IDENTIFYING INDICATORS OF SCHOOL TRAVEL PLAN EFFECTIVENESS

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EXECUTIVE SUMMARY

Background

School Travel Plans (STPs) provide schools with a formal strategy for promoting active travel behaviour change. STPs set out objectives and actions that a school has committed to undertake to address issues that prevent caregivers, children and staff from using active travel for school journeys.

Surrey County Council wants to assess the effectiveness of STPs in Surrey schools, but there is no clear guidance available on how to measure effectiveness. It is useful to understand not only to *what extent* a STP may change active travel behaviour, but also *why* it may do so. Identifying which barriers to active travel have successfully changed – that is, whether caregivers and children have, for example, become more motivated or more capable of using active travel – can provide valuable knowledge for developing, evaluating and implementing STPs.

Aims, Guiding Questions and Methods

Our primary aim was to identify criteria potentially indicative of an 'effective' STP, to inform decisions around how to quantify effectiveness in a future survey evaluating Surrey STPs. A subsidiary aim was to identify and explore content and effectiveness of previous active school travel initiatives.

We addressed three questions, the first of which related to our primary aim:

- *What criteria* can be used to assess the effectiveness of active school travel initiatives?

Additional questions related to our subsidiary aim:

- *What active school travel initiatives have been trialled...*
- *...and what is known about their effectiveness?*

Two work packages were undertaken:

- a literature review, to identify how the effectiveness of active school travel initiatives has previously been assessed
- focus groups with caregivers and staff at two Surrey primary schools, to capture their views on what would make an STP effective

Literature Reviews

Two literature reviews were undertaken, focusing on the published literature and on the non-published ('grey') literature.

Literature Review: Published literature

A formal review of published literature identified 11 studies, evaluating 12 interventions, from 2015 onwards.

Active travel *behaviour* was either objectively monitored using accelerometer devices (e.g., step counts) or swiping sensor cards, or children or caregivers reported actual or typical travel modes used (e.g., per-journey reports, or travel diaries).

Non-behaviour *capability* effectiveness measures focused on children's confidence in being able to travel actively. *Opportunity* measures included physical opportunity (e.g., active travel safety or accessibility), and social opportunity (e.g. social norms). *Motivation* measures focused on active travel attitudes, knowledge, and intentions, or beliefs regarding convenience, health and wellbeing.

Interventions were most typically STPs or similar (5 interventions), or gamification (3), training-based (e.g., 'Bikeability'; 2), or information-only interventions (2). STPs and gamification interventions had positive effects on behaviour, but training-based interventions had no effect on behaviour, and behaviour changes were not assessed for information-only interventions. All interventions changed one or more of capability, opportunity and motivation factors.

Literature Review: Grey literature

We identified three extraneous factors that may affect the effectiveness of interventions: age (children aged 5-10 years are more likely to walk, and those aged 11-16 are more likely to cycle); gender (boys are more likely to cycle than girls); and distance (active travel is common for journeys under 1 mile, but less common for journeys over 1 mile, especially among younger children).

Four additional interventions were identified. Two used data-driven tracking methods to raise awareness of active travel and its consequences, one used gamification methods, and one reported a Finnish intervention similar to a STP.

Focus Groups

Two Focus Groups were undertaken, with 13 caregivers and staff from two Surrey schools (one infant, one primary), to explore active travel experiences, and perceptions of effectiveness.

Four themes were identified, focusing on physical safety concerns, efficiency and convenience, physical and social environmental affordances, and fostering heath and wellbeing.

COM-B analysis of our findings suggested that most reported barriers related to a *lack of perceived opportunities* to engage in active school travel safely and conveniently. *Capability* concerns centred on children's ability to negotiate road traffic, and *motivation* factors included caregivers' concerns around the safety of active travel, and children's intrinsic motivation to use active travel modes.

Recommendations

We offer one key recommendation for *developing and evaluating active school travel initiatives:*

1. Active school travel initiatives should be developed using a 'systems-based approach'. In practice, this involves a collective effort coordinated across multiple stakeholders to develop, administer, and evaluate initiatives that target not only individual-level behaviour change but broader, systemic change

We offer six further recommendations for measuring effectiveness of STPs:

2. Behaviour should be measured objectively, otherwise using per-journey self-report
3. Actual and perceived opportunities for active travel should be measured
4. General motivation for active travel, and specific motivational beliefs for active and inactive travel, should be measured
5. Psychological capability, such as cycling proficiency, should be measured
6. Extraneous factors that affect the effectiveness of active travel initiatives, such as demographics, should be measured
7. A broad range of data, beyond individual-level COM-B data, must be measured to fully understand and contextualise responses to STPs

These recommendations will inform Surrey County Council's work on developing a tool to measure STP effectiveness (the STEP tool; School Travel Effectiveness of Planning tool), which aims to capture perceived and actual Capabilities, Opportunities, Motivations, and Behaviours (COM-B) – i.e., enablers and barriers to active school travel – via a pilot study of 10 participating Surrey schools with the support of Sustrans.

An extended version of this report is available at **https://osf.io/z3erq/.**

1. INTRODUCTION

Background

The importance of active school travel

Surrey County Council's 2024 Annual School Travel Survey suggests that 43% of primary school children and 15% of secondary school children travel to school by car, compared to 32% of primary school children and 48% of secondary school children who walk. Active travel – i.e., *"everyday 'journeys for a purpose' made by walking, wheeling, or cycling"* (UK Parliament, 2025) – offers a low-carbon, health-conducive school travel option. Up to four out of five children want to walk or cycle to school (Sustrans, 2023), and 85% of residents in England support active travel promotion (Active Travel England, 2024).

Although appropriate infrastructure is essential for promoting active travel, people often fail to shift their longstanding travel mode choices even if modifications are made to the built environment. People need to be encouraged to change their behaviour (Carroll et al., 2019).

School Travel Plans (STPs) are a form of behaviour change intervention designed to encourage active and sustainable travel for school journeys. STPs provide schools with a formal strategy for promoting active travel, by listing objectives and actions that a school has committed to undertake to target local barriers to active school travel among caregivers, children and staff. Over 1,400 schools have taken part in the UK-wide Modeshift STARS STP scheme since its inception in 2008 (Modeshift, 2024), and over 100 schools have taken part in Surrey (Surrey County Council, 2021).

Surrey County Council wants to assess the effectiveness of STPs among Surrey schools, but there is no clear guidance available on how to assess STP effectiveness. Modeshift STARS accreditation at higher levels, which requires documentation of the extent to which children have changed their travel modes, focuses only on whether targets have been met (e.g. 5+% increase in active travel modes), but does not identify how progress towards targets should be assessed.

What constitutes an 'effective' School Travel Plan?

A STP can be deemed 'effective' if it increases active travel among children, caregivers, or staff.

It is however useful to understand not only to *what extent* a STP is effective, but also *why* it may be effective. If, for example, an STP increases walking, and is found to have boosted parents' confidence that their child can travel to school safely, but had no impact on children's health beliefs, this would suggest that STPs should target parents' safety concerns, not children's health beliefs. This in turn could lead to more efficient, effective and cost-effective STPs that prioritise safety concerns. Understanding the mechanisms underpinning STP effectiveness provides valuable information for developing, evaluating and implementing STPs.

The COM-B Model (Michie et al., 2011) proposes that three fundamental determinants are required for behaviour to occur: capability, opportunity, and motivation. Each of these can be broken down further. Capability comprises *physical capability*, and *psychological capability,*

which captures the capacity to engage in thought processes needed for an action to occur. Opportunity combines *physical opportunity*, and *social opportunity*, which reflects the extent to which social conditions are conducive to action. Motivation comprises *reflective motivation,* based on conscious thought processes, and *automatic motivation*, based on emotions, habits and impulses.

Many of the COM-B determinants are underpinned by *specific beliefs*. For example, caregivers' perceptions that a child lacks the skills needed to cycle can be categorised as capability-related beliefs, whereas beliefs regarding the suitability of the built environment to walking to school are opportunity-related beliefs, and beliefs surrounding the health benefits of active travel are motivational beliefs. Many such beliefs are based on subjective perceptions, which may or may not be accurate, such as the belief that roads are too busy to permit safe cycling. Pertinent beliefs could usefully be targeted to bring about behaviour change.

From a COM-B perspective, successfully promoting active travel involves, first, identifying which one or more of the three determinants is lacking, and second, developing strategies to target the relevant determinants, via changing specific underlying beliefs.

Figure 1 presents a flowchart model depicting how beliefs influence active travel behaviour, and the consequences of successful behaviour change:

- Specific beliefs regarding the utility of active travel influence overall capability, opportunity, and motivation to use active travel
- Capability, opportunity and motivation influence whether and to what extent active travel is used
- Active travel use translates into positive sustainability outcomes (e.g., reduced traffic congestion, improved child health or wellbeing)
- Experiences of active travel, or outcomes of active travel, can in turn reshape specific beliefs regarding the utility of active travel

How should the effectiveness of School Travel Plans be measured?

STP effectiveness can be most directly assessed by measuring *behaviour change* – that is, the extent to which children, caregivers and staff increase their use of active travel, and/or decrease use of inactive travel, such as car use.

However, Figure 1 suggests additional *proxy criteria for effectiveness; i.e.,* factors that would be expected to change as a precursor, or consequence, of increased active school travel. For example, if an initiative successfully *motivates* caregivers to want to use active travel for school journeys, it is more likely that the intervention would change behaviour.

It can be useful to assess proxy indicators of effectiveness not only to capture behaviour change when behaviour cannot be directly or reliably measured, but also to identify the mechanisms through which active travel use may have been modified, or the consequences of such change.

Aims

The primary aim of this project was to identify criteria potentially indicative of an 'effective' STP, to inform decisions around how to quantify effectiveness in a survey evaluating the effectiveness of STPs among Surrey residents.

A subsidiary aim was to explore content and effectiveness of previous active school travel initiatives.

Guiding Questions

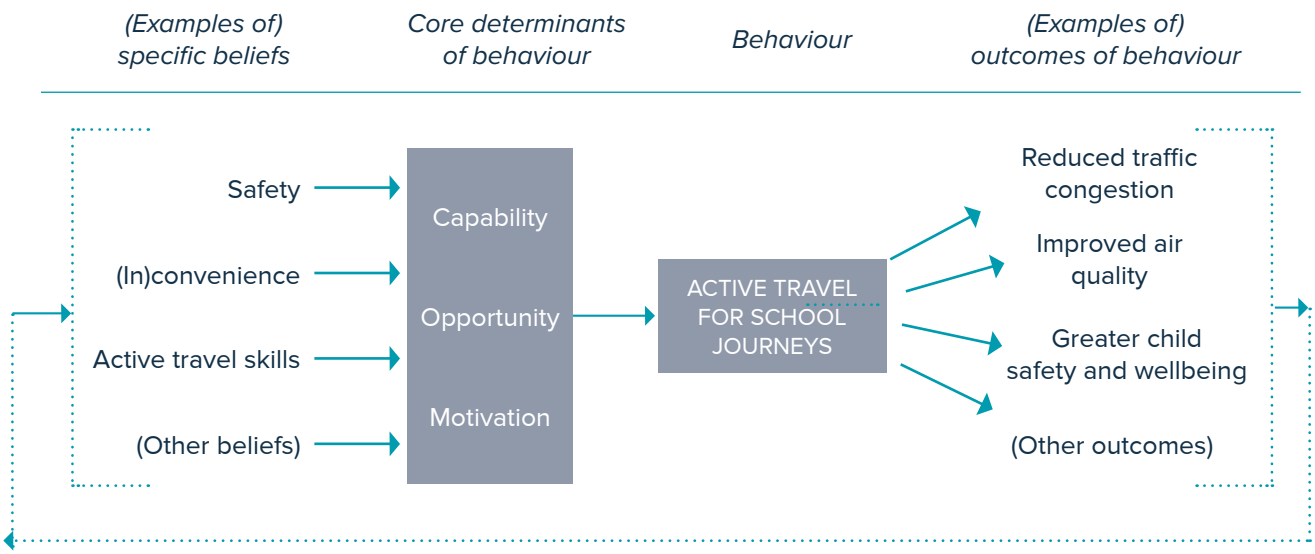
We organise our findings according to three guiding questions. The first question relates to our primary aim:

- *What criteria can be used to assess the effectiveness of active school travel initiatives?*

Additional questions relate to our subsidiary aim:

- *What active school travel initiatives have been trialled…*
- *…and what is known about their effectiveness?*

Figure 1. Flowchart model of the determinants and outcomes of active travel behaviour and behaviour change



Objectives and Methods

Specific project objectives were to:

- identify discrete criteria indicative of STP effectiveness, based on research-informed insights and evidence
- design, administer and analyse data from focus groups with stakeholders from two selected local schools to develop indicators of STP effectiveness
- synthesise evidence surrounding how to measure criteria indicative of STP effectiveness, as the foundation for a future survey comprising measures of indicators of STP effectiveness

We undertook two main work packages:

- a review of published scientific literature, and unpublished reports and other relevant documents (also known as 'grey literature'), to identify active school travel initiatives that have been undertaken to date, and how their effectiveness has been assessed
- focus groups with caregivers and staff to capture their views on what makes STPs effective

We supplemented the literature review with two in-depth Case Studies of school-based active travel initiatives from the UK (Case Study 1) and Europe (Sweden, Case Study 2), to showcase learnings around enablers and barriers to their implementation and effectiveness.

