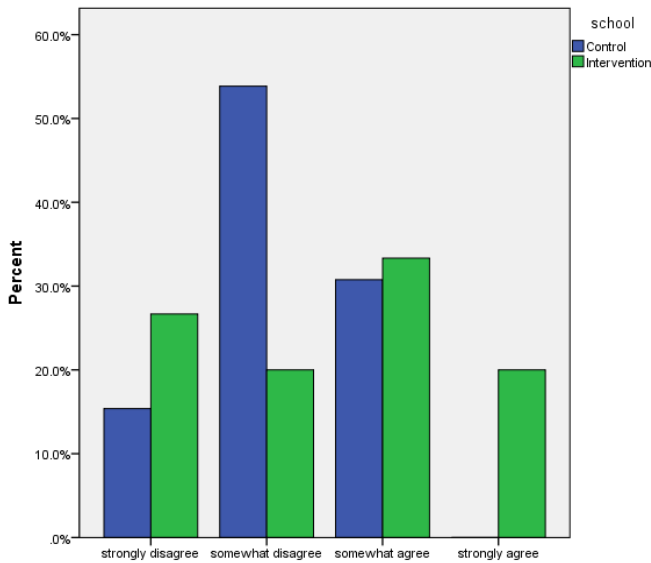




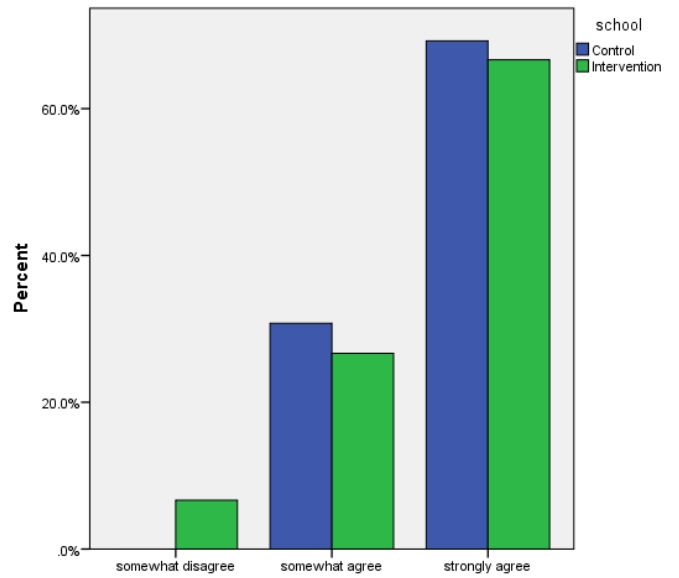
24e. There are pedestrian crossings to help walkers cross busy streets in my local area.



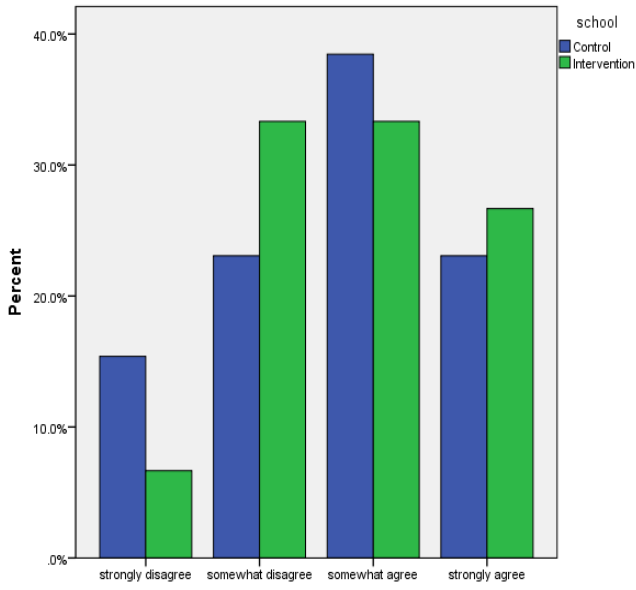
24f. I feel generally safe walking in my local area.



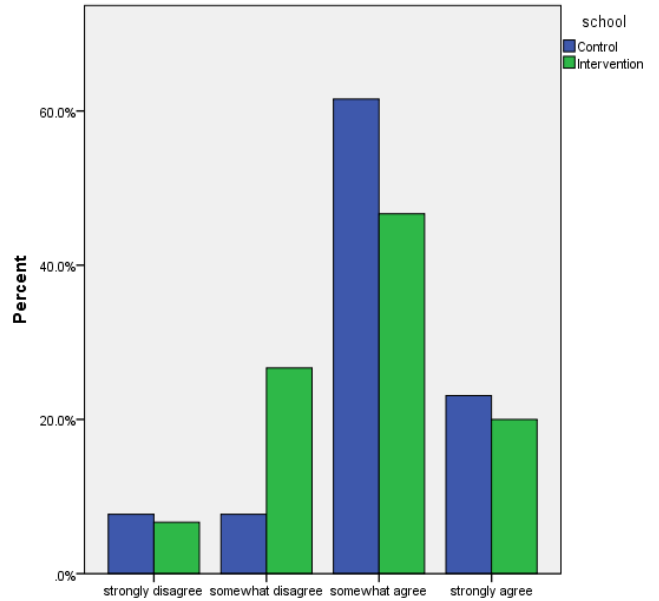
24g. The crime rate in my local area makes it unsafe to go on walks at night.



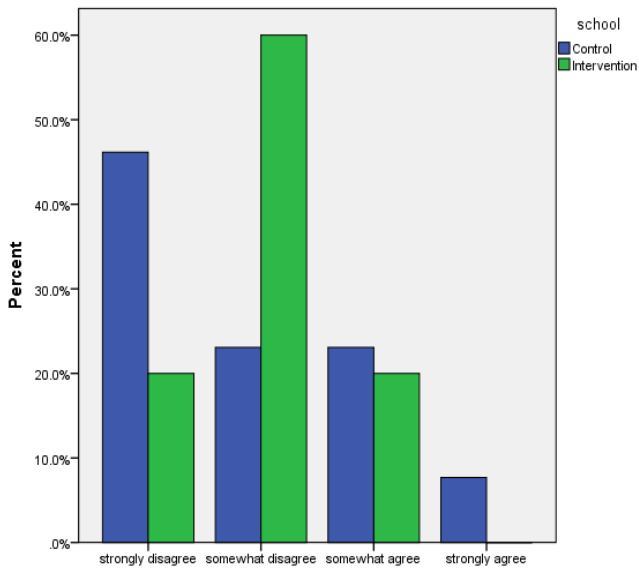
24h. It is easy to walk to a bus stop from my home.



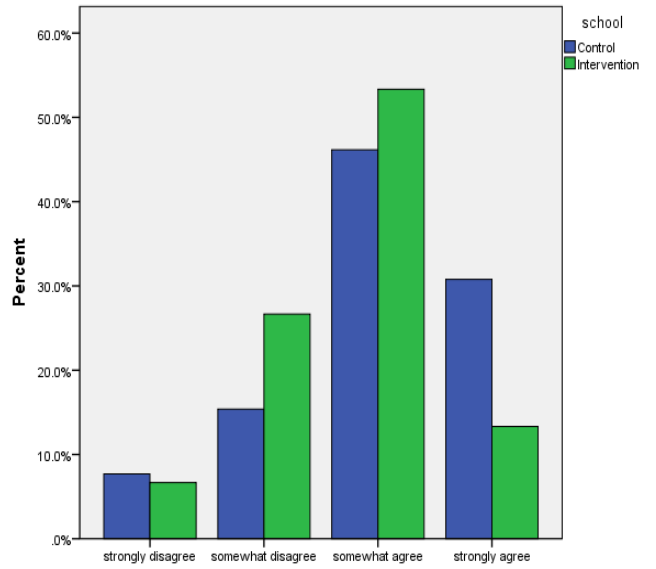
24i. There are few cul-de-sacs (dead-end streets) in my local area.



