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Promoting active school travel in elementary schools: A regional case study of the school travel planning intervention

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ABSTRACT

Introduction: Active school travel (AST) can be a viable way to increase children's low levels of daily physical activity by promoting opportunities to walk and wheel. To promote AST in Canada, School Travel Plan (STP) programs have been implemented throughout the country. The STP program is a comprehensive 2-year intervention that is facilitated by a committee of community and school partners who implement education, encouragement, enforcement, and engineering initiatives at their school to support AST.
Methods: This study examines the impact of the STP program on children's and parents' perceptions of AST barriers, and children's engagement in AST from pre- to post-intervention. In total, 13 elementary schools representing a total sample of 4720 parents and 2084 children from across Southwestern Ontario, Canada were involved in this program evaluation.
Results: Findings indicate that the STP program was successful in significantly reducing children's and parents' perceptions of AST barriers. An analysis of travel behaviour found the STP program was limited in affecting behavioural change, as the results show an insignificant trend of increasing AST use and decreasing car use.
Conclusions: Changing perceptions of AST barriers suggests that the STP intervention has the potential to change intentions and motivation for parents and children, which may lead to significant increases in future AST. This study recommends that future interventions focus on parental education and empowerment initiatives to reduce an apparent intention-behaviour gap that exists in their AST decision making process.

1. Introduction

Children's engagement in walking and wheeling to school, or active school travel (AST), is positively correlated with improved mental health (Yang et al., 2014), cardiorespiratory fitness (Voss and Sandercock, 2010), overall levels of physical activity (Larouche

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et al., 2014), and neighborhood social cohesion (du Toit et al., 2007). Despite these benefits, AST has declined in recent decades throughout many countries including Australia (van der Ploeg et al., 2008), Canada (Buliung et al., 2009), Switzerland (Grize et al., 2010), the U.K. (Pooley et al., 2005), and the U.S. (McDonald, 2007). In response to the decline in AST, a variety of interventions have been implemented; however, their effectiveness and impact have been limited primarily due to weak designs (Larouche et al., 2018; Villa-González et al., 2018). The purpose of this study is to evaluate the impacts of a prominent AST intervention known as school travel planning (STP).

Reasons for the decline in children's AST are voluminous, with a major factor being the complexity of the decision to participate in AST (Wilson et al., 2018a). The decision to engage in AST is influenced by many individual, social, environmental, and policy factors. Individual factors include children's demographics and perceptions related to AST. Older children (Martin et al., 2007; Merom et al., 2006) and males (Bookwala et al., 2014; Bungum et al., 2009; Larsen et al., 2009) are more likely to engage in AST. A child's own perception of their barriers can also influence their AST behaviour (Wilson et al., 2018a, 2018b).

Social factors include children's home context and social norms. For instance, children living in lower socioeconomic status neighbourhoods (Molina-García and Queralt, 2017) are more likely to engage in AST. Additionally, the influence of a culture that is car reliant (Lorenc et al., 2008), higher household income (Rothman et al., 2018), greater car ownership (Pont et al., 2009), and parental perceptions of child safety (Chillón et al., 2014) are correlated with lower AST participation.

Environmental factors include the physical or built environment associated with the daily school commute. Neighbourhood characteristics such as the presence of sidewalks and street connectivity (Fulton et al., 2005; Panter et al., 2010), higher levels of residential density (Carlson et al., 2014; Dalton et al., 2011), 'nice scenery' (Mandic et al., 2015), and marked street crossings (Timperio et al., 2006) have been positively associated with AST. Conversely, greater distance to/from school (Larsen et al., 2012; Panter et al., 2013; Rodríguez and Vogt, 2009; Trapp et al., 2012), manufacturing/trade/office employment land use areas (Mitra et al., 2010), and lower intersection density (Schlossberg et al., 2006) have been associated with lower levels of participation in AST.

Finally, the policy environment in which a child lives can lead to substantial differences in commuting behaviour. As distance between home and school plays such a large factor in commuting behaviour (Larsen et al., 2009; Wilson et al., 2018a), the school boundaries, subsidized school busing distances, and the resulting school attendance can also lead to changes in commuting behaviours. For instance, many Ontario school boards use 1.6-km as the cut-off for which elementary school children are eligible for busing or not (Southwestern Ontario Student Transportation Services, 2016). If that distance increased, a higher percentage of children would be driven to school. Similarly, by-laws allowing children to wheel (e.g., bike, scooter) on sidewalks may increase children's ability to use AST. Given this myriad of factors, policymakers, public health practitioners, and school communities have sought to develop and implement comprehensive interventions to support AST.

Interventions that seek to change commuting behaviours do so through implementing a number of targeted initiatives that encourage and support families to shift from passive (e.g., car, bus) to active transport (Buttazzoni et al., 2018). Common initiatives include health promotion activities like walking school buses (e.g., Sayers et al., 2012), which aim to increase AST participation through emphasizing physical health benefits. Engineering strategies such as the installation of sidewalks, bicycle lanes, and safe crossings (DiMaggio et al., 2015) to increase the accessibility for and safety of AST trips are also frequently employed. Other examples include awareness campaigns in the form of education curriculums that promote AST by improving children's safety knowledge (e.g., Bovis et al., 2016), and enforcement strategies such as crossing guard programs which can be used to support AST through increasing the visibility of trip safety (e.g., Gutierrez et al., 2014).