We synthesise these findings, and make suggestions for how to develop and evaluate the effectiveness of active school travel initiatives.

An extended version of this report, which more fully describes methods and findings, is available at https://osf.io/z3erq/.

2. LITERATURE REVIEWS

Aims

This work package was undertaken to review published studies, and unpublished reports and other documents (i.e., 'grey' literature), relating to school active travel initiatives.

2.1. LITERATURE REVIEW: PUBLISHED LITERATURE

Objectives

Specific objectives were to:

- identify sources in which an active school travel initiative was delivered and its effectiveness quantified
- identify which effectiveness criteria were used, and how these were measured
- categorise effectiveness criteria according to the COM-B Model

To maximise informational value, we also sought to summarise:

- the content of school active travel initiatives delivered to date
- the effectiveness of these initiatives for changing behaviour and proxy indicators of behaviour change

Methods

Literature was identified via systematic searches of a publicly accessible database, reference lists of published literature reviews, and websites of UK active travel organisations.

Eligible sources were those that reported primary evidence relating to the effectiveness of active school travel initiatives, published from 2015 onwards.

We organised effectiveness measures into COM-B categories, and categorised interventions according to their content and function(s) played by the intervention (for example, whether they sought to educate participants, or provide skills training).

Findings

"What active travel school initiatives have been trialled?": Description of interventions in published studies

Eleven studies were included, reporting 12 interventions. (One study reported two interventions.) A more detailed account of the studies and interventions is in **Appendix A: Supplementary Table 1.**

We categorised the 12 interventions into four types:

- **School Travel Plans or similar interventions**. Five interventions used strategies akin to STPs. These were coordinated campaigns run by or involving schools, in which education about active travel was provided alongside *enablement and/or training or incentivisation* strategies. Examples included encouraging children to discuss and reflect on the importance and benefits of active travel, and guiding children on walks in the local area.
- **Gamification interventions.** Three interventions used incentivisation only, through gamified systems. In two of these, children collected points by swiping cards on sensors located only on active travel routes to school. In one (the Living Streets Walk to School [WOW] programme), children earned badges by self-reporting walking to school, and could compete with others via leaderboards.
- **Training-based interventions**. Two interventions focused on *'Bikeability'*, an *education* and *training* scheme whereby children were taught to cycle proficiently.
- **Information-only interventions.** Two *education*-based variants of the same intervention were evaluated in one study. Both involved embedding information promoting active travel into lessons to older adolescents as part of their driving training ('Driving Licence at School'). One of the two also encouraged participants to join an active travel Facebook group.

"What criteria have been used to assess effectiveness of active school travel initiatives?": Effectiveness criteria used in published studies

Of the 12 interventions, 11 were evaluated for their effectiveness in changing behaviour, and one focused on capability, opportunity and motivation barriers only.

Of the 11 for which behaviour change was evaluated, four interventions were evaluated solely according to effects on behaviour.

Table 1. Literature Review: Study characteristics

Reference	Country	School setting*	Child age (years)
Aranda-Balboa et al. (2022)	Spain	Secondary	14-15
Buttazzoni et al. (2019)	Canada	Primary and secondary	9-14
Coombes & Jones (2016)	UK	Primary	8-10
Goodman et al. (2016)	UK	Primary	10-11
Humberto et al. (2021)	Brazil	Infant	5-6
Hunter et al. (2015)	UK & Canada	Primary and secondary	9-13
Living Streets Scotland (2023)	UK	Primary	4-11
Sahlqvist et al. (2019)	Australia	Primary	4-11
Stark et al. (2018)	Austria & Germany	Secondary	12-14
Verhoeven et al. (2016)	Belgium	Secondary	17-18
Villa-Gonzalez et al. (2016)	Spain	Primary	8-11

* UK equivalent provided for non-UK studies

Behaviour measures

Effects on behaviour were assessed using objective (monitor-based) assessments in two studies, via child self-report in seven studies, and caregiver-report (on behalf of children) in four studies respectively. Two studies used both objective and child self-report measures. Two studies assessed behaviour via both child self-report and caregiver-report on behalf of children.

Appendix B: Supplementary Table 2 illustrates sources of variation in behaviour measures.

Objective measures of physical activity were taken in one study using accelerometer devices that measured the extent of *activity* (according to step counts, minutes spent in physical activity) over a certain time period (e.g., one week). This generated data relating to *how much* activity was undertaken (step counts), activity *intensity* (e.g. moderate, vigorous), and *when* activity was recorded. In one study, active travel was objectively measured using card-swipes on sensors placed on walking routes, generating reliable data showing whether participants walked to school.

Across the two studies, objective measures were used to derive variables capturing:

- *step counts during school commuting hours, and at other periods (e.g., after school; weekends)*
- *amount of moderate-to-vigorous physical activity during school commuting hours, and at other periods*
- *number of participants who walked to school*

Child-self-reported or caregiver-reported measures varied on seven dimensions (see Appendix B: Supplementary Table 2). In three studies, children were asked to keep a one-week diary of all journeys made and per-journey travel modes used. In one study, children self-reported their travel mode via a travel tracker interface, on entering the classroom. In six studies, participants were asked to recall the actual or typical frequency with which they used one or more travel modes, for all journeys/purposes, or for school journeys in particular. Three studies focused on children's actual travel mode frequency over the past week, and three studies focused on children's travel mode frequency in a typical week. One study focused on both the child's and caregiver's travel mode use over a typical week.

These measures were used to derive variables capturing:

- *The frequency with which one or more travel modes was used*
- *The number of trips for which each travel mode was used*
- *Whether any part of a trip was made by one or more travel modes*
- *How much time was spent using one or more travel modes*
- *The main travel mode used to travel to school*
- *How many children used one or more travel modes, across all journeys, or school journeys only*

Proxy criteria: Capability, opportunity and motivation measures.

Proxy effectiveness measures across the 11 studies tended to focus on physical opportunity facilitators and barriers (Table 2). These included measures of specific beliefs regarding the:

- perceived safety of active travel
- accessibility of active travel
- conduciveness of the physical or built environment to active travel

Social opportunity criteria focused on perceptions of:

- approval or social support from other children for using active travel (i.e., 'injunctive norms')
- the extent to which other children were thought to be using active travel ('descriptive norms')

Multiple motivational measures were used. Reflective motivation measures focused on:

- intentions to use active travel, which represent an overall summary of conscious motivation
- positive attitudes towards active travel
- knowledge or perceptions of the benefits of active travel
- specific beliefs regarding the convenience benefits and barriers of active travel
- specific beliefs regarding the health and wellbeing benefits and barriers of active travel

One automatic motivation measure was observed, focusing on:

- active travel habit strength (as defined as the extent to which people are prompted to use active travel automatically, without conscious thought, due to a history of repetition)

The few *capability* measures found focused on psychological capability, including measures of:

- overall confidence in the child's ability to use active travel modes (i.e., self-efficacy)
- the child's ability to cycle in traffic-free areas (rated by an observer)
- the child's ability to cycle on roads with traffic (rated by an observer)

"What is known about the effectiveness of active school travel initiatives?": Effectiveness of interventions in published studies

In this section, we predominantly focus on the effectiveness of interventions for changing behaviour. **Table 3** summarises effectiveness of interventions for behaviour change and on other proxy criteria for effectiveness. For further detail, see **Appendix A: Supplementary Table 1.**

Table 2. Literature Review: Effectiveness measures identified across published studies included in the literature review, categorised according to COM-B model

Capability, opportunity, motivation measures			Behaviour measures
Capability measures	Opportunity measures	Motivational measures	
Psychological capability *General capability:* - Self-efficacy/ perceived control for active travel - Skills needed for active travel Context-specific capability: - Active travel (cycling) skills in traffic-free areas - Active travel (cycling) skills in situ (on roads) **Physical capability** (None found)	**Physical opportunity** *Specific beliefs – Safety concerns:* - (Not) allowed to walk or cycle - Unsafe to walk/cycle alone - Unsafe to walk/cycle with friends - Unsafe because of crime - Unsafe because of traffic - Too many busy streets - Drivers speed on streets - Too much traffic on street lived on - Might get bullied/ teased - Possibility of accidents *Specific beliefs – physical/built environment:* - Not enough pavements - Not enough cycle paths/lanes - Not enough walking trails - Lots of trees in area - Distance - Weather **Specific beliefs – accessibility**	**Reflective motivation** *General beliefs*: - Intentions to use active travel - Attitudes towards active travel - Positivity of children's statements about active travel - Active travel knowledge - Awareness of benefits of active travel - Perceptions of benefits of using active travel *Specific beliefs – convenience:* - Easier to drive - Cost - Get too hot/sweaty *Specific beliefs – health and wellbeing:* - Route is boring - Not fun to walk/cycle - Health - Independence - Helps me concentrate - Makes me feel calmer - Makes me feel more alert	**Individual-level measures** - Frequency with which any active travel modes used - Frequency with which specific active travel modes used (e.g. cycling) - Percentage of journeys made using any active travel - Percentage of journeys made using specific active travel modes - Percentage of journeys where active travel the dominant mode - Step counts during specified periods (e.g. mornings, afternoons, evenings; commuting hours) - Time spent using active travel - Whether any active travel mode used (yes/no) - Whether specific active travel modes used (e.g. cycling, walking) (yes/no) - Whether active travel was main mode used

	- Built environment suitable for active travel - Cycle lanes/trails easy to get to/access - No cycle rack - Too much to carry - Too far/takes too much time **Social opportunity** *General beliefs:* - Perceptions of others' active travel (descriptive norms) - Perceptions of social approval for active travel (injunctive norms) - Perceived social support for active travel *Specific beliefs:* - No one to walk with	- Helps me stay fit so I look better - Makes me feel happy - Makes me feel well - Gives more time with friends - More healthy than car **Automatic motivation** - Active travel habit strength	**Group-level measures** - Proportion of children using any active travel mode - Proportion of children using *specific* active travel modes (e.g. cycling, walking)

School Travel Plans or similar interventions

Of these five interventions, two showed no impact on children's active travel commuting frequency, though one increased caregivers' active travel and decreased their car use. Three interventions increased the frequency with which children used active travel modes for school journeys.

Gamification interventions

Effectiveness was mixed for these three interventions. In one study, accelerometer data showed no impact of the intervention on step count, and moderate-to-vigorous physical activity declined in both the intervention and control group, though this decline was lessened in the intervention group, suggesting a positive impact. Self-report data suggested that, in all three studies, the percentage of school commutes made by active travel increased, and two studies reported a high intervention engagement rate among children.

Training-based interventions

Neither of the two training-based (Bikeability) interventions were found to change active travel behaviour, though motivational gains were reported, with participants reporting increased cycling knowledge, and rating the intervention enjoyable and useful.

Information-only interventions

Accelerometer data in one study found that the number of walks to and from school decreased over the intervention period, though the number of participants walking to school at least once, and those walking 5-10 times, increased.

2.2. LITERATURE REVIEW: GREY LITERATURE

Objectives and Methods

We sought to review 'grey literature' to uncover additional insights that the review of published literature may have overlooked.

Specific objectives were to summarise:

- evidence relating to observed enablers and barriers of active school travel
- innovative approaches to designing or delivering active school travel initiatives
- approaches to evaluating the effectiveness of active school travel initiatives
- the content of school active travel initiatives that have been delivered to date

Findings

"What criteria have been used to assess the effectiveness of active school travel initiatives?": Identifying enablers and barriers to active school travel in the 'grey literature'

Here, we discuss extraneous factors that may influence active school travel, so may need to be considered when assessing the effectiveness of an active school travel initiative.