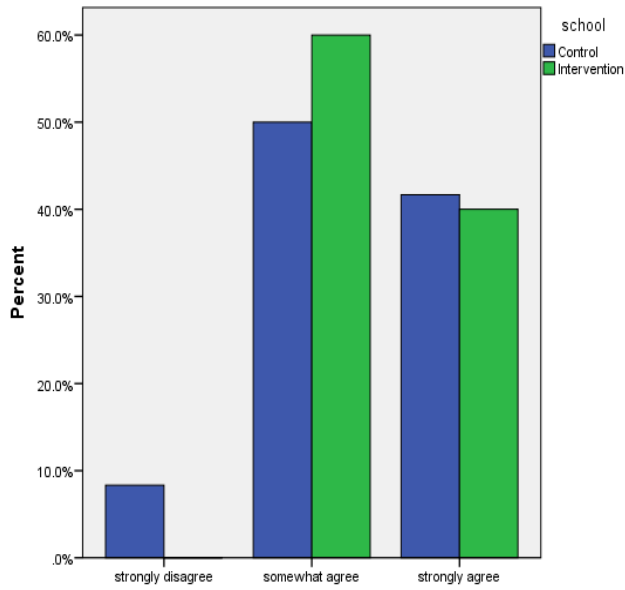
24j. There are lot of busy junctions in my local area.



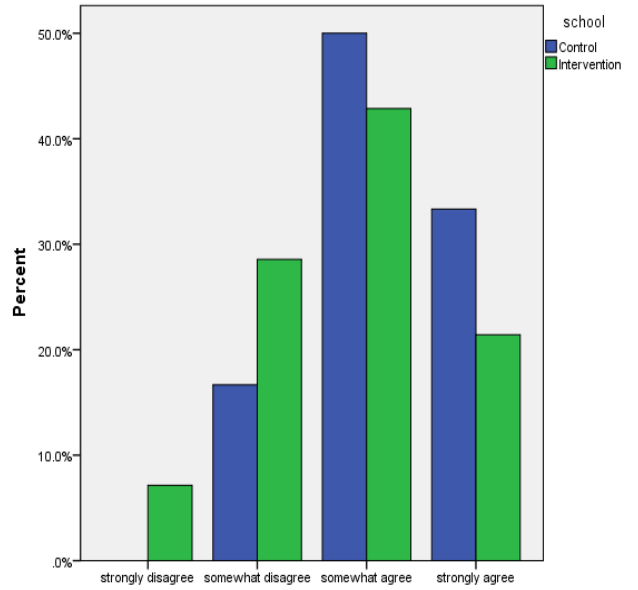
24k. There are major barriers to walking in my local area that make it hard to get from place to place (for example, busy roads, railway lines, rivers, hills).



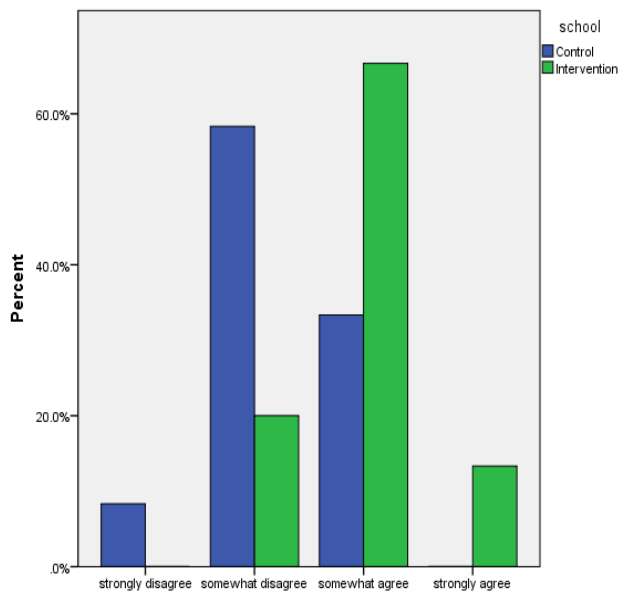
24L. There are many alternative routes for getting from place to place in my local area. (I don't have to go the same way every time).



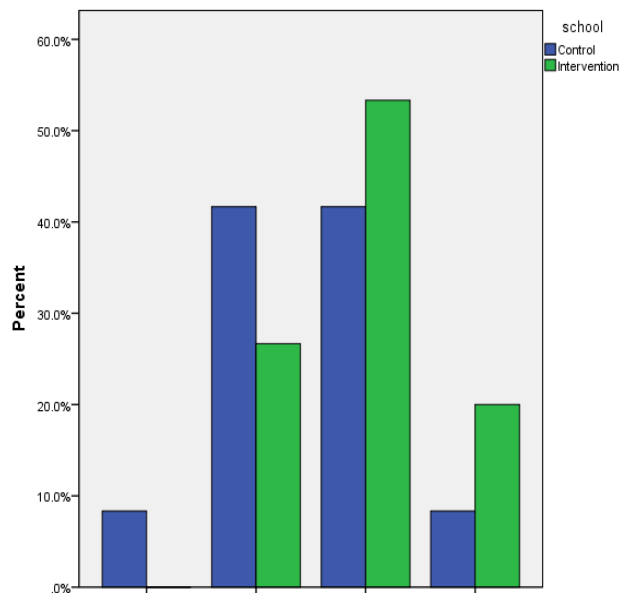
24m. There are pavements on most of the streets in my local area.



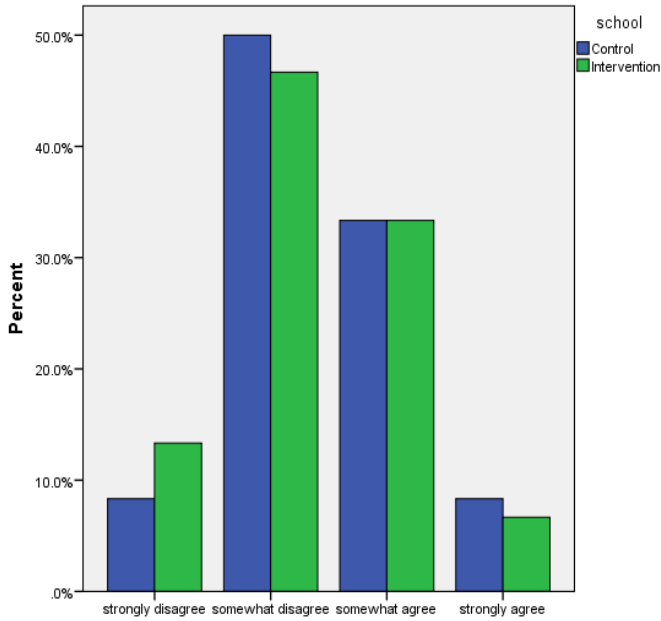
24n. There are cycle paths in or near my local area that are easy to get to.



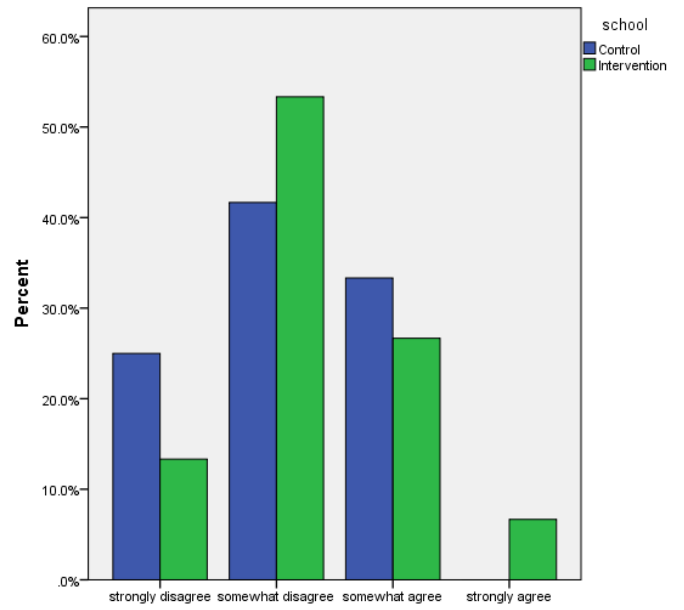
24o. There is a verge that separates the streets from the pavements in my local area.