In Canada, a nationwide initiative known as Active and Safe Routes to School (ASRTS) has sponsored STP since 2006 to support AST (Ontario Active School Travel, 2019a). STPs utilize multiple strategies in schools, and thus require each school to organize an STP committee comprised of municipal officials, parents, police, principals/vice-principals, and public health practitioners to implement the intervention (Ontario Active School Travel, 2019b). Strategies can be categorized according to the "Es" of the U.S. Safe Routes to School program (Safe Routes to School National Partnership, 2018): education (e.g., cycling skills program), encouragement (e.g., Walk to School Day), enforcement (e.g., ticketing illegal parking), and engineering (e.g., building of sidewalks). A five-phase model is utilized by schools to implement the STP model (Ontario Active School Travel, 2019b): *(1) Set-Up*: committee is established and a timeline is set; *(2) Baseline Data Collection*: surveys are distributed, collated, and analysed, a school walkabout (neighbourhood assessment of AST barriers) is conducted, and traffic counts are carried out; *(3) Action Plan Development*: STP committee develops an action plan; *(4) Action Plan Implementation*: action plan is implemented; *(5) Evaluation*: follow-up surveys are distributed, collated, and analysed, and the STP committee communicates its progress.

1.1. Study objectives and aims

Research specifically focused on the impacts and effectiveness of STP interventions is still emerging, with initial findings suggesting modest short-term gains (Buliung et al., 2011; Mammen et al., 2014a). In their Canada-wide evaluation of STPs, Mammen et al. (2014b) provided evidence of localized success and recommended that case studies be utilized to examine STPs in future research. This study follows their suggestion and offers a case study evaluation of a regional STP program. To guide this study, the following research questions were posed:

i) How does the STP intervention influence children's and parents' perceptions of known AST facilitators and barriers?
ii) How does the STP intervention influence the commuting behaviours of children?

iii) How does the STP intervention influence the commuting behaviours of children while accounting for key correlates of AST (i.e., age, gender, and distance)?

2. Materials and methods

2.1. Study context

We conducted a serial cross-sectional intervention case study which evaluated 13 elementary schools (Junior Kindergarten – Grade 8) participating in the Elgin-St.Thomas, London-Middlesex, Oxford ASRTS program in Southwestern Ontario, Canada. Home to 655,366 people (Statistics Canada, 2018), the study area is located approximately halfway between the major metropolitan areas of Toronto and Windsor. Of the 13 schools that were involved in this study, four were in urban areas, seven in suburban areas, and two in rural areas. Data were collected between September 2014 and June 2018, with matched seasonality between baseline and two-year follow-up surveys at each school. This study was approved by the University of Western Ontario's Non-Medical Research Ethics Board (NM-REB #: 105635) and by the research officers/committees of the participating school boards.

2.2. Participants and protocol

Schools self-selected their participation in this study via a needs assessment conducted by the principal and school health nurse, which resulted in their application to participate in the ASRTS program. Once in the program, classroom presentations were conducted by the school health nurse where they distributed a consent form and family survey to each family within the school. Parents of students in all grades (Junior Kindergarten to 8) who provided consent completed family surveys, and students in grades four to eight who received parental consent and provided their own assent completed a children survey. Only students in grades 4–8 (ranging from 9 to 14 years of age) were asked to fill out surveys because as children mature, starting around age nine, they begin to acquire more autonomy (Janssen et al., 2016). Therefore, these older children (i.e., grades 4–8) are more likely to have engaged in, and consequently have developed personal perspectives around AST. Additionally, our previous research with elementary school children indicates that 9 years old is the age children can start completing comprehensive self-report surveys (Mitchell et al., 2016; L. Taylor et al., 2018; L.G. Taylor et al., 2018; Tillmann et al., 2018; Wilk et al., 2018, 2017).

Data collection for baseline and follow-up were conducted two years apart during the same month to control for seasonality (e.g., November 2014 and November 2016). The family surveys were completed at home and returned with the child to school, while child surveys were facilitated by the respective STP facilitator (i.e., public health nurse or principal) at their school with the help of volunteers during a designated school day. Both surveys were adapted from versions of the Healthy Neighbourhoods Survey which incorporates previously-used questions from well-regarded data collection instruments (e.g., the Neighbourhood Environment Walkability Scale), subsequently allowing for our study's results to be compared to others (Cerin et al., 2006). Family and child surveys generally followed the same format and were used to document demographics, daily commutes to and from school, commuting considerations (e.g., accompanying individuals on trip), perceptions of AST neighbourhood characteristics and barriers, and areas of concern encountered during the regular commute. A full description of the sample is provided in Table A1.

2.3. Measures

2.3.1. Perceptions of AST barriers and neighbourhood characteristics

Data were obtained through a variety of question formats including dichotomous, multiple choice, and Likert-scale questions. Two mobility questions were first posed to parents and children about their trip to/from school: are they/you allowed to walk and allowed to bike to/from school (yes [1]; no [0]). Children's and parents' perceptions of barriers and facilitators were then gauged using a four-point Likert scale (ranging from strongly disagree/always no [1] to strongly agree/always yes [4]). Questions were posed to parents as “It is difficult for my child to walk or bike to school or their bus stop because … [e.g. It is too far or takes too much time]”, and to children as “Does this stop you from walking/biking to school or to your bus stop? [e.g., It is too far or takes too much time]”. The full list of AST barriers and neighborhood characteristics can be found in Table A2.