Table 3. Literature Review: Effectiveness of interventions in published studies included in the literature review, according to COM-B Model criteria

Source	Capability	Opportunity	Motivation	Behaviour
School Travel Plans or similar interventions				
Buttazzoni (2019)	+	+	+	0
Humberto (2021)	N/A	+	+	+
Sahlqvist (2019)	N/A	N/A	N/A	+
Stark (2018)	+	0	+	+
Villa-Gonzalez (2016)	N/A	N/A	N/A	+
Gamification interventions				
Coombes (2016)	N/A	N/A	N/A	+
Hunter (2015)	N/A	N/A	+	+
Living Streets Scotland (2023)	N/A	N/A	N/A	+
Training-based interventions				
Aranda-Balboa (2022)	?	+	+	0
Goodman (2016)	N/A	N/A	N/A	0
Information-only interventions				
Verhoeven (2016), Intervention 1	0	0	+	N/A
Verhoeven (2016), Intervention 2	0	0	+	N/A

NB: + = (at least some) positive impact, 0 = no impact, – = negative impact, ? = unclear, N/A = not measured

Opportunity: Age, Gender & Distance

Younger children aged 5–10 years walk to school more than their counterparts aged 11–16 years (DfT, 2024). Since 1995, children aged 11–16 years have been between three to five times more likely to cycle than their counterparts aged 5–10 years between 1995-2023, though the proportion of journeys to school by bicycle has typically range between 1-3% (DfT, 2024). This is understandable, given that younger children may not have been trained to cycle safely before the age of 10.

Gender also affects active school travel. The New Zealand National Household Survey found that female children cycled an average of 30km annually for school journeys, compared to 100km among male children (Curl et al., 2020), due to female school uniform being less conducive to cycling.

In England, journeys to school of 1 mile or less have been consistently completed on foot since 2002 for around 80% of all children aged 5–16 years (DfT, 2024c). Since 2002, between 47-69% of children aged 11–16 years have walked to school for journeys 1–2 miles long, compared to a typical 20-30% of children aged 5-10 years. This decreases to <15% for school journeys longer than 2 miles, suggesting that journey distance is a decisive factor regarding active travel.

"What active school travel initiatives have been trialled?": Innovative approaches to designing and delivering active school travel initiatives in the 'grey literature'

Moments of Change

The Department for Transport (2025a, 2025b) recently adopted an active travel intervention approach focusing on 'moments of change'; that is, context changes surrounding significant life events, such as starting school or starting a new school, or more broadly, moving home or changing jobs. This approach draws on theory that suggests that, when people are placed in all-new contexts, their old habits are discontinued and they tend to be more open to new information or persuasive communications regarding adopting new travel modes (Walker et al., 2015).

Positive deviance

The 'positive deviance' approach centres on learning how to promote and adopt behaviour change by understanding behaviours of a few individuals at school, or certain schools in the community, who apply uncommon but successful strategies and practices (Glasgow Centre for Population Health, 2013). This approach assumes that, given that these individuals and schools are from the same communities and share similar infrastructure to others, learnings from those who 'positively deviate' from norms may be enlightening for motivating others to introduce sustainable behavioural changes. Interestingly however, data from 18 Glasgow-based schools showed that positively deviant schools were no more likely to have a STP than other schools (Glasgow Centre for Population Health, 2013). While 'positive deviance' may be useful for understanding 'what works' for successful individuals and schools, having an STP does not appear to necessarily lead to positive deviance.

Embedding active travel into the curriculum

Incorporating active travel plan activities into the curriculum could potentially increase motivation and capability for school children (see **Case Study 2: System Innovation for Active School Journeys).** A Scottish Government (2017) study reported on a primary school

that successfully embedded discussion of sustainable transport, and design and presentation of traffic surveys into French lessons. Direct links with the teaching curriculum can also support the 20% of UK children that are neurodiverse by embedding, for example, wayfinding activities into the curriculum to support active travel to school through road works and road closures (Sustrans, 2024).

Evidence from the Finnish the 'Active Way to School' initiative (Fiksusti Kouluun, 2025) showed that children who travelled to school actively drew their journey colourfully, including plants, whereas those who were driven made black and white drawings. This speaks to a developing evidence base suggesting that early age interventions may sustain more sustainable practices in adult life, though no long-term studies have been conducted.

Data-driven approaches

Several interventions have employed technology-enabled data collection methods, including smartphone apps and air quality sensors. These approaches – for example, the Step2Get scheme (Gyergyay, 2015), and the REALLOCATE initiative (Kopp et al., 2024) – not only measure effectiveness, but also inform intervention content, by identifying optimal routes for active school travel, or encouraging nudging and gamification. Gamification schemes tend to attract good levels of engagement (e.g., Scottish Government, 2017).

A key advantage of technology-based options is that they enable collection of reliable baseline data, which is essential for rigorous long-term evaluation. Children, caregivers, school staff and scheme managers can benefit from having a 'live' overview of activities to update interventions regularly, if needed. Reported disadvantages included the discontinuation of engagement in active travel activities among children after the schemes have ended, privacy concerns, problems with travel tracking accuracy, common technology related challenges e.g. missing data due to network unavailability and the cost of incentives for participants.

"What active school travel initiatives have been trialled, and what is known about their effectiveness?": Description of 'grey literature' interventions and their effectiveness

Four interventions were found in the grey literature **(see Appendix C: Supplementary Table 3.)**

Data-driven travel tracking interventions

Two interventions – Step2Get (Gyergyay, 2015) and COMPAIR (European Commission, 2024) – used technology to gather travel data and thereby inform the development of interventions to create greater *opportunities* for active travel.

Step2Get focused on establishing routes used by children using travel tracking data and then suggesting safer routes to school, considering specific gender-based issues. Shopping and cinema vouchers were given to participants to incentivise engagement. Trials demonstrated successful changes in travel mode choices, with target groups switching away from congested or overcrowded routes and using safer walking routes (Gyergyay, 2015).

COMPAIR adopted a 'citizen science' approach to safe school travel. Local residents and schools participated in an initiative to monitor traffic and air pollution, and thereby increase their awareness of air quality issues and spur travel mode changes. Traffic data three months after traffic-counting began suggested there were fewer cars and more cyclists per hour during peak times in target areas, with negligible impact on traffic on side streets (European Commission, 2024).

Gamification

One intervention used a gamification approach whereby, during a time-limited intervention period, children earned points, and could win book tokens and stationery, for more frequent active school travel (BetterPoints, 2021). Travel mode frequency was self-reported using an app. The intervention was trialled in two areas. In one (Ebbsfleet), there was no evidence of a long-term impact beyond the duration of the initiative. In the other area (Leicester), the authors claimed that children continued to use the app after the intervention period ended, but did not provide any further detail or evidence to support this. BetterPoints have implemented a series of interventions in various UK cities, including schools and Universities, based on collecting data on children's travel mode.

School Travel Plans or similar

The 'Active Way to School' (or 'Smart to School') programme, run in Finland, offers a more systems-based approach (Fiksusti Kouluun, 2025). Information and advice on how and why to plan and implement active school travel is given not only to schools, children, and caregivers, but also to other stakeholders, including organisations and decision-makers. It aims to promote understanding, monitoring and greater uptake of active school travel, through greater cooperation between different stakeholders within the broader system that surrounds active school travel. Evaluations to date suggest that car journeys of 0-5km have reduced.

CASE STUDY 1: RAINBOW ROUTES (SHEFFIELD, UK)

"What active school travel initiatives have been trialled?": The 'Rainbow Routes' initiative

Rainbow Routes was a trial project in Sheffield, South Yorkshire, tested in 2022 (Local Living Streets - Sheffield SW, undated). It aimed to address barriers to safe active school travel among primary school children, including a lack of pedestrian crossings, air-polluted routes, and motorized traffic congestion. These environmental factors can limit caregivers' *motivation* to choose active travel modes and restrict *opportunities* for safe active school travel.

Rainbow Routes was a two-phase project that sought to offer safer routes for primary school children walking or cycling to local schools by making journeys to school more enjoyable, safe and healthy. In the first phase, caregivers used a smartphone app to track their school travel, which allowed intervention developers to accumulate data on commonly used school routes. In the second phase, routes identified in the first phase were selected for closure during school travel hours.

Smartphone ownership and use was important to support travel tracking and collect baseline data in Phase 1 of this project, which lasted for two weeks within a two-month period. Digital travel tracker data collection was combined with air quality data from the selected school areas, which was gathered using portable sensors throughout the two-month measurement period. Participating schools were culturally and socioeconomically diverse.

Caregivers were required to review and correct their recorded travel data to meet project objectives. To maximise engagement, local business vouchers were provided to participating caregivers.

At Phase 2, data from Phase 1 were reviewed by project partners and stakeholders, to co-create and select specific interventions and locations. Partners and stakeholders included ModeShift STARS co-ordinators, Sheffield City Councillors, Sheffield City Region representatives, consultants, the local Living Streets community group and researchers from the two local universities. Phase 2 focused on choosing five 'Rainbow Routes' and streets for closure to motorised traffic at selected times. Street design aesthetics were planned to be co-created by children, travel planners and local artists.

Key intervention elements

- Caregiver commitment for at least two weeks
- Smartphone app to track travel
- Incentives to increase engagement among caregivers
- Portable air quality sensors
- Baseline travel tracking and air quality data
- Stakeholder support

What criteria were used to assess the effectiveness of Rainbow Routes?

The developers of Rainbow Routes aimed to evaluate its effectiveness via:

- Continued *travel tracking* via the smartphone app used at Phase 1, providing data on how many journeys to and from school were made by active travel and other modes
- Continued air *quality tracking* using the portable sensors used at Phase 1, to monitor air pollution levels at the travel routes used

- *Interviews and surveys* conducted with teachers, children, and caregivers

What is known about the effectiveness of Rainbow Routes?

Stakeholders had expressed interest in follow-up activities with events, reports, academic publications and grant proposals at local, national or international level. We understand, however, that the project developers were unsuccessful in obtaining funding to evaluate Rainbow Routes, so its effectiveness has not been formally assessed.

Nonetheless, the project identified key implementation and evaluation enablers and barriers, which provide important learnings for developing and evaluating similar initiatives in future.

Intervention delivery and implementation: Enablers and barriers

Enablers included:

- *Availability* of *technology enabled data collection tools:* The travel tracking app and air pollution sensors were a valuable innovation of the Rainbow Routes project.
- *Stakeholder engagement:* Having a wide range of local and regional stakeholders involved in this project, in conjunction with academic expertise, provided a holistic approach in designing and delivering this intervention.
- *Participant incentives:* Offering vouchers to be used at local businesses was an innovative approach to meeting project objectives and increasing participation.

Barriers included:

- *School staff workload:* It was not possible to directly engage with teaching staff at the school and jointly develop supporting material, due to workload commitments.
- *Commitment among caregivers and stakeholders:* Maintaining buy-in from key project participants was challenging.
- *Quality of information and communications technology:* External problems relating to the quality of the technology, including poor phone network reception and accuracy of GPS tracking, potentially compromised data availability and quality.
- *Non-permanent intervention website:* The intervention website, which was crucial for maintaining intervention interest and visibility, depended on continued buy-in from project partners, increasing the risk of the site being discontinued when funding ceased, or champions changed careers.
- *Availability of, and willingness to use, smartphone technology:* Reliance on caregivers' smartphones risks excluding caregivers without smartphone access. Additionally, some caregivers voiced concerns around privacy concerns
- *Lack of funding and interest:* A lack of funding, and low or wavering interest among caregivers and stakeholders, precluded rigorous assessment of effectiveness

Evaluating effectiveness: Enablers and barriers

Enablers included:

- *Availability of technology enabled data collection tools*

Barriers included:

- *School staff workload*
- *Quality of information and communications technology*
- *Availability of, and willingness to use, smartphone technology*
- *Lack of funding and interest*

Further information

Rainbow Routes description:
https://www.sheffieldswlivingstreets.org.uk/campaigns/rainbow-routes

Rainbow Routes project concept video:
https://www.youtube.com/watch?v=dUFYQck5Gj0

Contact: Sheffield SW Local Living Streets (sheffieldsw.livingstreets@gmail.com)

CASE STUDY 2: SYSTEM INNOVATION FOR ACTIVE SCHOOL JOURNEYS (SKÅNE, SWEDEN)

"What active school travel initiatives have been trialled?": The System Innovation for Active School Journeys

The **System Innovation for Active School Journeys** project aims to develop a nationally scalable method to allow all publicly-run Swedish compulsory schools (ages 7–16) to systematically support active school travel and thereby enable long-term active travel behaviour change (Innovation Skane, 2025). The project takes a multi-pronged approach that integrates active travel into children's and teachers' daily routines, connects it to the national curriculum, involves caregivers, and engages the wider community. The project aims to boost motivation, capability and opportunity for active travel.