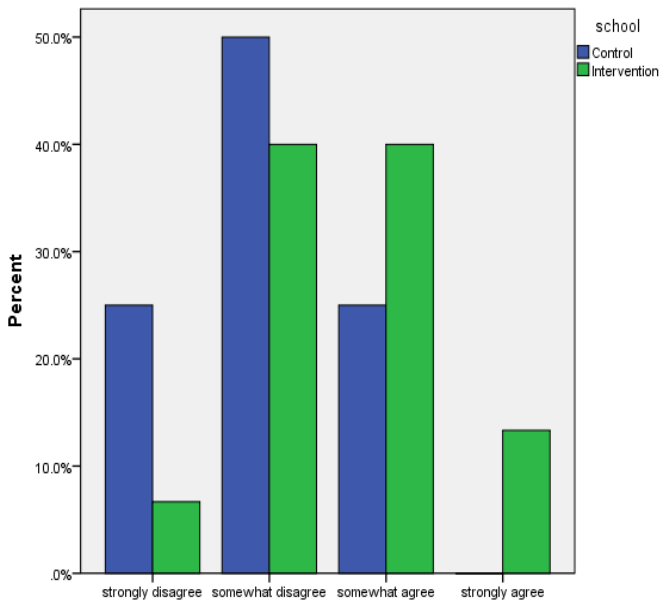
24p. There are trees along the streets in my local area.



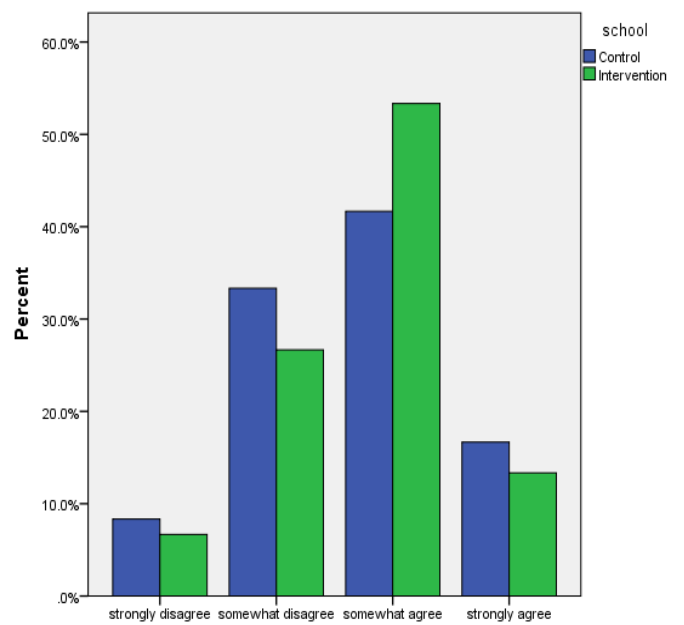
24q. There are diverse and interesting things to look at in my local area (e.g. buildings and views).



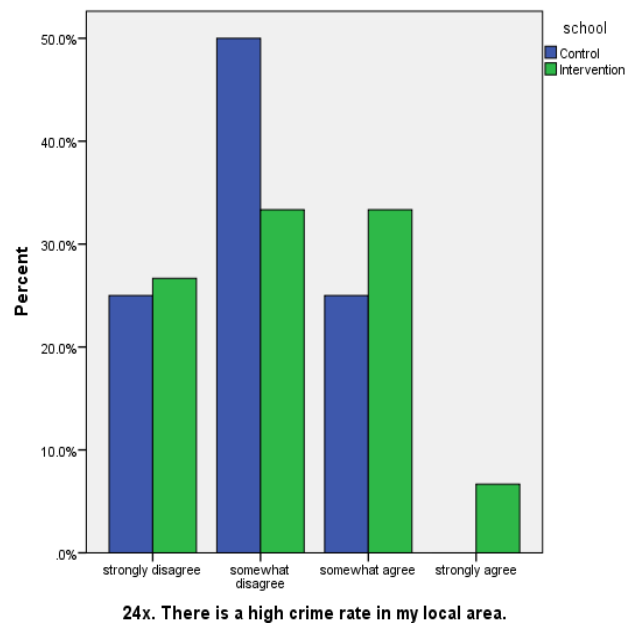
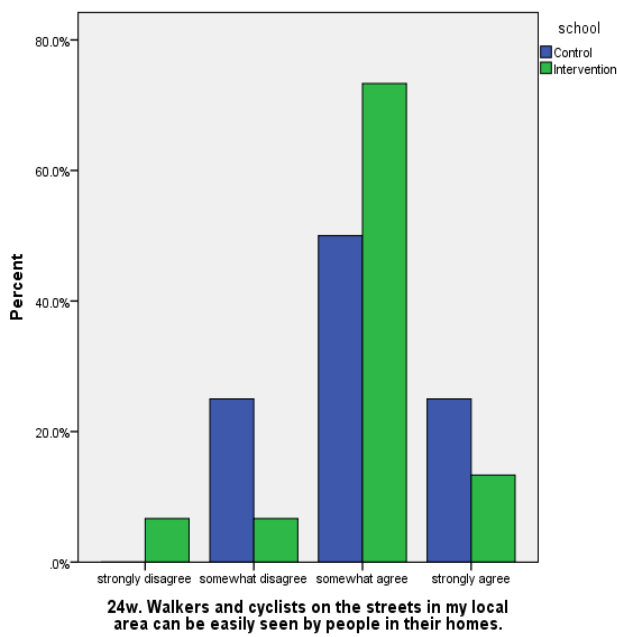
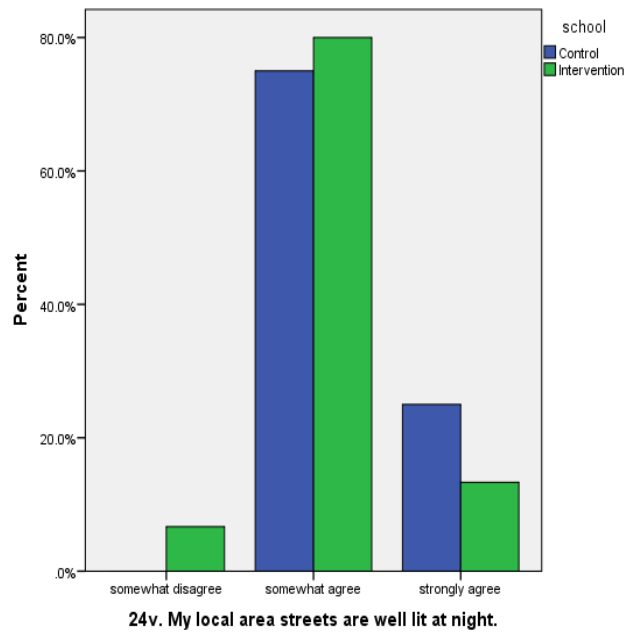
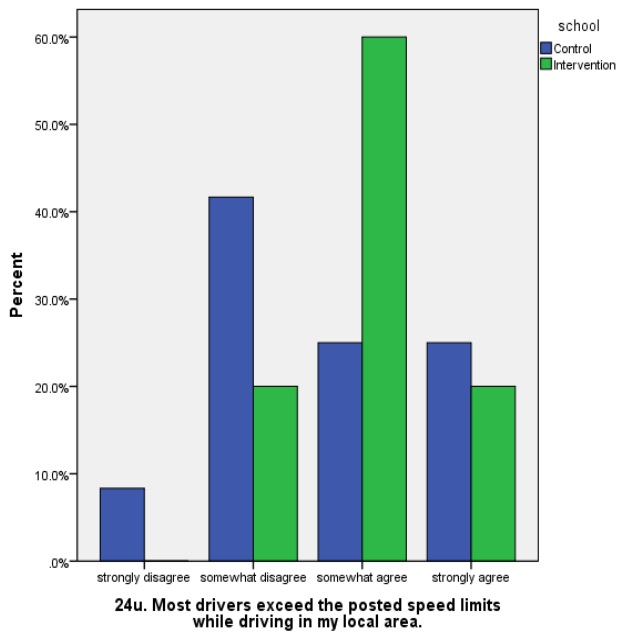
24r. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my local area.