2.3.2. Dependent variables

Commuting behaviour was measured by asking parents to self-report how often in a typical week (e.g., Monday – Friday) their child commutes to and from school by walking, cycling, skateboarding, rollerblading, personal vehicle, or bus. From this question, three dependent variables (i.e., to school, from school, all trips) were calculated for AST and by car trips to allow an examination of how the STP intervention influences school travel behaviours. AST trips were calculated based on the number of trips taken by walking, cycling, skateboarding, or rollerblading to school (out of 5), from school (out of 5), and both to and from school (total out of

10) during a typical week. Car trips were calculated based on the number of trips taken by personal vehicle to school (total out of 5), from school (total out of 5), and both to and from school (total out of 10) during a typical week.

2.3.3. Independent variables

Our study includes two cross-sectional groups of students from each school in the study sample; each child is assigned to the baseline group (0) or two-year follow-up group (1) to allow an assessment of how the STP intervention change behaviour over time. This pre-post study design using two cross-sectional groups, requires us to control for key factors that are most important in predicting school travel to ensure that any measured difference in behaviour is due to the intervention, not a result of sample differences. These variables include age (Larsen et al., 2012, 2009; Oliver et al., 2014), gender (Bungum et al., 2009; Larsen et al., 2009), and distance (Larsen et al., 2012; Wong et al., 2011). Age is presented as the number of years old of the child, which ranges from 3 to 14. Gender was parent-specified as boy, girl, or self-identify, although all parents in our study identified their child as a boy or girl, thus it is treated as binary in this evaluation. Distance is measured as the shortest network distance between a child's home postal code (as specified by parents) and the child's school. Shortest network distance is calculated in ArcGIS 10.5 (Environmental Systems Research Institute, Redlands, California, U.S.) using the Network Analyst tool. While postal codes do not provide exact home locations, they have been shown to be appropriate proxies for home locations in our study area (Healy and Gilliland, 2012).

3. Statistical analysis

A series of analyses were conducted to properly address the different research objectives of this study. For the first research question, to examine for changes in perceptions of AST barriers, Mann-Whitney U tests were conducted to determine whether there were any significant differences in means of the perceived barriers between the baseline and follow-up groups. A total of 24 (Table A1) and 22 (Table A2) relevant barriers, considerations, and neighbourhood characteristics relevant to AST were presented to parents (Table A1) and children (Table A2), respectively. With the STP program implementing a variety of initiatives that were aimed at the entire school communities of participating schools, the total samples for parents and children were included in this analysis.

To address the second research question of our study, the assessment of AST commuting behaviour changes from baseline to follow-up, again Mann-Whitney U tests were performed to compare commuting behaviours as reported by parents from baseline to follow-up. Commuting behaviour change for AST only included children who lived within 1.6 km of the school, as children outside this distance are eligible for the school bus. Commuting behaviour change for car trips included the entire sample regardless of distance from school, as one of the goals of the STP program is to decrease the number of children driven to school, regardless if they are AST or bus eligible.

To answer the final research question in this study, to understand the impact of the STP program while accounting for differences in gender, age, and distance between home and school, six multiple linear regression models were conducted. Each one of the six commuting behaviour variables (i.e., AST to school, AST from school, AST to and from school, car trips to school, car trips from school, car trips to and from school) were entered as dependent variables in regression models. The AST set of models included three multivariable models that all controlled for gender, age, and distance as key correlates of AST, while examining the difference between baseline and follow-up. The three car-trip multivariable models also focused on the difference between baseline and follow-up, but only gender and age were controlled for, as distance does not influence the likelihood of utilizing a car in trips to or from school. Gender (Bookwala et al., 2014; Bungum et al., 2009; Larsen et al., 2009), age (Martin et al., 2007; Merom et al., 2006), and distance (Pont et al., 2009) are controlled for in this analysis as they are the greatest predictors of travel behaviour in the literature and we want to ensure that any significant differences in travel behaviour is not the result of differences in sample characteristics. Distance was not included in car trip analyses, as our preliminary analysis showed that there was no correlation between distance and car trips. All statistical analyses were performed in IBM SPSS Statistics 24 (IBM Canada Ltd., Markham, Ontario, Canada).

4. Results

4.1. Descriptive statistics

Table A1 describes the sample population and descriptive statistics by baseline and follow-up time points for both family and child survey respondents. The total sample population for this study was 4720 parents and 2084 children. In our first independent sample at baseline, there were 2591 parent respondents (54.9%) and 1176 (56.4%) children completing surveys. For our second independent sample at follow-up, the parent sample population was 2129 (45.1%), and the child sample was 908 (43.6%). At baseline, parents (i.e., family survey respondents) reported average weekly commuting patterns for children, of whom 47.3% were boys and 52.7% were girls, with an average age of 8.41 (SD: ± 2.9). Within this baseline sample 63.8% of families lived within walking distance, with families who live within walking distance having to travel an average of 926 m to and from school. Meanwhile, at follow-up, commute trips were reported for students who were 49.7% boys and 50.3% girls, with an average age of 8.90 (SD: ± 3.0). Of the follow-up sample 62.4% of families lived within walking distance, with the average family living 16-metres farther from school compared to baseline. Regarding the child samples (i.e., childsurvey respondents), 42.7% were boys and 57.3% were girls with an average age of 10.63 (SD: ± 1.4) at baseline, and 49.1% were boys and 50.9% were girls with an average age of 9.96 (SD: ± 1.5) at follow-up.

