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Identifying the Influence of Parents' and Children's Perceptions of their Built and Social Environments on Children's Mode of Travel to and from School

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A thesis submitted in partial fulfillment of the requirements for the degree in Master of Arts

IDENTIFYING THE INFLUENCE OF PARENTS' AND CHILDREN'S PERCEPTIONS OF THEIR BUILT AND SOCIAL ENVIRONMENTS ON CHILDREN'S MODE OF TRAVEL TO AND FROM SCHOOL

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Abstract

This study examined the influence of parents' and children's perceptions of their built and social environments on children's use of active transportation (AT) between home and school. A mixed-methods approach was used including an environmental/behavioural survey completed by students (grades 5 through 8) and parents from 32 schools throughout London, Ontario, (*n*=1,623); Geographic Information Systems (GIS) for generating built environment variables to be controlled for; Principal Component factor analysis; and step-wise logistic regression models that divided analysis between the journey to and from school to determine the most influential factors in either direction. Children's personal attitudes were the primary barrier for use of AT in both directions between home and school with "having no one to walk with" and "it being easier to have someone to drive them" being associated variables within both factors. Urban planners, public health professionals, and policy makers need to improve environments, develop AT promotional initiatives, and develop policies that remove barriers to allow more children to profit from the health benefits associated with AT.

Keywords

Active transportation, active travel, children, school, perceptions, built environment, social environment

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List of Abbreviations

AT	Active transportation / active travel
BE	Built environment
CSEP	Canadian Society for Exercise Physiology
GIS	Geographic Information Systems
GPS	Global Positioning Systems
HEAL	Human Environments Analysis Laboratory
LDCSB	London District Catholic School Board
MOT	Mode(s) of travel
MVC	Motor-vehicle collision(s)
MVPA	Moderate to vigorous physical activity
PHAC	Public Health Agency of Canada
SES	Social-economic status
STEAM	Spatial and Temporal Environmental and Activity Monitoring
TVDSB	Thames Valley District School Board
UWO	University of Western Ontario
WHO	World Health Organization

Chapter 1

1 Introduction: Active travel to school

"The test of the morality of a society is what it does for its children." -- Dietrich Bonhoeffer

More than 40 million children under the age of five were deemed overweight in 2010 (World Health Organization [WHO], 2012a). In 2012, the World Health Organization (WHO, 2012b) stated that childhood obesity ss, "one of the most serious public health challenges of the 21st century" with worldwide obesity rates more than doubling since 1980. With increasing access to junk food and decreasing opportunities for physical activity, the obesity trend becomes an issue of accessibility and opportunity. Children in today's society are at a disadvantage with modern cities being built to satisfy the wants and needs of those over the age of 16 years old, in middle to high income classes, and who are able to drive their own motor-vehicles.

The daily journey to and from school offers children the opportunity to be physically active through active modes of travel (MOT), such as walking and cycling. Unfortunately, the number of Canadian children using active travel to school has decreased nearly 50% in the last 20 years (Buliung, Mitra, & Faulkner, 2009). Research identifies the need for supportive environments that make it safe, comfortable, and convenient for children to use active travel (Kerr et al., 2006). Impacts of the built environment, such as the presence of sidewalks, on children's travel mode choice to school are generally well understood (e.g., Larsen et al., 2009). However, a child's decision to choose a particular MOT to school does not solely depend on environmental characteristics, but also on their personal attitudes and perceptions towards their physical and social environments and the journey to school. Furthermore, children are somewhat, if not entirely, influenced by their parents when making such decisions. Unfortunately, the influences of parents' and children's perceptions on MOT to school are not well understood, and even less so in relation to the built environment, which is often studied independently. The primary purpose of this thesis was to examine the influence of parents' and children's perceptions of their environments on children's MOT between home and school. This study assessed previous studies that considered how perceptions

and objective measures of built environments influenced MOT to school, and built upon this work to develop a more comprehensive ecological approach towards understanding a child's choice to actively commute to school. The following introduction describes the theoretical framework and underlying constructs of this study, the key research question and objectives, and an outline of the remainder of the thesis.

1.1 Need for the study

Childhood obesity rates in Canada have tripled in the last 25 years, leading to approximately 1 in 3 children in Canada (as in the US and other developed nations) being overweight or obese (Centers for Disease Control and Prevention, 2012; Ebbeling, Pawlak, & Ludwig, 2002; Roberts, Shields, de Groh, Aziz, & Gilbert, 2012). Overweight and obese children are put at an increased risk for early onset of illnesses such as cardiovascular disease, bone fractures, diabetes, as well as premature death (Andersen et al., 2006; Hypponen et al., 2000; Hannon, Rao, & Arslanian, 2005). Being overweight as a child also increases the likelihood of remaining overweight and suffering from such ailments into adulthood.

Globally, being overweight or obese is listed as the fifth leading risk factor for adult deaths by the WHO (2012a). Co-morbidities related to adulthood obesity include cardiovascular diseases (CVD), type one and type two diabetes, musculoskeletal disorders, asthma, gallbladder disease, and certain types of cancer (Guh et al., 2009). CVD (including heart disease and stroke), cancer, and type one diabetes are among the top ten causes of death totalling 60.1% of all adult deaths in Canada (Statistics Canada, 2010). This means that of approximately 2.8 million adults dying in the world each year, more than half could be prevented through obesity prevention.

Obesity is caused by an energy imbalance between calories consumed and calories expended. Calorie consumption includes all dietary intake including meals, snacks, and beverages; calorie expenditure results from physical activity, where the higher the intensity of movement, the greater number of calories burned. Although energy intake and expenditure are equally influential on weight status, their predictors and influencers can differ greatly. This study solely focuses on energy expenditure as a means of decreasing childhood obesity through physical activity.