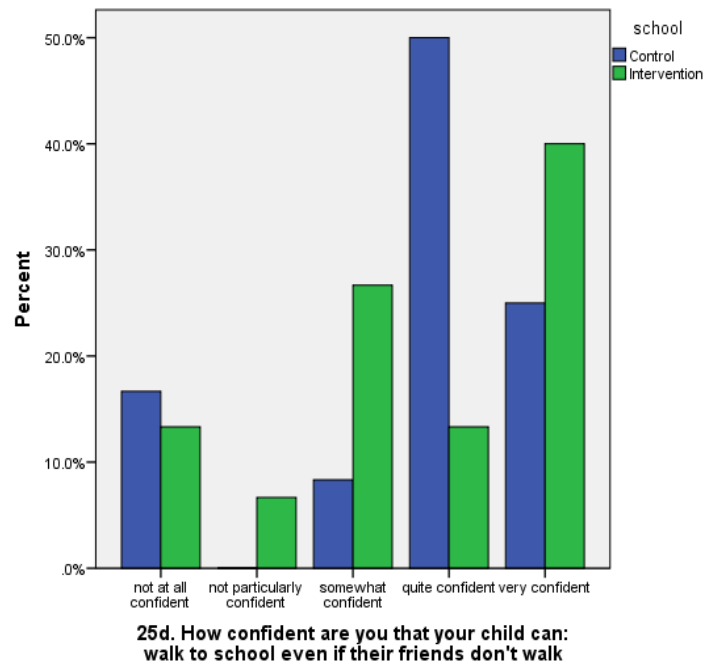
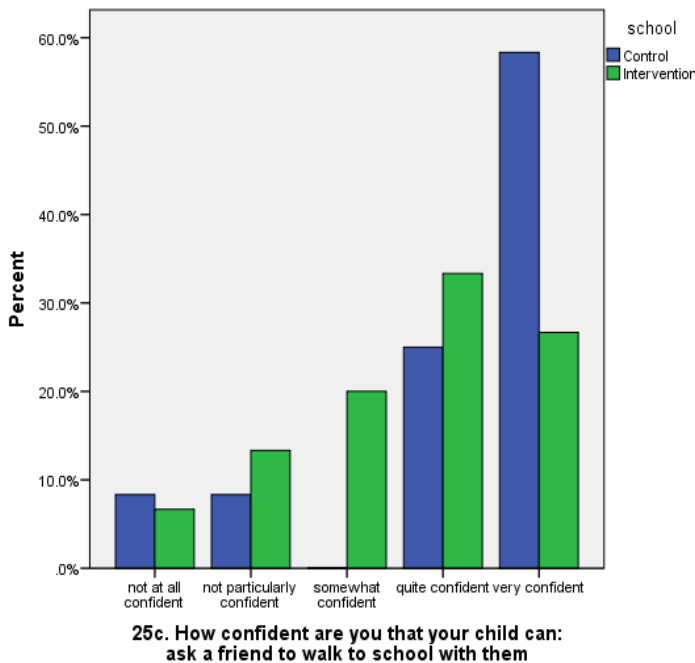
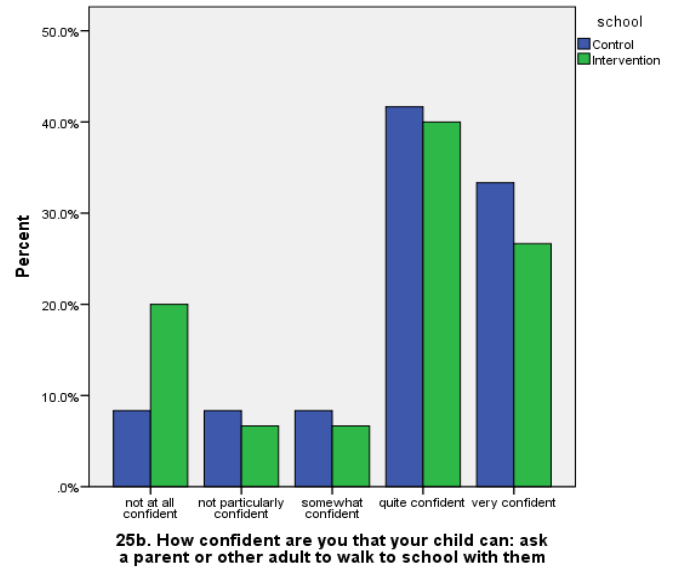
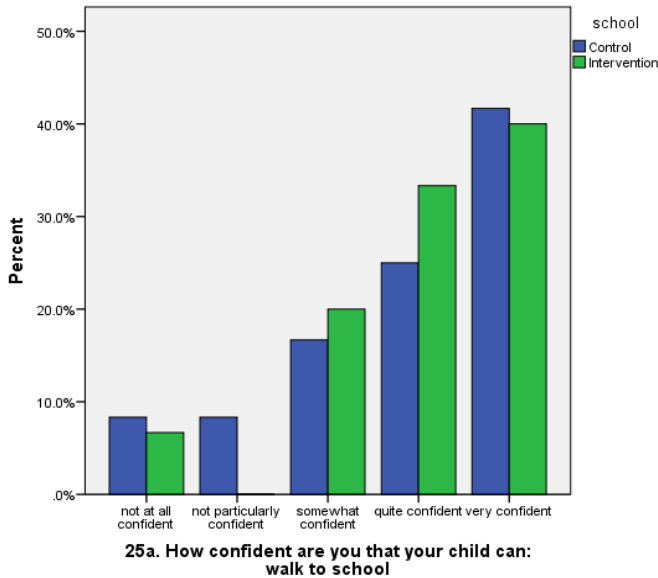
24s. There is so much traffic along nearby streets that it makes it difficult or unpleasant to cycle in my local area.

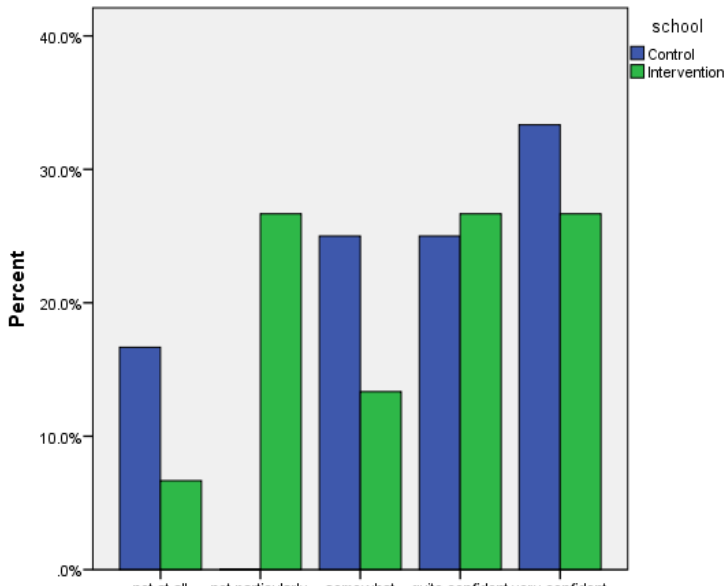


24t. The speed of traffic on most nearby streets is usually slow (30 mph or less).

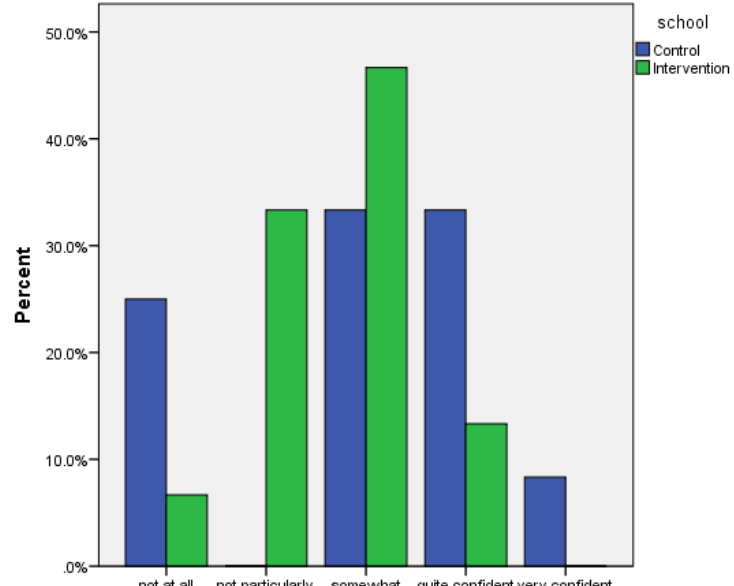


Appendix H – Bar charts, parental self-efficacy about child’s ability to walk and cycle to school (questions 25-26 on parental questionnaire)