4.2. Parents' perceptions

The presence of the STP intervention largely resulted in positive shifts among parents' perceptions of AST barriers from baseline to follow-up (see Table A2). Reports of perceived social barriers saw many promising trends as significant declines were observed with respect to the trip to school being easier to drive ($p = 0.02$), the trip not being fun ($p = 0.03$), and bullying or teasing happening during the trip ($p = 0.01$). Many traditional barriers also saw significant decreases, such as a lack of sidewalks ($p < 0.01$), the trip being too far or taking too much time ($p = 0.01$), not having anyone else to walk with ($p < 0.01$), and children lacking cycling skills ($p = 0.03$).

There was also a heightened awareness of neighbourhood characteristics that facilitate AST among parents, with built environment characteristics seemingly having the most increased visibility among parents. Notably, the neighbourhood having enough walking trails ($p = 0.01$) significantly shifted. Neighbourhood safety perceptions were similarly encouraging as parents' perceptions that their community was unsafe for their child to walk alone ($p < 0.01$) or with friends ($p < 0.01$) were curtailed. Conversely, there were some areas where parents seem to remain rather hesitant. Although ability to cycle ($p < 0.01$) saw a significant increase, the much more popular method of walking ($p = 0.19$) did not. Parents' feelings of AST and vehicular safety also showed no significant declines. This was highlighted in the results of the trip being unsafe due to traffic ($p = 0.12$) and drivers' speeds ($p = 0.07$), with the latter increasing, albeit insignificantly.

4.3. Children's perceptions

Children more so than their parents reported important significant changes in their perceptions of AST barriers (see Table A3). Foremost, children reported higher levels of efficacy as their permission to both walk ($p < 0.01$) and cycle ($p < 0.01$) to/from school saw significant improvements. Perceived social and convenience barriers such as bullying ($p < 0.01$), crime ($p < 0.01$), the commute not being fun ($p < 0.01$), and the daily commute being easier to drive ($p < 0.01$) all saw significant declines. Last, the perceived community safety barriers of drivers' speed ($p < 0.01$), traffic safety ($p < 0.01$), and worries about commuting alone ($p = 0.01$) were also reduced.

Children also reported improvements with recognizing features of the physical environment and other AST facilitators in the context of their daily commute. For example, they identified a lack of sidewalks ($p < 0.01$) and bike paths/lanes ($p < 0.01$) as less of a barrier at follow-up. They also reported having lots of trees on the streets of their route to school ($p < 0.01$) and good access to bicycle lanes ($p = 0.02$), the latter complementing their reported improvements in ability perceptions like a lack of cycling skills ($p < 0.01$) declining.

4.4. Commuting behaviours

4.4.1. AST trips

Initial analyses (see Table A4) illustrate that some significant shifts in AST commuting trips occurred from baseline to follow-up. Trips to ($p = 0.02$) and from ($p = 0.02$) school significantly increased, whereas the total to and from trips did not ($p = 0.10$). When controlling for age, gender, and distance in our multiple linear regression models, the baseline to follow-up active travel commutes (see Table A5) were no longer significant for any trip. AST trips to school ($\beta = 0.073$; $p = 0.32$; CI [95%]: − 0.07 to 0.22), from school ($\beta = 0.106$; $p = 0.13$; CI [95%]: − 0.03 to 0.25), and total trips ($\beta = 0.003$; $p = 0.81$; CI [95%]: − 0.24 to 0.30) were also insignificant from baseline to follow-up.

4.4.2. By car trips

The rise in AST trips seen in our initial analysis (see Table A4) coincided with a few significant decreases in personal car trips. Personal vehicle trips to school ($p = 0.04$) and overall car trips to and from school ($p = 0.01$) significantly decreased. However, there was no statistically significant change in trips by car from school ($p = 0.09$). Similar to the regression modelling of AST commuting behaviour, when controlling for gender and age, the outcomes for personal car trips to school ($\beta = -0.05$; $p = 0.38$; CI [95%]: − 0.17 to 0.07), from school ($\beta = -0.04$; $p = 0.46$; CI [95%]: − 0.15 to 0.07), and overall ($\beta = -0.138$; $p = 0.21$; CI [95%]: − 0.35 to 0.08) from baseline to follow-up were no longer significant (see Table A6).

The overall incidence of active commute trips among children to and from school saw no significant increases from baseline to follow-up when controlling for known AST correlates. Trends remained for both increasing active travel trips and decreasing the personal vehicle trips within these analyses, though.

5. Discussion

This study evaluated the impact of an STP intervention between baseline and a two-year follow-up on children's and parents' perceptions of AST barriers, as well as children's AST commuting behaviours at 13 elementary schools. Results of our analysis show that the two-year STP intervention was successful at positively influencing child and parent perceptions of AST barriers and their awareness of AST facilitators, but did not demonstrate significant behaviour changes.