Key intervention elements

Interventions are locally adapted to each school's specific context, including traffic conditions, available infrastructure, and student and teacher needs. A central component is a four-week campaign, run in Spring and tailored to each school's conditions. The campaign typically includes:

- **Gamification and co-creation**
  Weekly *"missions"* and class-based competitions to encourage participation by children. Activities are designed to be fun for children (e.g. pop-up bike days, chalk art, school yard posters), safe from a parental perspective (no active modes promoted for unsafe routes), and *simple* for teachers to integrate into everyday teaching.
- **Curriculum Integration**
  Ready-made teaching materials support the connection between the campaign and learning objectives. Activities are aligned with national curriculum goals in subjects like physical education, geography, mathematics, and civics.
- **Parental Involvement**
  Engagement tools include take-home reflections, schoolyard signage at drop-off points, and communication via school smartphone apps or newsletters to stimulate home discussion and support behaviour change.

Table 4 provides example in-class intervention activities and their links to the curriculum.

What criteria are being used to assess the effectiveness of the System Innovation for Active School Journeys?

The effectiveness of the System Innovation for Active School Journeys is being evaluated via:

- *Mapping and self-reporting tools* integrated into classroom activities (e.g. mapping routes to school and reflecting on travel safety)
- *Activity logging and tracking* (e.g. daily stickers or tally sheets)
- T*eacher observations* and pedagogical reflection, capturing engagement and integration
- *Caregiver feedback* through *surveys* or digital communication channels
- *Travel surveys for children,* using data collection methods tailored to cognitive and literacy levels, with visual tools and simplified language for younger children, and more detailed reporting for older children

What is known about the effectiveness of the System Innovation for Active School Journeys?

The project is ongoing, with the first pilots implemented in the Skåne region in southern Sweden. Formal evaluation results will be available in late 2026.

Intervention delivery and implementation: Enablers and barriers

Enablers include:

- *Curriculum alignment:* Linking activities to learning objectives increases relevance and acceptance among teachers, whilst minimising any additional workload.
- *Leadership support:* Backing from school leadership fosters prioritisation and better coordination among the different stakeholders required to set up and operate schemes.
- *User-friendly materials:* Clear guidelines, ready-to-use teaching aids, and low administrative burden help avoid the perception that this is 'extra work'.
- *Integrated approach:* Adopting an integrated approach, with dedicated time for active travel activities, and champions to lead the intervention, enables activities to be embedded into existing routines.

Barriers include:

- *Difficulty in reaching and engaging parents:* Communication through signs or newsletters may not be enough to involve parents meaningfully.
- *Parents' safety concerns:* Many parents are hesitant to let children walk or cycle due to traffic concerns, even in relatively safe areas.
- *Parents' inactive travel habits:* Established routines, like daily car drop-offs, can be hard to shift without strong motivation and support.
- *Teachers' confidence in incorporating activities into the curriculum:* Teachers may find it hard to connect activities to the existing curriculum. If not clearly linked to learning goals, activities risk being seen as additional work for teachers.
- *Built environment barriers:* Local conditions (e.g. unsafe roads, lack of bike storage) may limit what is realistically possible, even when people are motivated.

Table 4. Case Study 2, Sweden (System Innovation for Active School Journeys): Examples of class activities and their teaching curriculum links

School Level	Examples of Class Activities	Teaching Curriculum Links
Lower Primary (Years 1–3 / Lågstadiet)	"Skojj på hojj" (bike play and balance tracks), Startövning (map and color the way to school), postcards to par-ents, sticker/tally logging, outdoor scavenger hunts, simple story-based missions, posters or thank-you signs, tree-planting.	Physical Education and Health (Idrott & hälsa) – movement and outdoor activi-ty, Art (Bild) – creative expression, Geography (Geografi) – maps and local envi-ronment, Science/ Technology (NO/Teknik) – traffic safety, Swedish (Svenska) – oral and written communi-cation.
Middle Primary (Years 4–6 / Mellanstadiet)	Weekly class competitions, thematic missions (health, environment, traffic), map reflection and safety discussions, data exercises (CO_2 savings, graphs), debates or short essays, poster/slogan design, peer leadership (e.g., walk ambassadors).	Physical Education and Health (Idrott & hälsa) – health and lifestyle, Mathe-matics (Matematik) – statistics and gra-phing, Civics (Samhällskunskap) – sustainable development and traffic issues, Swedish (Svenska) – argumentation and reflection, Art (Bild), Geography (Geo-grafi).

Evaluating effectiveness: Enablers and barriers

Enablers include:

- *Age-appropriate data collection tools:* Visual mapping and simplified formats in many schools help ensure children can meaningfully participate.

Barriers include:

- *Age-inappropriate data collection tools:* Where schools do not use age-appropriate data collection methods, some younger children will struggle to self-report their travel.
- L*ow parent survey response rates:* Perhaps owing to difficulty in engaging parents, parent-based surveys tend to produce low response rates.
- *Lack of standardized methods across schools:* Variability in measurement methods precludes effective comparisons and long-term tracking, making it difficult to monitor progress regionally and nationally.

Further information

System Innovation for Active School Journeys description:
https://innovationskane.com/activeschooljourneys/

Example material used by school staff during this project (in Swedish):
https://trafikeniskolan.ntf.se/lektionsforslag/lektionsforslag-ak-f-3/ak-f-1-orientera-sig-i-narmiljon/

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3.
FOCUS GROUPS

Aim and Objectives

This work package aimed to identify discrete criteria that caregivers and staff believe must be satisfied for a STP to be deemed 'effective'.

Specific objectives were to:

- Run focus group discussions in which caregivers and staff reflect on how they travel to school, enablers of and barriers to using active travel modes to commute to school, and potential strategies that could be used as part of a STP
- Analyse transcripts to determine themes underlying perceptions of effectiveness, and barriers and enablers to achieving 'effectiveness' on each of these dimensions
- Identify potential indicators of effectiveness according to each of the dimensions

Methods

Two focus group discussions, each at a different school, were run in March 2025.

Selection of schools

Schools were selected based on their Modeshift STARS status: one school (Echelford Primary) previously had a STP, but had no active STP in place when this project was undertaken; and one school (Horley Infants) had an Outstanding STP at the time of the project.

The authors at Horley Infant School, March 2025

Six participants (3 caregivers [for children aged 7-11 years], 2 staff members, 1 caregiver & staff member; all female, age range 20-47) took part at Echelford Primary, and seven participants (4 caregivers [for children aged 4-7 years], 3 staff; 4 female, 3 male, age range 35-62) at Horley Infants (see **Table 5**).

Data collection

Focus groups were run by two facilitators. Discussion focused on awareness and understanding of STPs, perceptions of effectiveness, personal experiences and challenges in using active travel modes, and suggestions for increasing active travel among caregivers and staff.

Data analysis

Focus group transcripts were analysed using Thematic Analysis (Braun & Clarke, 2021), to identify discrete dimensions underpinning views of what would constitute an 'effective' STP. **Appendix D: Supplementary Table 4** provides an extensive list of example quotes.

Table 5. Focus groups: Participant characteristics

	School	
Characteristics	Echelford Primary (6 participants)	Horley Infants (7 participants)
Gender	6 x female	4 x female 3 x male
Caregiver age	20-47 years	35-62 years
Role	3 x caregivers 2 x staff 1 x staff & caregiver	3 x caregivers 4 x staff
Employment status	5 x full-time employed 1 x self-employed	4 x full-time employed 3 x part-time employed
Total number of children (caregivers only)	1 x 1 child 1 x 2 children 2 x 3 children	4 x 2 children
Number of children at host school (caregivers only)	3 x 1 child 1 x 3 children	4 x 1 child
Gender, year and age of child(ren) at host school (caregivers only)	1 x female, Year 6, 11yo 1 x female, Year 3, 7yo 1 x male, Year 2, 7yo 2 x male, year & age not reported 1 x female, year & age not reported	1 x male, reception (Year 0), 4yo 1 x female, reception (Year 0), 5yo 1 x male, Year 2, 7yo 1 x female, Year 2, 6yo
Child(ren) with disability? (caregivers only)	4 x no	4 x no
Child(ren) live at home? (caregivers only)	4 x yes	4 x yes
Distance to school	1 x 3-5 miles 3 x under 1 mile 2 x not reported	3 x 1-2 miles 1 x under 1 mile 3 x not reported
Current travel mode	3 x walk 1 x car 1 x combined car & walk 1 x not reported	2 x walk 2 x car 3 x not reported
Access to one or more bicycle?	3 x yes 1 x no 2 x not reported	3 x yes 1 x no 3 x not reported
Designated cycle path to school?	4 x no 2 x not reported	4 x no 1 x yes 2 x not reported
Destination after dropping children to school (caregivers only)	2 x home 2 x not reported	4 x home

Findings

Four themes were identified: physical safety; efficiency and convenience; physical and social environmental affordances; and fostering health and wellbeing.

Focus group discussions at Echelford Primary School (top two images) and Horley Infant School (bottom image)

Physical safety concerns

"We're worried for their safety"
(Echelford focus group)

Child safety was the main concern around active travel in both group discussions, and was of higher priority than sustainability. Participants felt that appealing to sustainability concerns was effective for changing children's motivation, but less so for caregivers. Participants saw little value in using digital route tracking tools to help authorities understand active travel routes, because they felt that safety hazards were concentrated around the school entrance, not en route.

Perceived barriers to safety focused on risks posed by traffic and obstructions on walking or cycling routes. These included:

- fast-moving road traffic
- concerns around whether car drivers can detect children
- concerns around whether children would detect cars
- the proximity of children to car emissions
- perceived vulnerability to crime-based threats to safety, including staff's own concerns, and concerns around the child's vulnerability

Participants voiced concern around children's capability to negotiate busy roads.

"It would be nice to start allowing him [to walk to school] ... but I will not do that while the roads are like this"
(Echelford)

Both groups felt that active travel initiatives were valuable for boosting children's proficiency for independent active travel, though some believed more fundamental travel skills were not delivered early enough for all children to benefit.

Perceived indicators of effectiveness in promoting safety when using active travel

Participants felt that, if a STP effectively tackled safety concerns, this would be demonstrated by:

- increased caregiver confidence in children's safety
- more positive mood, and decreased stress levels, among children when arriving at school
- children having access to age-appropriate active travel proficiency training
- greater active travel proficiency rates among children

Efficiency and convenience

"There's a safer route for walking, but that adds 10 minutes"
(Horley)

For many participants, the decision that they made prior to travelling to school was not focused on which travel mode to use, but rather on how to reach school (and other

destinations) most efficiently and conveniently. Travel mode choice was a mere by-product of this decision.

Participants cited multiple barriers that they felt made active travel modes prohibitively inefficient or inconvenient, including:

- the weather
- the need to travel to multiple destinations
- time pressure
- lack of suitable alternatives to driving

"It would make no sense for me to walk to school, then walk back home, then get in the car and go to work"
(Horley)

Perceived indicators of effectiveness in promoting efficient and convenient active travel

Participants felt that, if a STP effectively tackled efficiency and convenience concerns, this would be demonstrated by:

- caregivers' confidence in children using active travel modes safely without compromising caregivers' other valued priorities

Physical and social environmental affordances

"We have no jurisdiction at all ... we feel unsupported"
(Echelford)

Participants in both groups referred to modifications that had been made to the physical environment to encourage responsible driving, such as no-stopping and no-parking zones, and clearly demarcated pedestrian crossings. Yet, both groups described many drivers ignoring these, in a way they felt compromised the safety of children using active travel.

No-stopping area outside Horley Infants School

Participants described barriers to active travel arising from a lack of supporting physical infrastructure, including:

- uninviting areas for caregivers to wait to collect their child
- pavement obstructions arising from parked cars
- pavement obstructions relating to street features

Participants felt that effective traffic management was essential for supporting active travel. The main social environmental barriers to using active travel that were cited were all interlinked:

- anti-social driving behaviour, often from caregivers
- a lack of autonomy among school staff for addressing anti-social driving behaviour, coupled with misconceptions among caregivers and local residents regarding the enforcement powers held by the school
- a lack of perceived support from other organisations, bodies and stakeholders for enforcing traffic safety regulations
- inability to recruit or retain dedicated school crossing personnel

"Some parents will park over a driveway as if it's nothing, because there's not been any consequence for them, so they just do it"
(Echelford)

Perceived indicators of effectiveness in making physical or social environment changes conducive to active travel

Participants felt that, if a STP effectively made or supported physical or social environment changes, this would be demonstrated by:

- more welcoming, sheltered environments for caregivers to wait to pick up their children
- well maintained roads and pavements conducive to cycling and walking
- more physical adjustments conducive to active travel, including zebra crossings, pedestrian paths, and zig zag lines
- effective traffic management initiatives, including road closures, and the creation of park-and-ride options
- traffic management initiatives that reduce, rather than relocating, anti-social road use
- traffic management initiatives that are effectively and demonstrably enforced
- greater powers afforded to schools to enforce traffic management initiatives
- school crossing patrol staff
- clearer communication around appropriate road use

Fostering health and wellbeing

"[When walking to school, my daughter] has a little bit of time to play and explore"
(Horley)

Participants in both groups felt that active travel could be promoted in a way that enhances knowledge, confidence, health and wellbeing.