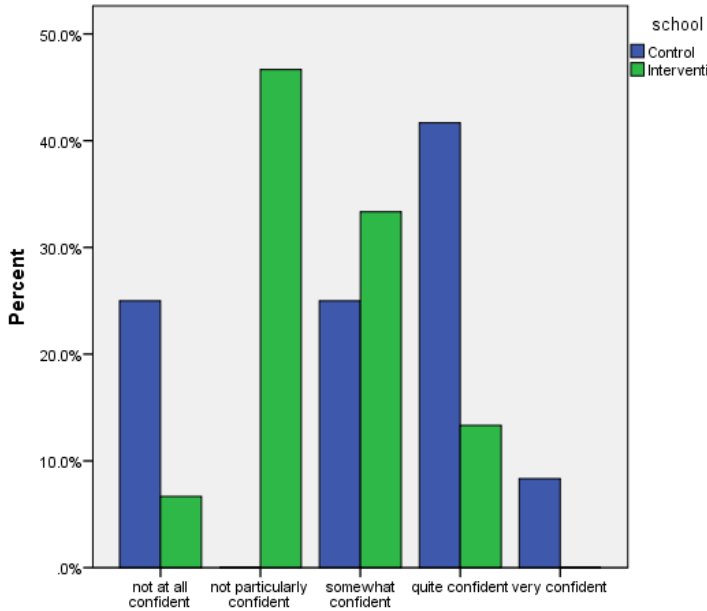




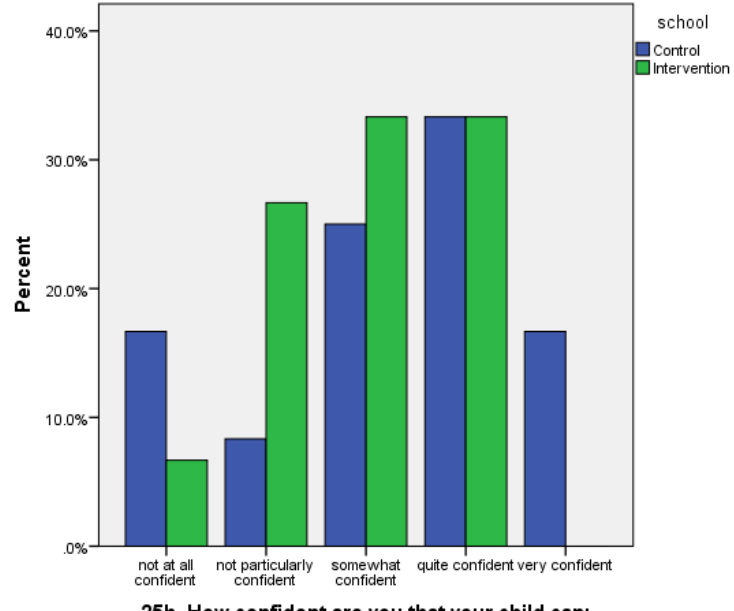
25e. How confident are you that your child can: walk to school in bad weather



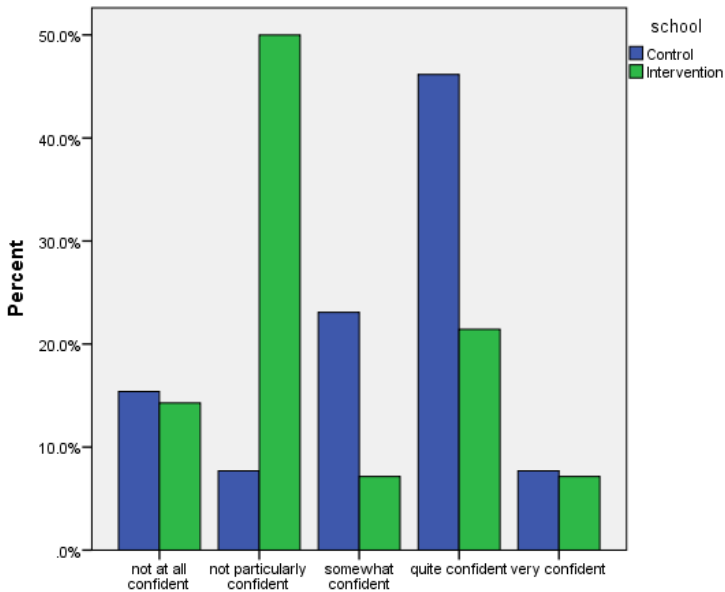
25f. How confident are you that your child can: cross difficult roads when walking to school



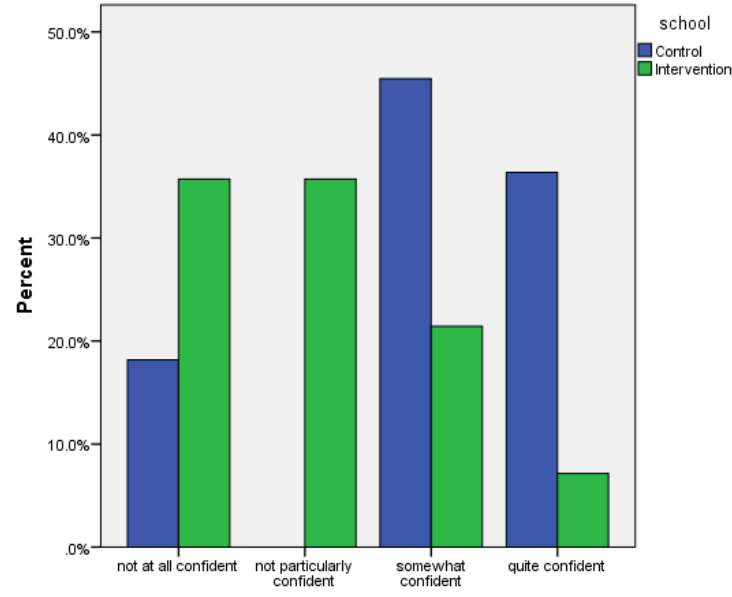
25g. How confident are you that your child can: cope with busy traffic when walking to school



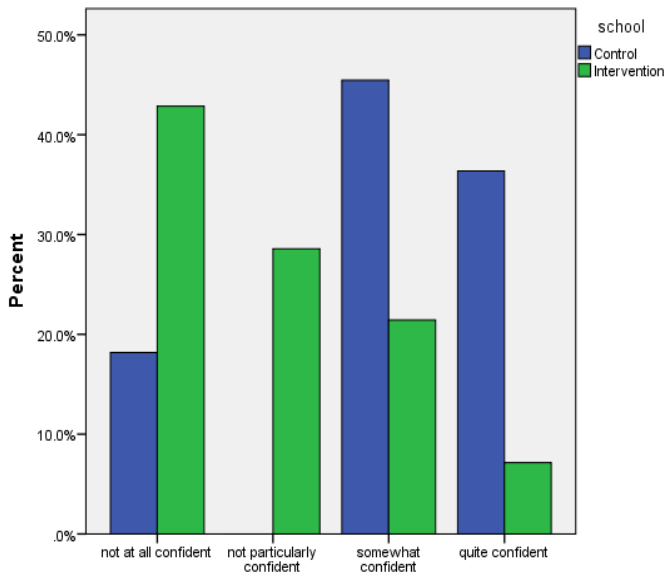
25h. How confident are you that your child can: walk to school even if there are many cars near the school entrance



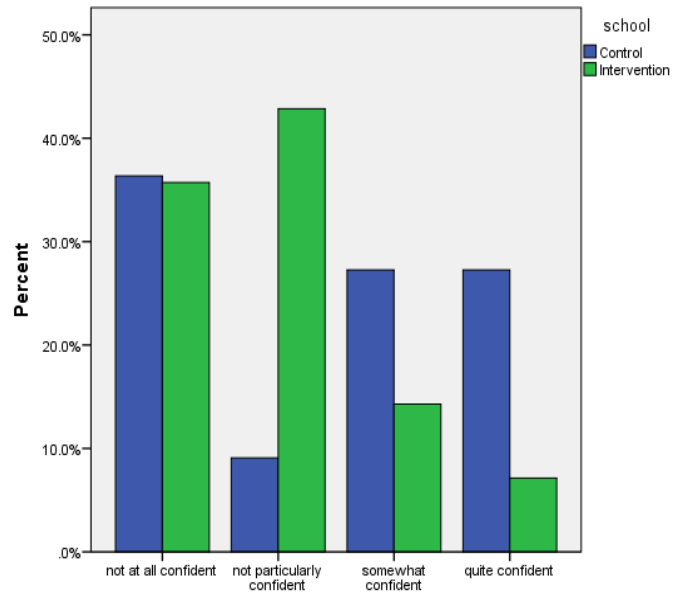
25i. How confident are you that your child can: walk to school even if there are not enough lollipop people