5.1. Intervention impact on perceptions

The STP intervention had a positive effect on parental perceptions of AST barriers. Parents are typically reluctant to let children actively commute due to concerns associated with strangers, traffic (Carver et al., 2008), a lack of confidence in cycling skills (Ducheyne et al., 2012) and their being too young (McMillan, 2007); the STP addressed a number of these perceived barriers in a positive manner. Particularly encouraging were the findings of declines in perceived barriers related to commuting preferences, the most notable result being the successful lowering of traditional convenience hurdles such as the trip being 'easier to drive' or 'too far' for AST. However, there are certain parental perceptions that were not as affected by the intervention, particularly known AST facilitators such as the presence of cycling and walking paths (Clark et al., 2016), sidewalks (Ewing et al., 2004), and trees/greenery/parks (Carver et al., 2005).

When viewed through the lens of behavioural theories such as the Theory of Planned Behaviour (TPB), which posits that an individual's intentions and behaviours are shaped by attitudes (i.e., one's appraisal of positive or negative associations of AST), perceived behavioural controls (i.e., one's perceived control over and confidence in AST), and subjective norms (i.e., perceived social pressure that influences one's conformation and engagement in a behaviour) (Ajzen, 1991), the STP intervention appears to have improved parents' perceptions in multiple respects. Regarding norms, the intervention has improved perceptions in a manner that suggests they have more pro-AST intentions at follow-up. For instance, at follow-up, reported perceptions of AST being inconvenient or taking too much time had declined among parents who are the ones that report time pressure concerns (Lorenc et al., 2008). Parents also reported a greater belief that their children have the ability and are better equipped to engage in AST, which is critical as autonomy has been recognized as an important influence on children's independent mobility (Alparone and Pacilli, 2012). In contrast, parental attitudes did not seem to be as clearly altered. Findings reflecting parental attitudes illuminate that initiatives to improve perceptions of traffic safety were much less cogent. Thus, even though parents' perceptions suggest their intentions to engage in AST are stronger at follow-up, this is only seen in their perceived social norms and behavioural control, not their attitudes about AST.

Children's perceptions of AST barriers also appear to have been influenced by the STP program, especially their awareness of built environment characteristics, the safety of AST commuting, and the increase of self-efficacy to participate in AST. Each of these specific concerns – perceived traffic safety (Tappe et al., 2013), personal safety (Kirby and Inchley, 2009), and parental controls (Foster et al., 2014) – have all been previously noted as key barriers to AST. Improving children's perceptions of these barriers (i.e., perceived traffic safety, personal safety, and parental controls) represents an important achievement for the STP program in helping to facilitate AST commuting behaviours in the future. This significant increase in children's allowance to walk and the declines in perceived traffic safety, though, were not fully shared in the parents' findings. Other studies have found that the two groups can diverge on perceived barriers (e.g., Huertas-Delgado et al., 2017); in the present study this may be due to children being exposed to several STP intervention initiatives at their school (e.g., promotional events, safety assemblies, education videos, etc.) which their parents would not be exposed to.

Again, the lens of TPB is useful in viewing these findings in a more critical light. Children's perceptions of barriers related to AST at follow-up highlight that strident shifts within their intentions occurred, which implies that they want to engage in AST. Although these indicators illustrate a uniformly positive impact, it is important to keep in mind that children may not fully comprehend the scale of certain issues (e.g., neighbourhood crime) to the same extent as their parents. Moreover, when coupled with the intervention taking place mostly in schools and directed at students, these findings likely reinforce an intervention dose-response gradient, wherein significantly different levels of program exposure unevenly influenced the reporting of parents and children.

5.2. Intervention impact on commuting behaviours

Changing the physical activity behaviours of children is a notorious challenge for health researchers (Baranowski et al., 2011; Barnett et al., 2008; Møller et al., 2014), and our evaluation further confirms this notion. The initial results suggested that important behavioural changes were occurring over the duration of STP intervention, but our multivariable regression models only support that modest behavioural trends emerged. Nevertheless, given the continuing trends of declining children's independent mobility (2006,2006) and the difficulty of changing AST culture in schools (LaJeunesse et al., n.d.; Rickwood, 2015), these observed modest behaviour changes could be viewed as a success for the intervention in the short-term. The influence of age, gender, and distance were further reinforced as important variables influencing AST in this study.

Taken with the discussions related to perceptions, the intervention has helped improve children's intentions to the point of their wanting to alter commuting behaviour, however parents' perceptions, in particular those that reflect their attitudes, are the probable barrier encumbering the facilitation of AST behaviour change. In other words, these results may point to what can be classified as an intention-behaviour gap among parents regarding AST decisions. The STP program has taken the first steps to addressing this gap but given the complexity of physical activity behaviour change, this should be an issue that is approached with a long-term focus. Based on research examining the contextual influence of schools (Guldager et al., 2018), it would be worthwhile to explore how behaviour change is best achieved through school communities taking a long-term approach of developing supportive social environments, a concept that has been evaluated in other fields such as education (e.g., Fullan, 2015; McLeskey and Waldron, 2006).