Many caregivers spoke of the benefits of educating children about the importance of active travel, including that children became more influential over caregivers' travel mode choices, increasing the likelihood of active travel use. Others felt that encouraging walking fostered connections with the local environment.

"The pester power children have is the best way to get the parent to do anything ... if [the children] are onboard then they won't stop until you do whatever they have in mind"
(Horley)

Participants in both groups described initiatives that they had run, or had heard of, that had promoted active travel in a way that fostered children's intrinsic motivation to be active, including:

- gamification of active travel
- initiatives designed to enhance interest in the physical objects required for active travel
- class or house competitions promoting active travel

Perceived indicators of effectiveness in encouraging active travel for wellbeing

Participants felt that, if a STP effectively promoted active travel in a way that enhances knowledge, health and wellbeing, this would be demonstrated by:

- greater knowledge around the importance of active travel among children, including knowledge of sustainability-related issues
- enhanced intrinsic motivation to use active travel modes among children
- greater engagement between children and aspects of the physical environment
- enhanced enjoyment of active travel to and from school among children
- greater child autonomy when travelling (actively) to and from school
- greater child involvement in and influence over school travel mode decisions
- greater social cohesion and wellbeing among children travelling to school together
- increased sense of community among caregivers using active travel
- greater 'walk-pooling', whereby caregivers agree to walk each others' children into school

Table 6. Focus Groups: Potential barriers and enablers of active travel, organised according to the COM-B model

Theme	Capability factors	Opportunity factors	Motivational factors
Physical safety concerns	Drivers' lack of capability to detect children (-) Children's lack of capability to detect cars (-) Children's lack of capability to negotiate busy roads (-)	Fast-moving road traffic (-) Proximity of children to car emissions (-) Active travel proficiency programmes delivered too late (-) Vulnerability to crime-based threats to safety when using active travel (-)	Prioritisation of child safety (-)
Efficiency and convenience		Bad weather (-) Trip-chaining (-) Time pressure (-) Lack of suitable alternatives to driving (-)	
Physical and social environmen-tal affordances	Lack of capability to address anti-social driving behaviour (-)	Uninviting physical spaces to wait (-) Pavement obstructions (parked cars, street features) (-) Anti-social driving behaviour from road users (-) Lack of perceived support from other stakeholders for enforcing traffic safety regulations (-) Lack of dedicated school crossing personnel (-)	
Active travel as a route to health and wellbeing			Educating children about importance of active travel (+) Children becoming influential over caregivers' travel mode choices (+) Fostering connections with local environment (+) Gamification of active travel (+) Initiatives that enhance interest in objects required for active travel (+) Competitions promoting active travel (+)

NB: '+' enabler of effectiveness, '–' barrier to effectiveness

A COM-B summary of focus group findings

Table 6 organises core concepts within each of the four themes using the COM-B model.

"What criteria can be used to assess the effectiveness of active school travel initiatives?": Determinants of active school travel

Most of the factors that reportedly affected engagement in active travel predominantly related to a lack of perceived opportunity to travel safely, efficiently or conveniently, with concerns also raised about lack of opportunities afforded by physical and social environments (Table 6). Concerns relating to capability tended to focus on the capability of children to negotiate potentially dangerous roads, the capability of other road users to identify children using active travel modes, and the capability of schools to enforce travel management initiatives. Motivational factors focused on caregivers' concerns that active travel was potentially unsafe, though participants identified multiple ways in which children could become more strongly and more intrinsically motivated to use active travel, and could also encourage caregivers to embrace active travel.

4. RECOMMENDATIONS

What criteria can be used to assess the effectiveness of active school travel initiatives?

Table 7 summarises findings regarding how STP 'effectiveness' can be conceived of and measured.

Behaviour measures

STPs should ideally demonstrably displace inactive travel modes (e.g., car use) with active travel alternatives (e.g., walking, cycling).

Recommendation for Measurement (1): Measure behaviour objectively, otherwise use per-journey self- or other-report

We recommend assessing behaviour change using objective measures where feasible, or using both objective measures and report-based measures, because report-based measures can help to contextualise objective measures. We recommend only using self- or caregiver-report measures in isolation when objective measures are unavailable.

If using self- or caregiver-report measures, these should be measured on a per-journey basis, and obtained in close temporal proximity to each journey.

We recommend referring to **Appendix B: Supplementary Table 2,** which describes the different ways in which objective and reported behaviour measures can differ, when deciding how to assess behaviour change.

Behaviour measures should ideally be triangulated using measures of likely outcomes of behaviour, such as (changes in) traffic counts and (increased) air quality. Evidence suggests that many people are willing to voluntarily contribute to efforts to measure traffic and air quality, and that doing so may offer a valuable active travel intervention of its own, by raising awareness of the need for behaviour change (European Commission, 2024).

Capability, opportunity and motivation measures

The main observed barriers to active school travel related to caregivers' perceptions that there is insufficient physical opportunity for safe active school travel among children. Caregivers reported concerns around safety and children's lack of active travel proficiency, perceived hazards in the physical environment, and a perception that non-car travel is inconvenient.

Recommendation for Measurement (2): Measure actual and perceived opportunities for active travel

We recommend focusing heavily on measures of opportunity when assessing STP effectiveness. As the COM-B model outlines, it is the perception of opportunity (or a lack thereof) that determines behaviour. While it may be possible to objectively assess aspects of the physical environment that provide or limit opportunities for active travel (e.g., number of cars parked dangerously), it is also important to obtain self-report measures of pertinent opportunity beliefs, to understand the perceived conduciveness of the environment to active travel. Self-report measures should focus on safety and vulnerability, the conduciveness of the physical environment, and efficiency and convenience beliefs.

Table 7 sets out some of the key opportunity factors that emerged from this project, though not all will be relevant to all contexts.

We observed several motivational factors, including generic factors such as children's enjoyment of active travel, and caregivers' specific beliefs around health and wellbeing benefits.

Recommendation for Measurement (3): Measure, via self-report, general motivation, and specific motivational beliefs, surrounding active and inactive travel

We recommend assessing motivation for both active and inactive travel, which realistically requires use of self-report measures. Motivation can be captured generically, by assessing global intentions and attitudes towards active travel, or the extent to which someone is intrinsically motivated to use active travel. Motivation can also be captured in relation to specific knowledge, awareness and beliefs surrounding the benefits of active travel, such as its health and sustainability benefits.

Table 7 sets out some key motivational factors that emerged, though not all will be relevant to all contexts.

On the few occasions that they have been assessed, capability measures have focused on perceptions of children's skills for using active travel modes, such as whether they can ride a bicycle, or whether they are able to negotiate busy roads.

Recommendation for Measurement (4): Measure, via self-report, psychological capability

We recommend assessing psychological capability for active travel, particularly when assessing bicycle use initiatives. Measures should seek to establish whether children have the requisite skills (e.g., whether they have learned to ride a bike), and children and caregivers' confidence in the child's proficiency.

Extraneous factors

Recommendation for Measurement (5): Measure extraneous factors, such as demographics, that may affect the effectiveness of active school travel initiatives

Age, gender and distance to school must be accounted for when assessing the effectiveness of a travel plan.

Additionally, evaluations of active school travel initiatives should account for restrictions in physical capacity, because initiatives that do not acknowledge children or caregivers with physical impairments may widen inequalities. Temporary constraints on physical capability, such as how much luggage is taken to school (e.g., school bags), or to subsequent destinations (e.g., work or gym equipment), may prohibit active travel.

Extraneous factors will determine the effectiveness of a travel plan but cannot feasibly be targeted to bring about behaviour change. Examples include:

- travel mode availability
- caregivers' employment status and time available for the school run
- household composition (e.g., child age, special needs)
- trip-chaining needs
- availability of changing facilities, to accommodate gender-specific needs
- carrying needs (e.g., clothes, equipment, luggage)

What active school travel initiatives have been trialled, and what is known about their effectiveness?

Training-based interventions

Studies of the 'Bikeability' cycling promotion scheme surprisingly found it had no impact on children's cycling frequency, though it boosted children's motivation for active travel. This suggests that, despite the benefits of cycling training, caregivers remain unconvinced of the appropriateness of primary-age children cycling to school. Training-based schemes may have to also engage with caregivers to demonstrate that children have learned to travel to school safely.

Gamification interventions

Interventions that gamify active travel appear engaging for children, and thereby lead to greater uptake of active travel, though there is minimal evidence of their long-term effectiveness. Providing external incentives, such as tangible rewards, may however undermine long-term effectiveness. Encouraging people to change their behaviour solely for the purpose of obtaining the incentive leads to short-term behaviour change that is abandoned when the incentive is removed (Deci et al., 1999).

High engagement in gamification interventions demonstrates that when children find active travel rewarding, they are willing to change their behaviour. Rewards such as badges and praise from caregivers and staff may be sufficient to enhance intrinsic motivation, which will likely sustain active travel in the absence of external rewards.

Data-driven tracking interventions

Data-driven tracking approaches show promise for promoting intrinsic motivation, even without explicitly seeking to motivate people to change their travel behaviour. Contributing to technology-aided efforts to track travel mode choices, and its consequences (e.g., air quality), appears to raise awareness of travel mode choices. This in turn encourages people to adopt active travel modes, to mitigate problems that they have become aware of, such as local traffic congestion. Tracking data is also useful for informing intervention design, by revealing and subsequently targeting the most opportune contexts in which to promote active school travel (see **Case Study 1: Rainbow Routes**). Accuracy, availability, and privacy needs and perceptions must however be considered when using digital travel tracking tools.

Reflections and Future Directions: How to promote active school travel?

Need for a systems-based approach in designing and evaluating active school travel initiatives

Staff in one of the focus groups expressed feeling unsupported when attempting to manage antisocial behaviour among some caregivers who drive to school. This highlights one of the key limitations of a solely school-based approach: *whether a child, caregiver or staff member chooses to use active travel for school journeys is determined not only by whether school staff support active travel, but also the support offered by other stakeholders.*

Active travel sits within a broader system of behaviours and stakeholders. Enhancing the safety of the school run requires buy-in not only from school staff, but also from planners (e.g., to ensure safe crossings), enforcement officers (to ensure traffic management measures are adhered to), local residents (e.g., to avoid parking on pavements), and others.

Few of the initiatives we reviewed adopted systems-based approaches, with two exceptions. The Finnish 'Active Way to School' initiative is built on cross-sector collaboration between stakeholders, including school staff, caregivers, decision-makers, and organisations (Fiksusti Kouluun, 2025). Buttazzoni et al's (2019) STP intervention was notable because schools were empowered to form committees of stakeholders including traffic enforcement authorities, and planners who were able to build pavements to create safer physical environments. These initiatives speak to the importance of addressing active school travel through a collective effort, coordinated across multiple stakeholders.

We recommend that systems-based approaches are used to promote active travel.

> **Recommendation for Developing Active Travel Initiatives:** To achieve active travel for all, schools should be supported by additional stakeholders to develop, administer, and evaluate coordinated initiatives that target not only individual-level behaviour change, but also systemic changes, such as modification of infrastructure, enforcement of road traffic management systems, and development of policy.

Adopting a systems-based approach will require several key questions to be addressed:

- *Who are the key stakeholders within the broader 'ecosystem' that surrounds active school travel?*

We recommend conducting a 'system mapping analysis' to understand the broader network in which active travel sits. This involves identifying stakeholders (other than children, caregivers and school staff) that play a role – or could play a role – in the school travel behaviour of

children, caregivers and school staff, and how those stakeholders' behaviour or decision-making affects active school travel. This analysis can identify which stakeholders to work with to gain most leverage over active school travel behaviour change. Framing active travel solely as an individual-level behaviour change issue downplays the importance of systemic change, such as policy and infrastructural modifications.

- *Who is responsible for developing and maintaining School Travel Plans (or similar, systems-based initiatives)?*

Adopting a systems-based approach to active school travel initiatives would alleviate the current burden on school staff to develop and maintain STPs. However, it is important to ensure that responsibility for active school travel is not diffused among stakeholders such that no stakeholder feels responsible for acting. The effectiveness of a systems-based approach depends on determining which stakeholders are responsible for which contributions to the development and maintenance of STPs, and how and by whom such contributions will be monitored.