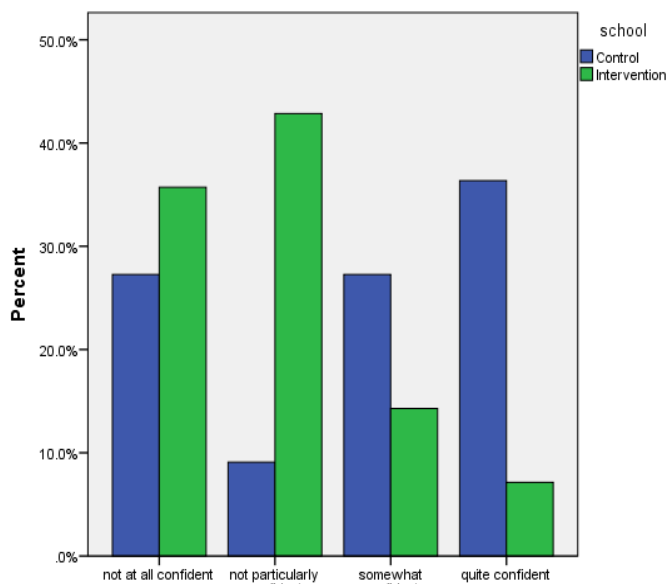
25j. How confident are you that your child can: walk to school even if they are frightened of meeting strangers



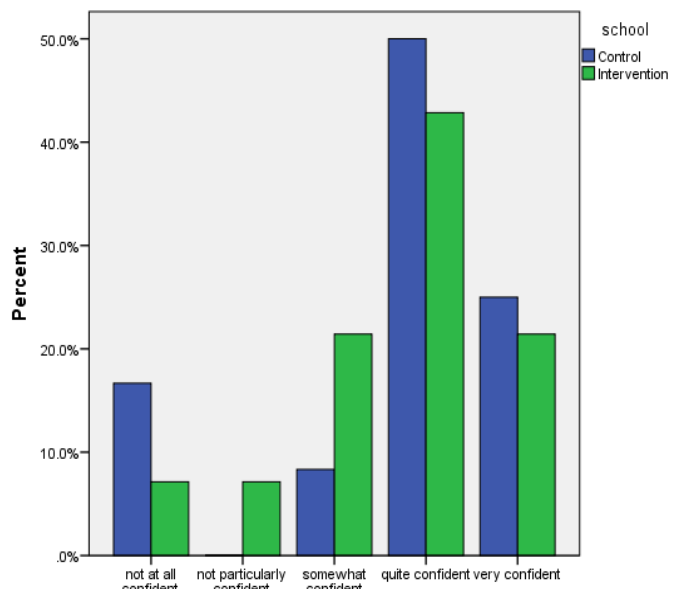
25k. How confident are you that your child can: walk to school even if they are frightened of being bullied



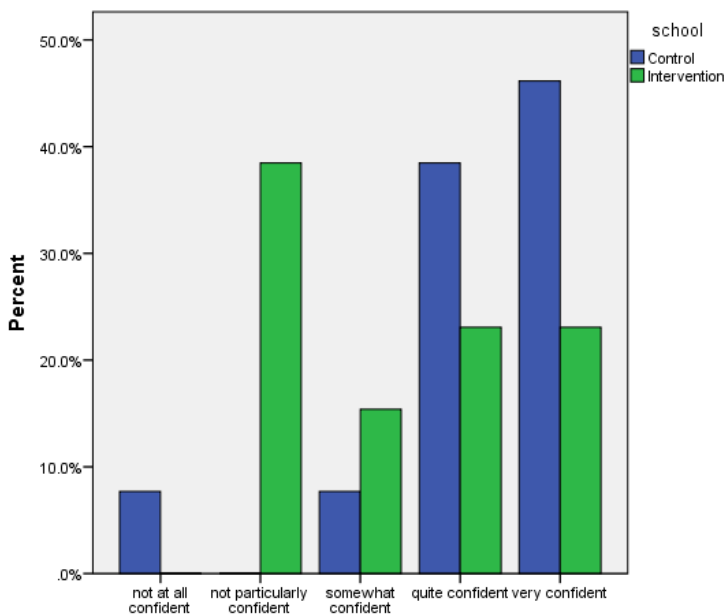
25L. How confident are you that your child can: walk to school even if there is poor lighting



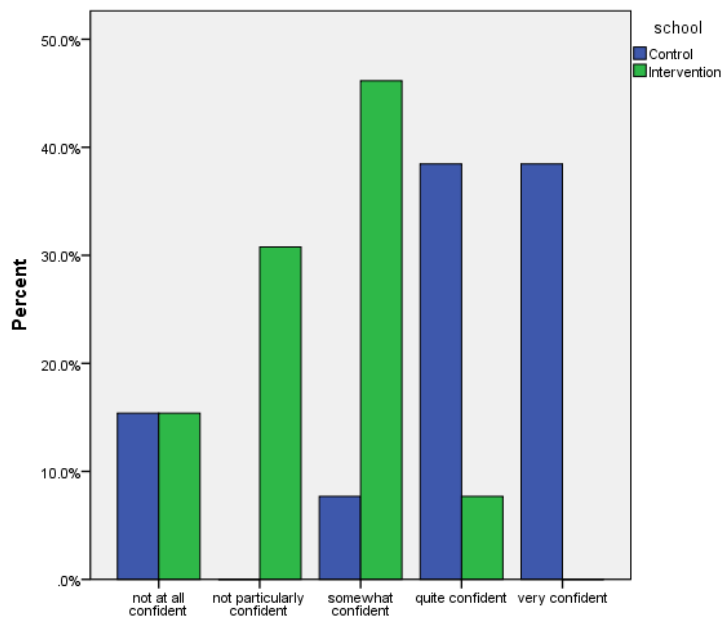
25m. How confident are you that your child can walk to school even if it takes a long time



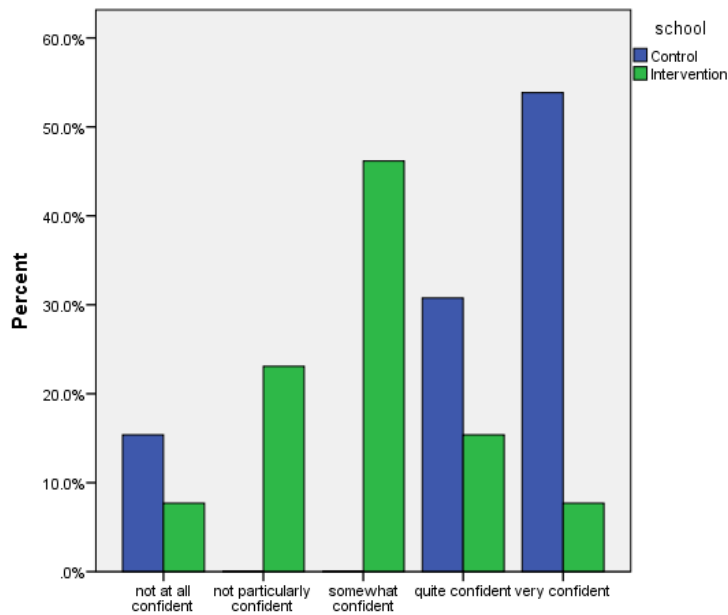
25n. How confident are you that your child can find a route to walk to school