5.3. Future interventions, implications for policy and practitioners

The STP program's multiple strategies model (the SRTS “Es”) can be a sagacious approach to AST intervention programming. Of all the different strategies utilized in the STP model, based on our results, it is likely that education initiatives were the most effective, as they can be complementary to many other strategies. For instance, the awareness of engineering or built environment changes can arise as a consequence of the prompting from education campaigns. As previously noted, the STP intervention also seemed to considerably change perceptions about social issues such as crime and neighbourhood safety (Chillón et al., 2014). Encouragement, along with education strategies, could have been the main drivers for the aforementioned developments by increasing the opportunities for and knowledge of the benefits about AST commuting. It is difficult to decipher from this evaluation what specific effects enforcement and engineering strategies may have had, especially with their primary aim being to support longer-term behaviour change goals.

Like other studies (e.g., Terrón-Pérez et al., 2018), our findings suggest that future interventions would be prudent to focus on parental education, motivation, and empowerment strategies to successfully achieve AST behaviour change. In particular, emphasis should be placed on strategies that target parental perceptions of their local built environment features (e.g., location of pedestrian crossovers, access points for paths/trails), AST skills (e.g., how to use a crosswalk light, how to cross 4-way intersections), and social cohesion (e.g., walking school buses, walking buddy systems). Put another way, to facilitate the intention change necessary to produce the desired AST behaviour outcomes, future strategies would do well to educate and encourage parents to recognize that AST is a relatively facile, accessible, and socially desirable and beneficial way to commute. To this point, Fusco et al. (2012) found that children who commute actively to/from school had greater opportunities to reflect on social interactions, while Ramanathan et al. (2014) found that parents who are involved in AST reported more positive emotions vs passive travelers. Additionally, a recent meta-analysis which included adults found that nearly twice as many people (36%) fail to translate their physical activity intentions into behaviours than simply have no intention to be active (21%) (Rhodes and de Bruijn, 2013); therefore, future interventions should seek to empower parents by educating them on the accessibility and benefits of AST in furtherance of developing more nuanced perceptions that help facilitate their intentions manifesting into behaviours.

5.4. Study limitations

Within our novel case study of a regional ASRTS program there are a few limitations to note. Foremost, the use of a serial cross-sectional design limits the ability of this study to identify cause and effect relationships. This makes it difficult to assess if the observed changes in AST perceptions and behaviours reflect a trend or simply the differences between two different groups of participants. But given that the catchment areas and demographic profiles of participating schools remained unchanged over the two-year time period, this is an acceptable constraint for a study this large in scale. The self-reporting nature of our data collection process also makes this study subject to a level of recall bias. Parents may have inaccurately recalled or assessed their children's average weekly commuting behaviours. Our survey tool was also only offered in English, and as a result the input of a small but nevertheless important proportion of families at participating schools who have limited English skills may have been lost. Finally, most schools that decided to participate in the STP program, and were subsequently evaluated, were mid-high socio-economic status schools which possessed more resources and social capital than their lower socio-economic status counterparts. Conclusions should not be assumed to be representative of the ASRTS program's effectiveness across schools and communities of different socio-economic status.

6. Conclusions

This study has presented a quantitative case-study evaluation of a regional two-year STP intervention at 13 elementary schools, finding that the program is effective in altering parents’ and children's perceptions of AST barriers, but not their commuting behaviours. Findings also suggest that potential next steps for AST intervention programming should be to focus on parental education and empowerment regarding AST and finding methods that address the possible intention-behaviour gap in their AST decision-making process. Another identified area where future stakeholders of AST interventions should focus their efforts is on taking longer-term approaches, such as building supportive environments, or pro-AST cultures, in schools to procure meaningful behavioural changes. Future research would be prudent to conduct longitudinal studies focusing on how multiple strategies to support AST can support one another. Understanding the interplay of multiple initiatives may provide insights on how intervention facilitators and stakeholders can more effectively develop a change in school culture which discourages the car from use in school commuting behaviours.

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Conflict of interest

None.

Appendix A

See Tables A1–A6.

Table A1
Descriptive statistics.

	Baseline		Follow-up	
	All	**Within 1.6-km**	**All**	**Within 1.6-km**
Parent Sample (n = 4720)	2591	1654	2129	1329
Age, mean (SD)	8.41 (SD: ± 2.9)	8.46 (SD: ± 2.9)	8.90 (SD: ± 3.0)	9.10 (SD: ± 2.9)
Gender (%)				
Boy	43.7%	45.6%	49.7%	48.8%
Girl	52.7%	54.4%	50.3%	51.2%
Distance (%)				
Live within 1.6 km of school	63.8%	N/A	62.4%	N/A
Live outside 1.6 km of school	36.2%	N/A	37.6%	N/A
Distance in metres, mean (SD)	N/A	910.2 (SD: ± 511.5)	N/A	926.7 (SD: ± 498.1)
Child Sample (n = 2084)	1176	736	908	577
Age, mean (SD)	10.63 (SD: ± 1.5)	10.63 (SD: ± 1.4)	9.96 (SD: ± 1.5)	10.91 (SD: ± 2.2)
Gender (%)				
Boy	42.7%	41.5%	49.1%	48.9%
Girl	57.3%	48.5%	50.9%	51.1%
Distance (%)				
Live within 1.6 km of school	63.7%	N/A	64.3%	N/A
Live outside 1.6 km of school	36.3%	N/A	35.7%	N/A
Distance in metres, mean (SD)	N/A	945.1 (SD: ± 484.7)	N/A	953.9 (SD: ± 546.2)

Table A2
Changes in parents' perceptions of AST barriers from baseline to follow-up.