- *How visible should School Travel Plans be?*

Interestingly, none of our focus group participants referred spontaneously and explicitly to the existence or content of an STP. This may suggest that the visibility of the STP may not be essential for caregivers to be motivated to engage in active travel. Alternatively, it may suggest that STPs, which are typically hidden on school websites, or password-protected, are not sufficiently visible to caregivers and other stakeholders. If a systems-based approach to active travel promotion were adopted, it would be important to ensure visibility and access to STPs among stakeholders.

- *How should a systems-based active travel initiative be evaluated?*

Evaluating the effectiveness of a systems-based initiative will require a broader set of criteria than are currently used to evaluate active school travel initiatives. The criteria we focused on in this report predominantly pertain to individual-level determinants of behaviour change; that is, whether children or caregivers engage in active travel behaviour, and their motivation, capability and opportunity to use active travel modes. A systems-based approach will however necessitate a broader range of effectiveness data obtained from a broader range of stakeholders, such as rates of engagement among local residents, or cost-benefit data from local government.

Recommendation for Measurement (6): Collect a broad range of data, beyond individual-level COM-B based data, to more fully understand and contextualise responses to STPs

Undertaking the system mapping exercise that we have recommended above will help to reveal what can be measured in the ecosystem surrounding active travel, to better understand the effectiveness of active school travel initiatives.

There are many factors that affect active travel, and relationships between these factors are complex. Using the PASTA framework (Physical Activity through Sustainable Transport Approaches; PASTA, undated), these factors can be categorised into: policies; physical environment; individual factors; behavioural theories; and social environment factors. Although we attempted to group factors into COM-B categories in this project, it is seldom possible to disentangle individual-level factors from other factors. Measures to increase active school travel should adopt a multi-pronged approach that focuses on all these aspects, as implemented in broad schemes characterised by collaboration among key stakeholders. Evaluating such initiatives will require a broad range of effectiveness measures, that go beyond individual-level psychological and behaviour change.

Table 7. Summary of potential indicators of effectiveness of School Travel Plans or related initiatives, organised according to the COM-B model

Capability, opportunity, motivation measures (all self-reported)			Behaviour measures	Measures of outcomes of behaviour
Capability measures	Opportunity measures	Motivational measures		
Psychological capability - Self-efficacy/ perceived control for active travel - Skills and proficiency needed for active travel **Physical capability** (None found)	**Physical opportunity** *Specific beliefs – safety:* - Allowed to walk or cycle - Safe to walk/ cycle alone or with friends (no concerns over crime, traffic, bullying) - Clear communication and understanding of appropriate driver behaviour *Specific beliefs – proficiency:* - Low possibility of accidents - Proficiency training opportunities available Specific beliefs – physical/built environment: - Adequate number of pavements, cycle paths/lanes, walking trails - Feasible distance - No weather concerns Specific beliefs – accessibility and convenience:	**Reflective motivation** *Generic measures:* - Intentions to use active travel - Intrinsic motivation to use active travel, make school travel mode decisions - (Positive) attitudes towards active travel - Active travel knowledge - Awareness/ perceptions of benefits of active travel *Specific beliefs – health and wellbeing:* - Active travel is fun, enjoyable - Fosters independence, autonomy - Helps concentration, mood, alertness, calmness, stress levels	*Objective measures* - GPRS tracking, RFID or equivalent (technology-assisted) Accelerometer data *Self- or other-report measures* - Travel diaries - Per-day logs - Per-journey logs *Derived variables* - Frequency with which active travel modes used - Percentage of journeys made using active travel - Percentage of journeys where active travel the dominant mode - Step counts - Time spent in active travel	- Traffic counts - Bus ridership - Air quality

	- Suitable or conducive built environment (e.g., roads, pavements) - Accessible cycle lanes, trails, cycle rack - No luggage concerns - Enough time available for active travel and other priorities - Easier to use active travel - Low(er) cost - No concerns about getting hot/sweaty **Social opportunity** *General beliefs:* - Favourable perceptions of others' own active travel - Favourable perceptions of others' approval for active travel - Perceived social support for active travel *Specific beliefs:* - Friends to walk/ cycle with	- Helps fitness, look better - Increases happiness, wellness, health - Gives more time with friends - Social cohesion among children - Sense of community among caregivers **Automatic motivation** - Active travel habit/decisional automaticity	- Engagement in STP activities	

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Appendix A: Supplementary Table 1. Review of published literature: active travel interventions and their effectiveness

Reference, study design & setting	Active travel intervention description	Intervention function(s)	Effectiveness criteria and how measured	Summary of intervention effectiveness (comparisons with control group, unless stated)
School Travel Plans or similar interventions				
Buttazzoni et al. (2019) Uncontrolled (pre-post) trial 13 schools 4,720 caregivers and 2,084 children Follow-up duration: 2 years Canada	School Travel Plan, including education around importance of active travel, encouragement to use active travel, and formation of committee of stakeholders to enforce travel management (e.g. parking tickets) and make changes to physical environment (e.g. building pavements) Intervention duration: ongoing	Education, enablement, environmental restructuring	*Behaviour:* School commuting mode frequency, typical week (self-reported) (Used to calculate **active commuting mode frequency (a) to school, (b) from school, (c) to and from school**) *Capability Caregivers' perceptions* **Perceptions of social environment barrier to active travel** (caregiver reported): no skills needed to cycle *Children's perceptions* **Perceptions of social environment barrier to active travel** (child self-reported): no skills needed to cycle *Opportunity: Caregivers' perceptions* **Perceptions of 4 built environment barriers** to active travel (caregiver reported) *Perceived barriers were:* not enough pavements; not enough cycle paths/lanes; enough walking trails; no cycle rack	*Behaviour* No impact (when controlling for age, gender, and distance) *Capability* Caregivers' perceptions **More favourable perceptions of skills needed to cycle** *Children's perceptions* **More favourable perceptions of skills needed to cycle** *Opportunity* *Caregivers' perceptions* **More favourable perceptions of 2 of 4 built environment barriers among caregivers** (not enough pavements, enough walking trails) **More favourable perceptions of 3 of 5 social environment barriers among caregivers** (might get bullied/teased, too far/ takes too much time; no one to walk with)

			Perceptions of 5 social environment barriers to active travel (caregiver reported) *Perceived barriers were:* too much stuff to carry; might get bullied/teased; lots of trees in area; too far/takes too much time; no one to walk with **Perceptions of 10 safety-related barriers** to active travel (caregiver reported)Perceived barriers were: child is (not) allowed to walk; child is (not) allowed to cycle; unsafe to walk alone; unsafe to walk with friends; too young to walk or cycle; unsafe because of crime; route unsafe because of traffic; too many busy streets; drivers speed on streets; too much traffic along street we live on *Children's perceptions* **Perceptions of 4 built environment barriers to active travel (child self-reported)** Perceived barriers were: not enough pavements; not enough cycle paths/lanes; cycle lanes/trails easy to get to/access; walking trails; no cycle rack **Perceptions of 8 safety-related barriers** to active travel (child self-reported) Perceived barriers were: (not) allowed to walk; (not) allowed to cycle; unsafe to walk alone; unsafe to walk with friends; unsafe because of crime; route unsafe because of traffic; streets too busy to cross; drivers speed on streets **Perceptions of 5 social environment barriers** to active travel (child self-reported) Perceived barriers were: too much stuff to carry; afraid of being bullied/teased; lots of trees in area; too far to walk/cycle; no one to walk/cycle with	**More favourable perceptions of 5 of 10 safety-related barriers among caregivers** (allowed to cycle, unsafe to walk alone, unsafe to walk with friends, too young to walk/ cycle, unsafe because of crime) *Children's perceptions* **More favourable perceptions of all 4 built environment barriers among children** (not enough pavements, not enough cycle paths/lanes, lanes/trails easy to get to/ access, no cycle rack) **More favourable perceptions of all 8 safety-related barriers among children** ((not) allowed to walk; (not) allowed to cycle; unsafe to walk alone; unsafe to walk with friends; unsafe because of crime; route unsafe because of traffic; streets too busy to cross; drivers speed on streets) **More favourable perceptions of 4 of 5 social environment barriers among children** (too much stuff to carry, afraid of being bullied/teased, lots of

			Motivation *Caregivers' perceptions* **4 motivational barriers to active travel** (caregiver reported) Barriers were: route is boring; not fun to walk/cycle; get too hot/sweaty; easier to drive *Children's perceptions* **4 motivational barriers to active travel (caregiver reported)** Barriers were: route is boring; not fun to walk/cycle; get too hot/sweaty; easier to drive	trees in area, too far to walk/cycle) *Motivation* *Caregivers' perceptions* **More favourable perceptions of 2 of 4 motivational barriers among caregivers** (not fun to walk/cycle; easier to drive) *Children's perceptions* **More favourable perceptions of 3 of 4 motivational barriers among children** (route is boring; not fun to walk/cycle; easier to drive)
Humberto et al. (2021) Quasi-experiment (pre-post trial) 299 children, across 3 schools Follow-up duration: 2 months post-intervention Brazil	Guided walks to local destinations and group discussions Intervention duration: 4 months	Education, enablement	*Behaviour:* **Caregiver's travel mode frequency,** typical week (caregiver-reported) **Child's school commuting mode frequency,** typical week (caregiver-reported) *Opportunity:* **Perceptions of other children's school walking frequency (i.e. school walking descriptive norms)** (caregiver-reported) *Motivation:* **Positivity of children's statements about active travel** modes during discussion sessions (child-reported, observer-coded)	Behaviour: **Increased caregiver use of active travel modes and decreased caregiver use of motorised travel** No impact on child's school commuting mode frequency *Opportunity:* **Enhanced perceptions of school walking as normative** *Motivation:* **More positive statements by children about active travel**

Sahlqvist (2019) Quasi-experiment (pre-post trial) 347 children who participated in Walk to School campaign Vs 368 children who did not participate Multiple schools, state-wide Follow-up duration: 6 weeks post-intervention Australia	State-wide active travel promotion campaign ('Walk to School'), including school-hosted activities (e.g. competitions, promotion events), smartphone app for children to track school journeys, website with multiple tips to encourage walking Intervention duration: ongoing	Education, enablement	*Behaviour:* **Child's school travel mode frequency to school,** previous five weekdays (caregiver-reported) **Child's school travel mode frequency from school,** previous five weekdays (caregiver-reported) (Used to calculate: **Proportion of children using any active travel over five days; Frequency of active school travel over five days)**	*Behaviour:* **Increased proportion of children using active travel** **Increased frequency of active travel**
Stark et al. (2018) Quasi-experiment (pre-post trial)	Campaign involving information sessions, individualised travel mode	Education, incentivisation	*Behaviour:* Per-journey travel diary over one-week (self-reported) (Used to calculate **number of trips where main mode was car, or public transport, or cycling, or walking; whether any part of trip was made by car, by public transport, by cycling, by walking; how much time s**	*Behaviour:* **Increased number of trips where cycling the main mode** **Increased number of trips where public transport is the**

90 children in intervention schools Vs 79 children in control schools 4 schools Follow-up duration: 2 weeks post-intervention Austria & Germany	feedback, reflection discussion workshops, gamification competition Intervention duration: ongoing		**pent per trip travelling by car, by public transport, by cycling, by walking)** *Motivation:* **Attitudes towards travelling by car, by public transport, by cycling, by walking** (self-reported) **Intentions to travel by car, by public transport, by cycling, by walking** (self-reported) *Opportunity:* **Perceptions of social approval (norms) for travelling by car, by public transport, by cycling, by walking** (self-reported) *Capability:* **Perceived control over travelling by car, by public transport, by cycling, by walking** (self-reported)	**main mode** **Increased number of trips where bicycle was used at any point** **Increased number of trips where public transport was used at any point** **Increased time spent walking per trip** **Increased time spent cycling per trip** *Motivation:* **Walking: more positive attitudes, no impact on intentions** **Cycling: no impact on attitudes or intentions** **Public transport: no impact on attitudes, more positive intentions** **Car travel: less positive attitudes, less positive intentions** *Opportunity:* Walking: no impact on norms Cycling: no impact on norms Public transport: no impact on norms