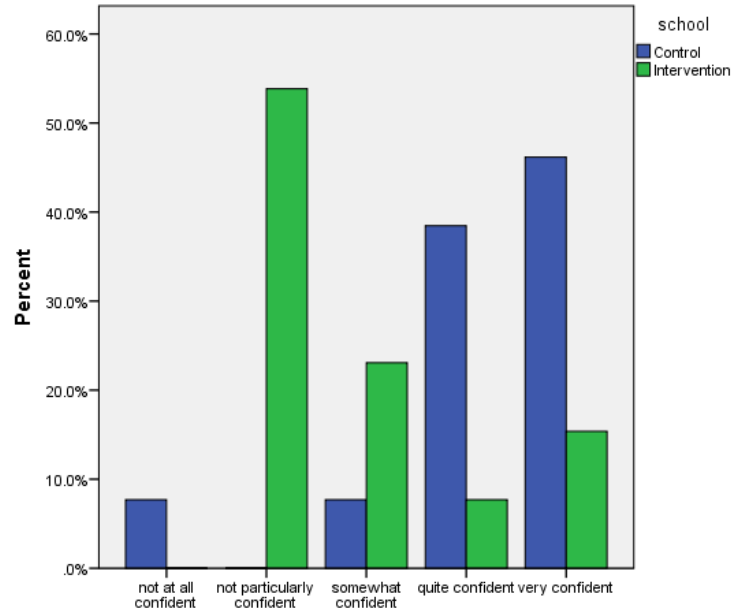
26a. How confident are you that your child can cycle to school



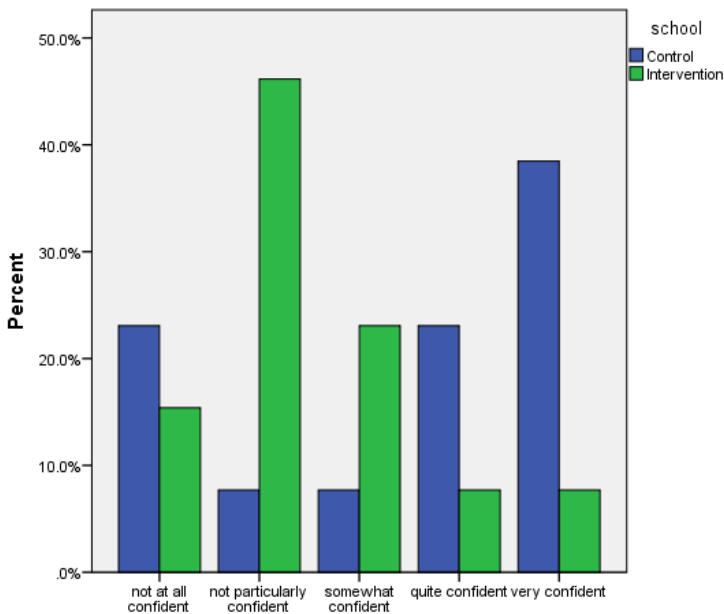
26b. How confident are you that your child can ask a parent or other adult to cycle to school with them



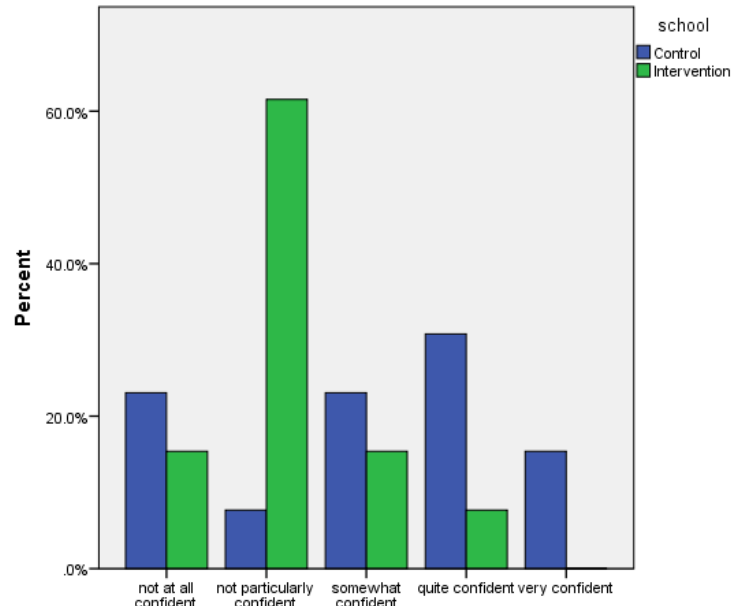
26c. How confident are you that your child can ask a friend to cycle to school with them



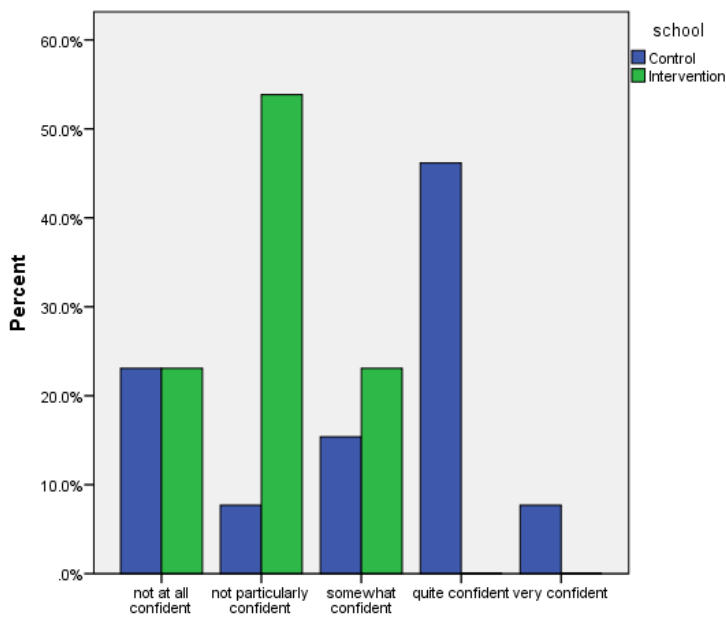
26d. How confident are you that your child can cycle to school even if their friends don't cycle



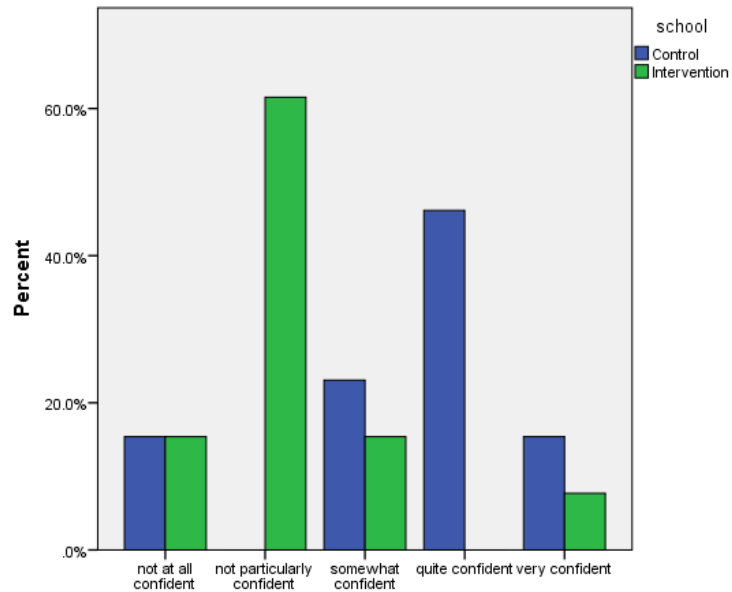
26e. How confident are you that your child can cycle to school in bad weather



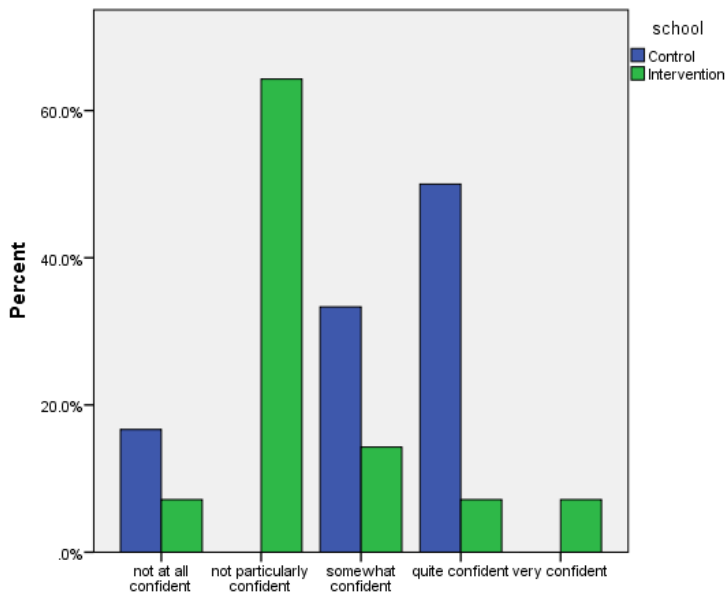
26f. How confident are you that your child can cross difficult roads when cycling to school