	Baseline				Follow-up				
	Strongly Disagree (%)	Somewhat Disagree (%)	Somewhat Agree (%)	Strongly Agree (%)	Strongly Disagree (%)	Somewhat Disagree (%)	Somewhat Agree (%)	Strongly Agree (%)	p
Neighbourhood Built Environment Perceptions									
Not enough sidewalks	57.9	15.2	14.6	12.4	61.9	16.0	10.6	11.5	< **0.01**
Not enough bike paths/lanes	45.9	12.7	20.6	20.8	45.8	16.6	17.2	20.5	0.44
There are enough walking trails	21.9	18.8	27.4	31.9	18.7	19.2	27.3	34.8	**0.01**
No bike rack	58.9	23.8	13.0	4.4	61.2	21.5	12.8	4.5	0.21
Neighbourhood Safety Perceptions									
Allowed to walk	35.2 (No)		64.8 (Yes)		33.3 (No)		66.7 (Yes)		0.19
Allowed to bike	58.3 (No)		41.7 (Yes)		54.2 (No)		45.8 (Yes)		< **0.01**
Unsafe for child to walk alone	32.4	27.7	24.1	15.8	36.7	28.0	20.8	14.5	< **0.01**
Unsafe for child to walk with friends	43.0	32.6	15.8	8.6	48.4	30.8	12.5	8.3	< **0.01**
Too young to walk/bike	38.1	14.7	18.1	29.2	41.7	14.3	17.2	26.7	**0.01**
Feels unsafe because of crime	51.4	21.1	17.3	10.2	56.9	21.7	13.4	7.9	< **0.01**
Route feels unsafe due to traffic	32.5	16.5	22.1	28.9	36.3	13.8	21.8	28.2	0.12
Too many busy streets	40.2	18.4	19.2	22.3	40.6	19.0	18.9	21.5	0.57
Drivers speed on streets	11.7	25.6	35.5	27.3	12.3	22.0	36.1	29.5	0.07
Too much traffic along street we live on	37.8	31.6	19.1	11.4	39.1	31.2	19.2	10.5	0.34
Social Perceptions									
Route is boring	76.7	15.9	5.4	2.0	75.5	18.9	4.3	1.2	0.62
Not fun to walk	71.0	19.8	6.3	2.9	74.0	17.5	6.7	1.8	**0.03**
Too much stuff to carry	47.3	24.6	22.4	5.7	47.9	25.2	21.8	5.1	0.45
Get too hot/sweaty	67.4	19.4	9.8	3.4	69.4	18.7	9.4	2.5	0.12
Easier to drive	43.0	16.2	23.3	17.5	47.4	13.4	23.1	16.1	**0.02**
Might get bullied/teased	52.2	28.3	14.1	5.4	56.9	24.7	13.6	4.8	**0.01**
There are lots of trees in area	8.5	19.3	34.3	37.8	9.0	17.5	32.9	40.4	0.14
No skills to bike	45.0	13.2	19.6	22.2	46.3	15.1	20.8	17.9	**0.03**
Too Far/Takes too much time	54.5	12.0	14.4	19.1	57.8	12.6	11.9	17.6	**0.01**
No one to walk with	54.5	19.9	14.0	11.6	59.5	16.4	14.1	10.0	< **0.01**

*Significant results **bolded**. $p < 0.05$.

Table A3
Changes in children's perceptions of AST from baseline to follow-up.

	Baseline				Follow-Up				
	Strongly Disagree (%)	Somewhat Disagree (%)	Somewhat Agree (%)	Strongly Agree (%)	Strongly Disagree (%)	Somewhat Disagree (%)	Somewhat Agree (%)	Strongly Agree (%)	p
Neighbourhood Built Environment Perceptions									
Not enough sidewalks	60.3	16.2	13.0	10.5	74.2	14.9	5.7	5.2	< **0.01**
Not enough bike paths/lanes	48.0	17.1	19.4	15.5	70.1	13.8	9.1	7.0	< **0.01**
Bicycle lanes/trails easy to get to/access	31.3	22.3	24.8	21.7	25.0	22.1	28.7	23.1	**0.02**
No bike rack	66.0	18.2	10.8	5.0	76.6	10.7	7.4	5.3	< **0.01**
Neighbourhood Safety Perceptions									
Allowed to walk	26.8 (No)		73.2 (Yes)		20.2 (No)		79.8 (Yes)		< **0.01**
Allowed to bike	49.2 (No)		50.8 (Yes)		38.5 (No)		61.5 (Yes)		< **0.01**
Unsafe to walk alone	67.3	16.6	8.8	7.3	71.0	20.1	5.6	3.3	**0.01**
Unsafe to walk with friends/ siblings	79.8	12.7	3.5	4.1	87.9	8.7	2.1	1.3	< **0.01**
Feels unsafe because of crime	65.4	16.2	11.6	6.8	75.1	14.9	3.8	6.2	< **0.01**
Route feels unsafe due to traffic	53.8	18.2	14.3	13.7	65.6	18.1	9.5	6.8	< **0.01**
Streets too busy to cross	56.7	16.8	14.6	11.8	67.3	17.5	8.9	6.4	< **0.01**
Drivers speed on streets	38.0	28.1	4.3	2.0	40.1	36.1	16.3	7.5	< **0.01**
Social Perceptions									
Route is boring	57.7	21.5	13.7	7.2	66.1	18.4	8.0	7.4	< **0.01**
Not fun to walk/bike	61.5	21.2	10.2	7.0	68.8	17.3	6.4	7.5	< **0.01**
Too much stuff to carry	52.7	26.5	15.0	5.8	61.1	25.1	9.9	3.8	< **0.01**
Too hot/sweaty	63.8	23.0	8.5	4.7	66.7	23.1	7.7	2.5	0.08
Easier to drive	45.3	17.1	18.9	18.7	52.5	15.0	17.5	14.9	< **0.01**
Afraid of being bullied/teased	74.5	14.3	8.1	3.1	81.6	13.7	2.4	2.3	< **0.01**
There are lots of trees in area	14.4	21.7	27.1	36.7	8.5	18.1	33	40.4	< **0.01**
No skills to bike	77.6	9.6	6.6	6.2	85.5	6.5	2.9	5.2	< **0.01**
Too far to walk/bike	61.4	15.2	10.3	13.1	69.8	17.1	5.5	7.7	< **0.01**
No one to walk/bike with	67.7	14.1	10.3	7.8	69.3	14.2	8.9	7.6	0.40