				Capability: **Walking: more positive perceptions of control** Cycling: no impact on perceived control Public transport: no impact on perceived control **Car travel: less positive perceived control**
Villa-Gonzalez et al. (2016) 2-arm controlled trial 117 children in intervention group Vs 89 children in control group 5 schools Follow-up duration: 6 months post-intervention Spain	Monthly structured activities (60-120mins per session) in school, promoting understanding of active travel, knowledge of local area, promotion of road and pedestrian safety, active travel themed games Intervention duration: 6 months	Education, training, enablement	*Behaviour:* *Child's school travel mode frequency to school, previous five weekdays (self-reported)* *(Used to calculate* **frequency of active travel [walking or cycling] to and from school over 5 days, and main mode used for commuting to and from school over 5 days)**	*Behaviour:* **Greater frequency of active travel journeys** **Increase in walking to/from school** No impact on cycling, car, motorbike or bus use to/from school

Gamification interventions				
Coombes & Jones (2016) 2-arm controlled trial 2 schools Intervention (60 children, 1 school) Vs Control (62 children, 1 school) Follow-up duration: 20 weeks Spain	Children earn points by tapping 'Beat Box' sensors placed on school route, with children using active travel modes able to earn more points than those using inactive travel modes Intervention duration: 9 weeks	Incentivisation	*Behaviour:* Physical activity over one week (objectively monitored using accelerometer) **(Used to calculate: Step counts per minute (a) at all times, (b) weekday mornings 8-9am, (c) weekday afternoons 3-4pm, (d) weekday evenings (4-10pm), (e) weekends at all times; moderate-vigorous physical activity minutes (a) at all times, (b) weekday mornings 8-9am, (c) weekday afternoons 3-4pm, (d) weekday evenings (4-10pm), (e) weekends at all times)** **Engagement in intervention (**i.e. tapped a Beat Box sensor at least once) (objectively monitored) Travel diary over one school week (5 days) (self-reported) (Used to calculate: **percentage of school commutes made using active travel)**	*Behaviour:* No impact on any step count measure **Moderate-vigorous physical activity declined in both groups, but less decline in intervention group** **Positive engagement** (84% of children at intervention school tapped at least once, average taps per child per day 5.4) **Increased self-reported percentage of school commutes made by active travel**
Hunter et al. (2015) Uncontrolled (pre-post) trial 12 schools 3817 children	Children earn points for scanning sensors placed along walking routes to/ from school, with more points for longer (>0.5km) walks, and points for reporting walks.	Incentivisation	*Behaviour:* **Number of walks to/from school** (i.e. swiping card on sensors) (objectively monitored) Travel diary over one school week (5 days) (self-reported) (Used to calculate: **percentage of participants walking at least once to/from school, percentage of participants walking at least 5-10 times to/from school)** *Motivation:* Perceptions of walking	*Behaviour:* Negative trend in objectively monitored number of walks to/from school over intervention period **Increased walking to/from school at least once** **Increased percentage of participants walking at least 5-10 times/to from school**

Follow-up duration: 4 weeks UK and Canada	Children compete individually and as part of class. Website available to monitor progress. Intervention duration: 4 weeks		*Perceptions included:* helps me concentrate in class; makes me feel calmer in class; makes me feel more alert; helps me stay fit so I look better; helps me feel well; makes me feel happy; gives more time with friends; more healthy than car; helps you stay healthy	*Motivation:* **Positive perceptions of walking on all 9 criteria**
Living Streets Scotland (2023) Quasi-experiment (pre-post trial) 314 participating schools vs 1477 non-participating schools (Number of children not reported) Follow-up duration: N/A – ongoing data collection UK	Children self-report their travel mode on entering classroom, using an interactive whiteboard ('Walk to School' programme; 'WOW'). Children earn badges by reporting walking at least once per week. Some participating schools offer leaderboards to promote competition. Intervention duration: ongoing	Incentivisation	*Behaviour:* Travel mode used to get to school (In participating schools, self-reported by children on WOW 'travel tracker'; In non-participating schools, self-reported via hands-up surveys) Used to calculate: **walk mode share** and any **active travel mode share**	*Behaviour:* 2022-23 data: **Increased walking mode share in participating schools vs non-participating schools** **Schools delivering intervention for longer report higher walk mode share** **Increased active travel mode share in participating vs non-participating schools** **Schools delivering intervention for longer report higher active travel mode share**

Gamification interventions				
Coombes & Jones (2016) 2-arm controlled trial 2 schools Intervention (60 children, 1 school) Vs Control (62 children, 1 school) Follow-up duration: 20 weeks Spain	Children earn points by tapping 'Beat Box' sensors placed on school route, with children using active travel modes able to earn more points than those using inactive travel modes Intervention duration: 9 weeks	Incentivisation	*Behaviour:* Physical activity over one week (objectively monitored using accelerometer) **(Used to calculate: Step counts per minute (a) at all times, (b) weekday mornings 8-9am, (c) weekday afternoons 3-4pm, (d) weekday evenings (4-10pm), (e) weekends at all times; moderate-vigorous physical activity minutes (a) at all times, (b) weekday mornings 8-9am, (c) weekday afternoons 3-4pm, (d) weekday evenings (4-10pm), (e) weekends at all times)** **Engagement in intervention (**i.e. tapped a Beat Box sensor at least once) (objectively monitored) Travel diary over one school week (5 days) (self-reported) (Used to calculate: **percentage of school commutes made using active travel)**	*Behaviour:* No impact on any step count measure **Moderate-vigorous physical activity declined in both groups, but less decline in intervention group** **Positive engagement** (84% of children at intervention school tapped at least once, average taps per child per day 5.4) **Increased self-reported percentage of school commutes made by active travel**
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Follow-up duration: 4 weeks UK and Canada	Children compete individually and as part of class. Website available to monitor progress. Intervention duration: 4 weeks		Perceptions included: helps me concentrate in class; makes me feel calmer in class; makes me feel more alert; helps me stay fit so I look better; helps me feel well; makes me feel happy; gives more time with friends; more healthy than car; helps you stay healthy	*Motivation:* **Positive perceptions of walking on all 9 criteria**
Living Streets Scotland (2023) Quasi-experiment (pre-post trial) 314 participating schools vs 1477 non-participating schools (Number of children not reported) Follow-up duration: N/A – ongoing data collection UK	Children self-report their travel mode on entering classroom, using an interactive whiteboard ('Walk to School' programme; 'WOW'). Children earn badges by reporting walking at least once per week. Some participating schools offer leaderboards to promote competition. Intervention duration: ongoing	Incentivisation	*Behaviour:* Travel mode used to get to school (In participating schools, self-reported by children on WOW 'travel tracker'; In non-participating schools, self-reported via hands-up surveys) Used to calculate: **walk mode share** and **any active travel mode share**	*Behaviour:* 2022-23 data: **Increased walking mode share in participating schools vs non-participating schools** **Schools delivering intervention for longer report higher walk mode share** **Increased active travel mode share in participating vs non-participating schools** **Schools delivering intervention for longer report higher active travel mode share**

Training-based interventions				
Aranda-Balboa et al. (2022) 2-arm controlled trial 2 schools Intervention (60 children, 1 school) Vs Control (62 children, 1 school) Follow-up duration: unclear Spain	Cycling education and off-road and on-road proficiency training (Bikeability) in school PE lessons Intervention duration: 4 sessions over 1 month	Education, training	*Behaviour:* School commuting mode frequency, past week (self-reported) (Used to calculate **active commuting frequency**) *Motivation:* **Cycling knowledge** (self-reported) **Enjoyment and usefulness** of intervention (self-reported) (only measured in intervention group, following final session) **4 motivation barriers** to active school travel (self-reported) Barriers were: convenience; physical and motivational barriers (overall); physical and motivational barriers for walking; physical and motivational bar-riers for cycling *Capability:* **Cycling skills in traffic-free area** (observed) (only measured in initiative group, during session) **Cycling skills on road** (observed) (only measured in initiative group, during session) *Opportunity:* **9 perceived** opportunity barriers to active school travel (self-reported) Perceived barriers were: distance; traffic safety; built environment; crime-related safety; weather; built environment for walking; built environment for cycling; social support for walking; social sup-port for cycling	*Behaviour:* No impact on active commuting rates *Motivation:* **Increased cycling knowledge** **Positive enjoyment and usefulness ratings** No impact on motivational barriers *Capability:* Cycling skills in traffic-free area rated ~12.5 out of 22 (22 = highest score) Cycling skills on road rated ~12 out of 22 *Opportunity:* **Positive impact on 1 of 9 barriers (more favourable perceptions of built environment)**

Goodman et al. (2016) Natural experiment Children at schools that had delivered Bikeability initiative (2563 children) Vs Children at schools that had not yet delivered Bikeability (773 children) Follow-up duration: at least 1 month post-intervention UK	Cycling education and off-road and on-road proficiency training (Bikeability) in school lessons Intervention duration: 4 sessions (over 1 month?)	Education, training	*Behaviour:* Total **cycling frequency**, typical (caregiver-reported) **Whether child usually travels to school by bicycle** (caregiver-reported) **Whether child travels independently by bicycle** (caregiver -reported)	*Behaviour:* No impact on any outcome
Information-only interventions				

Verhoeven et al. (2016) 3-arm controlled trial 197 children in active travel lesson schools (5 schools) Vs 213 children in active travel lesson + Facebook group schools (5 schools) Vs 450 children in control schools (10 schools) 20 schools Follow-up duration: 8 weeks post-intervention Belgium	Intervention 1: Active travel information session, added at end of existing driving theory training programme Intervention duration: 2hrs Intervention 2: Active travel information session + invite to join Facebook group on active travel, added at end of existing driving theory training programme Intervention duration: 2hrs (information session), ongoing (Facebook group)	Intervention 1: Education Intervention 2: Education	*Motivation:* **Intention to use active travel** (self-reported) **Perceived benefits of using active travel** (self-reported) *Perceived benefits included:* health, cost, independence (other benefits not reported) **Active travel habit strength** (self-reported) **Awareness of benefits of active travel** (self-reported) *Opportunity:* **Perceptions of social approval (norms) for active travel** (self-reported) **Perceived barriers to using active travel** (self-reported) **Perceived barriers included:** time, accidents, weather, sweating (other barriers not reported) *Capability:* Self-efficacy for active travel (self-reported)	*Motivation:* **Enhanced intention to use active travel in Intervention 2 group only** No impact on perceived benefits or active travel habit strength **Enhanced awareness of car sharing schemes in both Intervention 1 and Intervention 2 groups** *Opportunity:* No impact on perceived social approval for active travel No impact on perceived barriers to active travel *Capability:* No impact on self-efficacy for active travel

Appendix B: Supplementary Table 2. Review of published literature: sources of variation in how behaviour measured

Dimension	Variants
Accelerometer-based measures	
Activity metri	Step counts Minutes standing Minutes spent in any physical activity Minutes spent in physical activity of different intensities (e.g. light, moderate, vigorous)
Time period	Week Weekends / weekdays Day Hours within the day (e.g. school commuting hours, evenings)
Self- or other-reported measures	
Behaviour-related dimensions	
Behavioural focus	All physical activity All active travel modes Mode-specific active travel (e.g. cycling, walking)
Person-related dimensions	
Person/people to whom measure relates	Child: One child Multiple children (including whole class) Adult: Caregiver
Journey dimensions	
Journeys to which measure relates	All journeys All school journeys To-school journeys From-school journeys
Recall dimensions	
Time period to which measure relates	Multiple months (e.g. 6 months) Month Week Day Per hour
Actual vs typical	Actual behaviour Typical behaviour
Reporting methods	
Recall method	Retrospective recall Travel diary (e.g., one-week)
Who reports behaviour	Self-report Other-report (e.g. reported by caregiver, observers)

Appendix C: Supplementary Table 3. Review of grey literature: active travel interventions and their effectiveness

Reference, intervention name & setting	Active travel intervention description	Intervention function(s)	Effectiveness criteria and how measured	Summary of intervention effectiveness
Data-driven travel tracking interventions				
Gyergyay (2015) 'Step2Get' London, 2009-10	Children use RFID tracker cards, with battery-enabled sensors allocated along two designated walking routes. Data transmitted via GPRS. Data used to inform intervention development. *Wimbledon:* Girls encouraged to walk rather than use free public bus due to congestion and overcrowding at peak times. *Bexleyheath:* Boys diverted away from dangerous crossing of three-lange carriageway, and directed to a safer crossing area. Shopping and cinema vouchers offered to participating children.	Incentivisation, enablement	*Behaviour:* Travel times, travel distance, travel route proxy, all measured using RFID, NFC and GPRS technology (Used to calculate **walking frequency to and from school**) Surveys of participating children Bus-stop surveys *Motivation* Perceptions of Step2Get interventions	*Behaviour:* *Wimbledon*: Average dwell time between 0750am and 0820am fell by 62% during the trial. Number of children unable to board the bus fell by 50%. Number of bus pick-ups during the same morning period fell by 57% from 398 to 149. 13-18% modal shift from bus to walking. 45% of children said they would switch to walking from other means of transport. *Motivation:* Positive perception of Step2Get interventions, and willingness to continue walking to school after scheme ended.