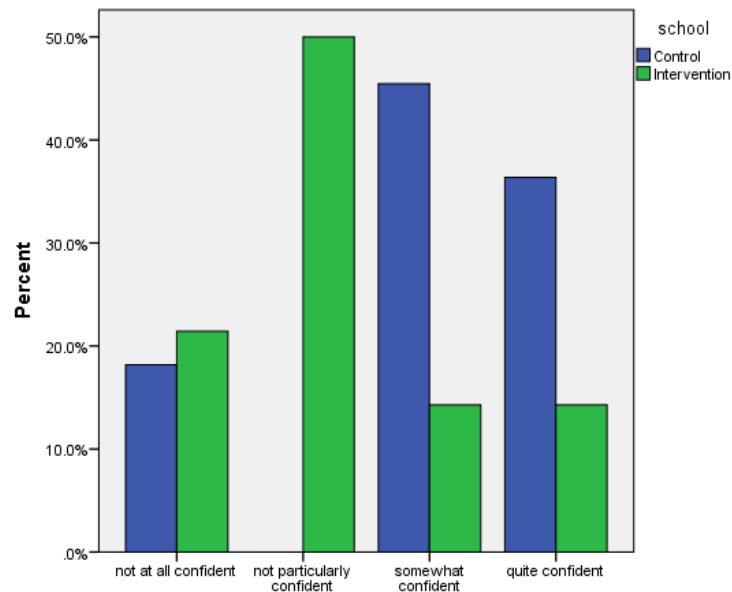
26g. How confident are you that your child can: cope with busy traffic when cycling to school



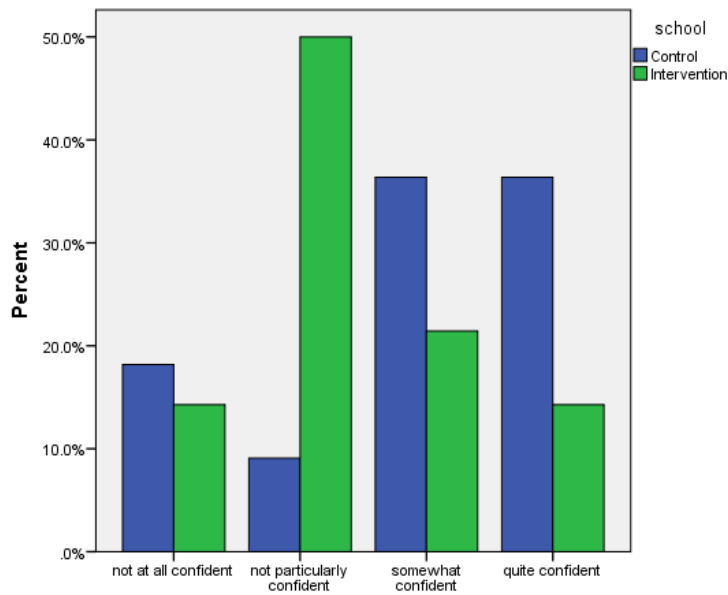
26h. How confident are you that your child can: cycle to school even if there are many cars near the school entrance



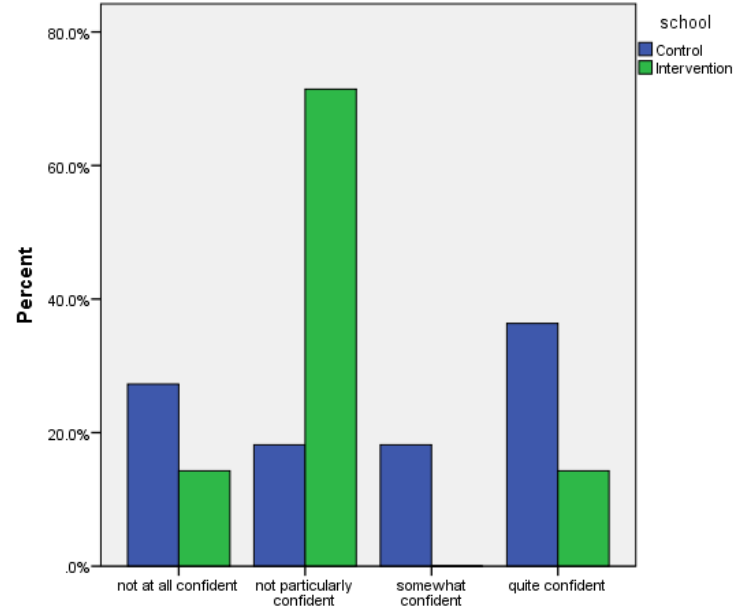
26i. How confident are you that your child can: cycle to school even if there are not enough lollipop people



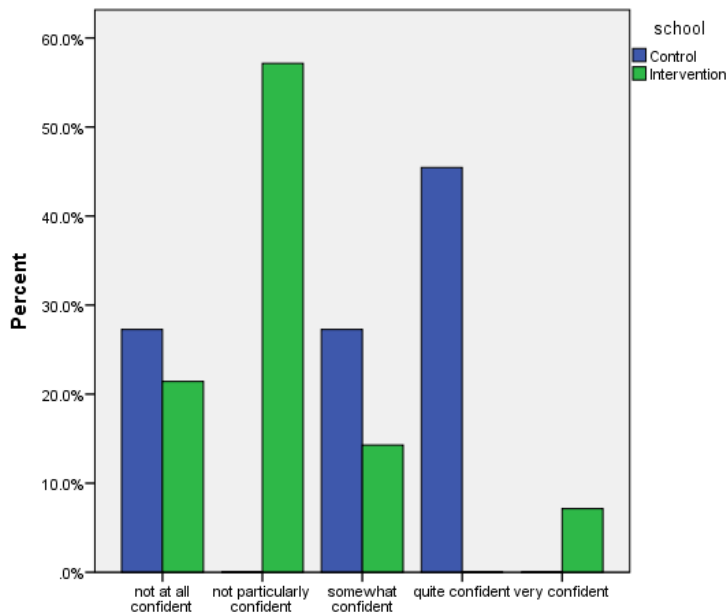
26j. How confident are you that your child can: cycle to school even if they are frightened of meeting strangers



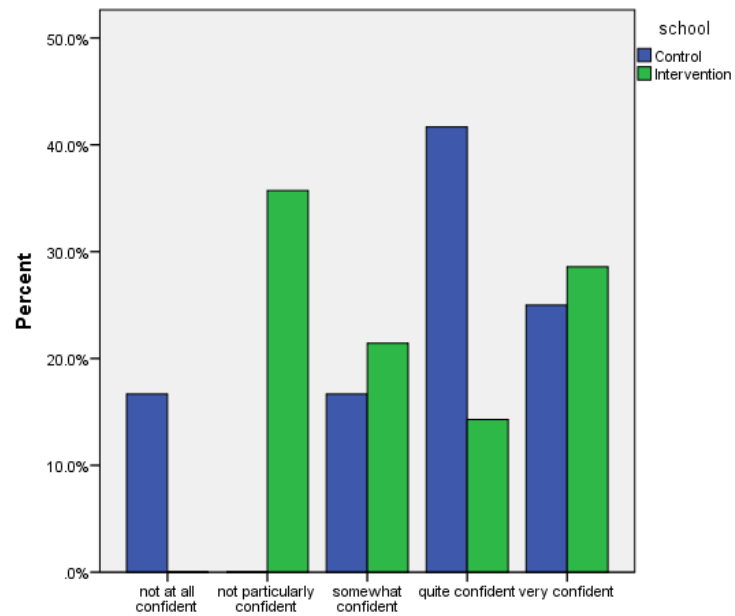
26k. How confident are you that your child can: cycle to school even if they are frightened of being bullied



26L. How confident are you that your child can: cycle to school even if there is poor lighting



26m. How confident are you that your child can: cycle to school even if takes a long time



26n. How confident are you that your child can: find a route to cycle to school

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