*Significant– > *Significant results **bolded**. < 0.05.– > p < 0.05.

Table A4
Changes in children's trips to/from school by AST vs by car.

	Baseline					Follow-up					p
Trip	0–1 Day	1–2 Days	2–3 Days	3–4 Days	4–5 Days	0–1 Day	1–2 Days	2–3 Days	3–4 Days	4–5 Days	
Number of days actively traveling to school	45.5	3.9	6.9	3.5	40.2	42.3	3.6	7.7	4.6	41.8	**0.02**
Number of days actively traveling from school	41.7	4.8	4.9	5.9	42.5	38.3	3.9	6.5	6.0	45.3	**0.02**
Number of days traveling to school by car	58.1	5.8	8.0	2.2	25.9	60.4	4.8	8.5	3.1	23.1	**0.04**
Number of days traveling from school by car	62.3	5.2	6.2	4.3	21.9	63.4	6.0	7.7	3.9	19	0.09
	0–2 Days	2–4 Days	4–6 Days	6–8 Days	8–10 Days	0–2 Days	2–4 Days	4–6 Days	6–8 Days	8–10 Days	
Number of days actively traveling to/from school	41.3	5.5	9.0	5.9	38.3	37.9	5.9	10.0	6.4	39.8	0.1
Number of days traveling to/from school by car	57.3	7.1	11.5	3.7	20.4	58.5	8.3	11.7	4.1	17.4	**0.01**

*Significant– > *Significant results **bolded**. < 0.05.– > $p < 0.05$.

Table A5
Changes in children's trips to/from school By AST (multivariable models).

	Model 1: AST to & from school			Model 2: AST to school			Model 3: AST from school		
	β	p	CI [95%]	β	p	CI [95%]	β	p	CI [95%]
Constant	3.621	0.00	3.18, 4.06	1.822	0.00	1.59, 2.06	1.767	0.00	1.54, 1.99
Follow-Up (referent: Baseline)	0.033	0.81	− 0.24, 0.30	0.073	0.32	− 0.07, 0.22	0.106	0.13	− 0.03, 0.25
Gender (referent: Girl)	0.032	0.81	− 0.24, 0.30	0.024	0.74	− 0.12, 0.17	0.023	0.75	− 0.12, 0.16
Age	0.309	< **0.00**	0.26, 0.35	0.144	< **0.00**	0.12, 0.17	0.172	< **0.00**	0.15, 0.20
Distance (in 100-m)	− 0.011	< **0.00**	− 0.01, − 0.01	− 0.006	< **0.00**	− 0.01, − 0.00	− 0.005	< **0.00**	− 0.01, − 0.00
R^2	0.06			0.05			0.07		

*Significant– > *Significant results **bolded**. < 0.05, β = standardized – > p < 0.05, β = standardized coefficient.

Table A6
Changes in children's trips to/from school by car (multivariable models).

	Model 4: by car to & from school			Model 5: by car to school			Model 6: by car from school		
	β	p	CI [95%]	B	p	CI [95%]	β	p	CI [95%]
Constant	5.067	0.00	4.72, 5.42	2.564	0.00	2.37, 2.76	2.601	0.00	2.42, 2.78
Follow-Up (referent: Baseline)	− 0.138	0.21	− 0.35, 0.08	− 0.053	0.38	− 0.17, 0.07	− 0.043	0.46	− 0.15, 0.07
Gender (referent: Girl)	− 0.267	**0.01**	− 0.48, − 0.05	− 0.131	**0.03**	− 0.25, − 0.01	− 0.128	**0.02**	− 0.24, − 0.02
Age	− 0.240	< **0.00**	− 0.28, − 0.20	− 0.108	< **0.00**	− 0.13, − 0.09	− 0.136	< **0.00**	− 0.15, − 0.12
R^2	0.04			0.03			0.03		

*Significant– > *Significant results **bolded**. < 0.05, β = standardized – > p < 0.05, β = standardized coefficient.

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