European Commission (2024) 'COMPAIR' Belgium	'Citizen science' intervention. Multi-modal traffic counters installed at specific locations/homes in the surrounding area. Data collected via 29 volunteers, 21 devices, 17 residents, 3 schools. Data used by participants and schools to inform wiser and safer (less polluted) travel mode decisions. Aimed to improve participant health and safety, increase awareness around air quality challenges, reduce car travel and promote active travel.	Education, enablement	*Outcomes of behaviour:* 3-month before and after traffic counting *Motivation:* Surveys assessing awareness and motivation	*Outcomes of behaviour:* 100-120 fewer cars per hour during peak times. 50 more cyclists per hour, leading to increased modal share by bike (from 16% to 26%). No changes during off-peak times and during weekends, when the scheme was not implemented. Side street only experienced an increase in car traffic by 30-40 cars per hour during peak times, so no adverse side effects. *Motivation:* Participating residents moved from being sceptical to being advocates
Gamification intervention				
BetterPoints (2021) Ebbsfleet, UK (2021) & Leicester, UK (2019)	Time-limited intervention in which children earn points, and can win book tokens and stationery, based on how often they use active travel.	Incentivisation	*Behaviour:* School commuting mode frequency, tracked by app (self-reported) Used to calculate **active commuting mode frequency for school journeys**	*Behaviour:* Ebbsfleet: No evidence of long-term impact beyond scheme duration Leicester: Claims that some children continued to use the app after the scheme ended, but no details or evidence provided

School Travel Plans or similar				
Fiksusti Kouluun (2025) 'Active Way to School' / 'Smart to School' programme Finland	Offers information and advice for planning and implementation of smarter ways of getting to school through active travel. Aims to achieve 40–60% of the recommended daily amount of moderate-intensity physical activity through active school travel among participating children. Targets schools, children, caregivers, municipalities, decision-makers and organisations	Education, enablement	*Behaviour:* Number of 0-5km car journeys (unclear how measured) *Motivation:* Analysis of drawings by children when asked to draw a school journey	*Behaviour:* 0-5km car journeys to school reduced *Motivation:* Children who travelled to school by bicycle tended to draw multicoloured drawings containing nature and plants. Children who travelled to school by car tended to make black and white drawings

Appendix D: Supplementary Table 4. Focus Groups: illustrative quotes

Type of point made	Concept	Example supporting quotes
Theme: Physical safety concerns		
Barriers	Safety a higher priority than sustainability	“the pollution and stuff is in our minds, but it’s not up top … we worry everyone’s got in safely, everyone’s got home safely” (Echelford)
Barriers	Sustainability concerns effective for changing chil-dren’s motivation, but not caregivers	“kids like the idea of environmental benefits more than the parents do … [whereas] we’re consumed with the safety element” (Echelford)
Barriers	Safety hazards are concentrated around the school entrance	“My problem’s not how I get to school. […] My problem is when I get here I’ve got to get my children out of the car safely and into the school safely and vice versa” (Horley)
Barriers	Fast-moving road traffic	“the cars are very fast and don’t often stop at the pedestrian crossings” (Echelford)
Barriers	Car drivers may not detect children	“cars are pulling out of the driveways and [drivers] have blind spots” (Horley)
Barriers	Children may not detect cars	“I’ve heard my friend’s son say I can’t actually hear the cars coming, some of the cars are so silent” (Echelford)
Barriers	Proximity of children to car emissions	“my four year old is this high, and parents park on the corners with their engines running … so your daughter is getting a face full of car fumes” (Echelford)
Barriers	Perceived crime-based threats to safety	Staff: “I have to come down a country road, unlit, and I don’t fancy walking in the dark on my own … at quarter to seven in the morning” (Horley) Children: “knowing your child is in the dark waiting another 20 minutes … for the next bus … I can see why people say let’s just get the car, because I’m so fearful of what might happen if I don’t” (Echelford)

Barriers	Concern around children's capability to negotiate busy roads	"it would be nice to start allowing him [to walk to school] … but I will not do that while the roads are like this, because I think my son will not be able to get safely across two or three roads" (Echelford).
Barriers	Travel skills training not delivered early enough	"'Feet First' teaches them crossing the road and observing what's going on … but they do [that] in Year 3, which might be a bit late" (Echelford)
Perceived indicators of effectiveness	Caregiver confidence in child safety	"they can run along the pavement and [you will] not be worried … that they're going to get run over, and it feels safe, and a happy start to the day" (Echelford)
Perceived indicators of effectiveness	Enhanced child mood when arriving at school	"they get to school in a happy, safe environment … going to school is a nice experience" (Echelford)
Perceived indicators of effectiveness	Child access to age-appropriate travel proficiency training	"we use our sports premium funding to fund level one [cycling] ability, [but] we had only 50% take up; […] we thought maybe some people didn't have bikes … but actually a lot of the children couldn't ride a bike" (Echelford)
Theme: Efficiency and convenience		
Barriers	Weather	"my hair goes a bit funny in the rain" (Horley)
Barriers	Trip chaining	"I mostly drive to school, because I then have to drive on to work, so it would make no sense for me to walk to school, then walk back home, then get in the car and go to work" (Horley)
Barriers	Time pressure	"[I have to] get back to the dogs … it's my time that makes me drive instead of walk" (Horley)
Barriers	Lack of alternatives to driving	"If you miss one [bus] you have to wait at least another 20 minutes"; Echelford)
Perceived indicators of effectiveness	Caregiver confidence in children using active travel modes safely and conveniently	"if there was somewhere that [parents] could drop off their children safely, and then [the child walks] that last bit, people who are on a timescale for work and needing to get somewhere, that might help" (Echelford)

Theme: Physical and social environmental affordances		
Barriers	Uninviting waiting areas	“if it’s chucking it down or if it’s really cold … there’s 20 minutes standing in the rain or the cold” (Horley)
Barriers	Pavement obstructions – parked cars	“the [parked] cars have the privilege of the pavement, and I walk on the road, it’s ridiculous” (Echelford)
Barriers	Pavement obstructions – street features	“the main road outside our house is quite overgrown and the shrubbery is protruding, which makes it quite narrow … there’s a safer route for walking, but that adds 10 minutes” (Horley)
Barriers	Antisocial driver behaviour	“some parents will park over a driveway as if it’s nothing, because there’s not been any consequence for them, so they just do it … [to think] that’s the example they’re setting to their kids, ‘do what you want’” (Echelford)
Barriers	Lack of autonomy for school staff for addressing antisocial driver behaviour	“as a school we have no jurisdiction at all … there is aggressive behaviour outside the school, and parents report it to us … but there’s very little we can actually do” (Echelford)
Barriers	Misperceptions among caregivers and local residents regarding school enforcement powers	“we have no power but [some people] think we do, so we seem to not please anybody, because they [say] ‘why have you not done anything about it?” (Echelford)
Barriers	Lack of perceived support from other organisations and stakeholders	“I’ve emailed the council, I’ve spoken to traffic control, [but] nothing, they’re not interested, nothing’s done” (Horley)
Barriers	Inability to recruit or retain school crossing patrol	“We advertised for a lollipop lady [for] 10 months, every week, and we didn’t get a single application, no one wants to do it” (Echelford)
Perceived indicators of effectiveness	Need for effective travel management initiatives	“I would shut the road off … between certain times so that you can literally walk across the road and there’s no cars” (Echelford) “There’s a whole stretch of road at the end of [here] that could be opened up to 30 minute parking … which would take people away from directly outside the school” (Horley)
Perceived indicators of effectiveness	Need for traffic management initiatives that reduce, rather than relocating, antisocial driving	“We’ve got the yellow zig zag lines on one side of the road, but the majority of families park on the other side, which is non-enforceable, so that can create unsafe places to cross and just shift that behaviour elsewhere” (Horley)

Perceived indicators of effectiveness	Need for effectively and demonstrable enforcement of traffic management initiatives	“Why can’t they have cameras out here and if you have even stopped for a second on the zig zag line you get a fine” (Echelford)
Perceived indicators of effectiveness	Greater power for schools to enforce traffic management initiatives	“[We should be able to] say it’s three times you’ve done this, [and] on the third time we will give that information to the council”; Echelford)
Perceived indicators of effectiveness	Availability of school crossing patrol staff	“we used to have a lollipop lady … that stopped people parking on the zigzag, she would move them on” (Horley)
Perceived indicators of effectiveness	Clearer communication around appropriate road use	“more visual signs, like ‘don’t idle here’, a lot of schools do that” (Echelford)
Theme: Fostering health and wellbeing		
Enablers	Educating children about the importance of active travel leads to children becoming more influential over travel mode choices	“We walk 99% of the time now … [because] for however many weeks, [the school] asked the children how they got to school and whether they scooted or walked or took the car, and my daughter was absolutely adamant that we had to walk or scoot” (Horley)
Enablers	Gamification initiatives	“make [active travel] a game for the kids and they’ll want to [do it]” (Horley)
Enablers	Initiatives to enhance interest in objects required for active travel	“other schools sometimes do things like dressing up the scooter or the bike, decorating it to encourage kids” (Echelford)
Enablers	Need for class or house competitions	“create a class competition … [where] every day the kids can come in and demonstrate that they have walked or whatever, it’s a points system […] and every month you go, ‘this class has won this month and they’re getting this prize’” (Horley)
Perceived indicators of effectiveness	Greater social cohesion and wellbeing among children travelling to school together	“they can meet up with friends … it feels like a safe and happy start to the day”; (Echelford)
Perceived indicators of effectiveness	Greater ‘walk-pooling’ among caregivers	“small groups of children maybe with just one parent, you’re pooling together to … create more of a community feel [among] people getting to school” (Echelford)

Appendix E: Supplementary Information. Possible survey questions

Potential items for a future Active Travel survey for school children and/or caregivers are included here to support its design by Surrey County Council. Survey contents and questions would need to be reviewed and adjusted after the specific context and survey participants have been defined. The University of Surrey can support such survey design, distribution, administration and analysis, if requested.

Variable	Possible item wording	Response options	Source
Behaviour			
Actual behaviour, whether active travel used, single to-school journey (Self- or other-reported)	"How did (you/your child) travel to school today?"	(I/they) walked (or ran) (I/they) rode a bike (I/they) used a scooter (I/they) used rollerskates or rollerblades (I was/they were) driven to school (I/they) did something else (If so, what else did [you/they] do? _____)	N/A
Actual behaviour, dominant travel mode used, single to-school journey (Self- or other-reported)	"Did (you/your child) use more than one way to get to school today?" "If so, tick everything (you/they) did on the way to school today"	Yes / No (skip next question) (I/they) walked (or ran) (I/they) rode a bike (I/they) used a scooter (I/they) used rollerskates or rollerblades (I was/they were) driven to school (I/they) did something else (If so, what else did [you/they] do? _____)	N/A
Capability			

Psychological capability	"I am confident that, if (I/they) wanted to, (I/my child) could (walk/cycle) to school tomorrow"	([I/they] definitely could not [1] – [I/they] definitely could [7])	Fishbein & Ajzen (2010)
Opportunity			
Safety beliefs - crime	"If [my child] (walked/cycled) to school tomorrow, they would be safe from crime"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Safety beliefs - traffic	"If [my child] (walked/cycled) to school tomorrow, they would be safe from traffic"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Active travel proficiency	"If [I/my child] wanted to, [I/they] could receive training in how to (walk/cycle) safely"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Convenience/trip-chaining	"[My child] could (walk/cycle) to school tomorrow, and I would still have enough time to do what I need to do afterwards"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Motivation			
Intention	"I intend [for my child] to (walk/cycle) to school tomorrow"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Intrinsic motivation	"(Walking/cycling) to school tomorrow would be fun (for my child)"	(Strongly disagree [1] – Strongly agree [7])	Markland & Tobin (2004)
Health and wellbeing beliefs - concentration	"If [I/my child] (walked/cycled) to school tomorrow, it would help (me/them) concentrate"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Health and wellbeing beliefs - fitness	"If [my child] (walked/cycled) to school tomorrow, it would help them stay fit"	(Strongly disagree [1] – Strongly agree [7])	Fishbein & Ajzen (2010)
Habit	"Deciding to (walk/cycle) to school is something (I/my child) does automatically"	(Strongly disagree [1] – Strongly agree [7])	Gardner et al (2012, 2016, 2024)


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