Increasing physical activity levels in children has been proven to help decrease obesity and related health ailments, and improve activity habits and routines likely to continue into adulthood (Gielen et al., 2004; Tucker et al., 2009; Ziviani, Kopeshke, & Wadley, 2006). The Public Health Agency of Canada (PHAC) and the Canadian Society for Exercise Physiology's (CSEP) Physical Activity Guidelines state that 5 to 17 year olds require at least 60 minutes of moderate to vigorous physical activity (MVPA) a day. It is also recommended that they should engage in vigorous activities at least 3 times per week (CSEP, 2011). Unfortunately, according to Colley et al. (2011), only 7% of Canadian children (9% of boys and 4% of girls) achieve the recommended 60 minutes of MVPA a day. This shows a great need to develop or encourage ways for children to increase their level and time engaged in physical activity.

Many options exist for increasing physical activity, from organized sports, athletic competitions, and gym classes, to dancing, playing, or walking the dog. The level of intensity varies by activity as does the level of personal enjoyment. For some individuals little pleasure is found engaging in intense physical activity that feels like a "workout" and would rather do something fun that also happens to increase their heart rate (Sherwood & Jeffery, 2000). More competitive individuals on the other hand may only enjoy physical activity if it feels like they are accomplishing a goal such as training for a sports competition. Walking and cycling have recently gained attention because of their ability to increase physical activity through competition, recreation, and particularly for utilitarian purposes as a mode of transportation to practical destinations (Forsyth, Hearst, Oakes, & Schmitz, 2008; Foster, Panter, & Wareham, 2011; Lee & Vernez Moudon, 2006). The term used for any person using an active MOT is defined as active transportation (AT).

The Public Health Agency of Canada (2010) defines AT as "any form of human-powered transportation – walking, cycling, use of a wheelchair, in-line skating or skateboarding." Active MOT demonstrate positive effects on individuals physically (long-term health effects previously discussed), emotionally (improved self-esteem), academically (enhanced scholastic success), and environmentally (Hillman et al., 2009; Strauss, Rodzilsky, Burack, & Colin, 2001; Warburton, Nicol, & Bredin, 2006; Woodcock et al., 2009). Decreased numbers of trips made by automobiles reduces the

level of greenhouse-gases being emitted, which can aid in slowing the thinning of the ozone layer and the crises of global warming (Woodcock et al., 2009). Decreased emissions also benefit individuals who suffer from asthma or other respiratory illnesses as it lowers the number of pollutants and irritants in the air (Schwartz, 2004). Fewer vehicles on the road also leads to decreased mortality and morbidity rates associated with motor-vehicle collisions (MVC). Between 1979 and 2004, 97,964 Canadians were killed due to MVC (Statistics Canada, 2008). The Public Health Agency of Canada (1999) states that MVCs are the "leading cause of injury or death in children older than one year of age", contributing to the 57.6% of child deaths between 1 and 19 years of age.

The study of AT often focuses on the commute to work and running errands for adults, whereas for children, the ideal opportunity to use AT is in their daily commute to and from school as it is their most regularly attended destination (Davison, Werder, & Lawson, 2006; Lachapelle & Noland, 2012). A recent trend of closing neighbourhood schools to build new ones in the suburban outskirts or under-developed areas of towns and cities, however, is making them too far away for children to access actively or independently. The schools that remain within populated areas on the other hand often lack the necessary infrastructure to encourage the use or allowance of AT by children. The development of modern suburban neighbourhoods has decreased the likelihood of AT among all residents because they are being built to be more convenient for adults and the use of automobiles, which in turn is making them less suitable for the needs of vulnerable populations such as children.

While school location and supportive infrastructure are influential in increasing children's use of AT to and from school, it is not the sole factor. It is common to see more students using AT for the journey home from school than the journey to school (Green Communities Canada, 2010; Larsen et al., 2009). If a child is able to actively travel one way, what is preventing them from using it in the opposite direction? If AT were only controlled by objective environmental factors, then the same children should always be using the same MOT between home and school as their environment would not change from morning to afternoon. While the difference in proportion of children using AT to school versus home is often discovered through research, it is a factor that has yet to be fully explored.

The body of research regarding the built environment (BE) is better understood due to the availability and ease of studying objective data. The impact of subjective perceptions on modal choice leaves much to comprehend. Previous studies have identified fears of traffic or bullying as deterrents from allowing children to use AT, while the media often exacerbates parents' fears on topics such as child abduction. Studying such influences becomes very complex with several layers of factors contributing to a final outcome variable of whether a child is active or passive on their journey between home and school. In order to combine the study of individual, societal, and environmental factors on children's AT to and from school, an ecological framework was espoused.

1.2 Research framework

An ecological approach was used in order to understand the influences that parents' and children's perceptions of their environments have on children's use of AT to school. An ecological conceptual framework (Figure 1) consists of multiple levels and factors including individual (biological, psychological), socio-cultural, organizational, environmental (built, natural), and political (laws, rules, regulations, codes) levels of influence (Glanz, Rimer, & Viswanath, 2008; Sallis et al., 2006, p. 299). Stokols (1992) describes an ecological framework within Public Health as one where people interact with their physical and socio-cultural surroundings. This framework was appropriate for this study as the aim was to understand the interpersonal level between parents and children, their individual perceptions of their social and physical environments, the societal influences on these perceptions, and the objective environmental characteristics, all while controlling for intrapersonal factors such as age and gender.

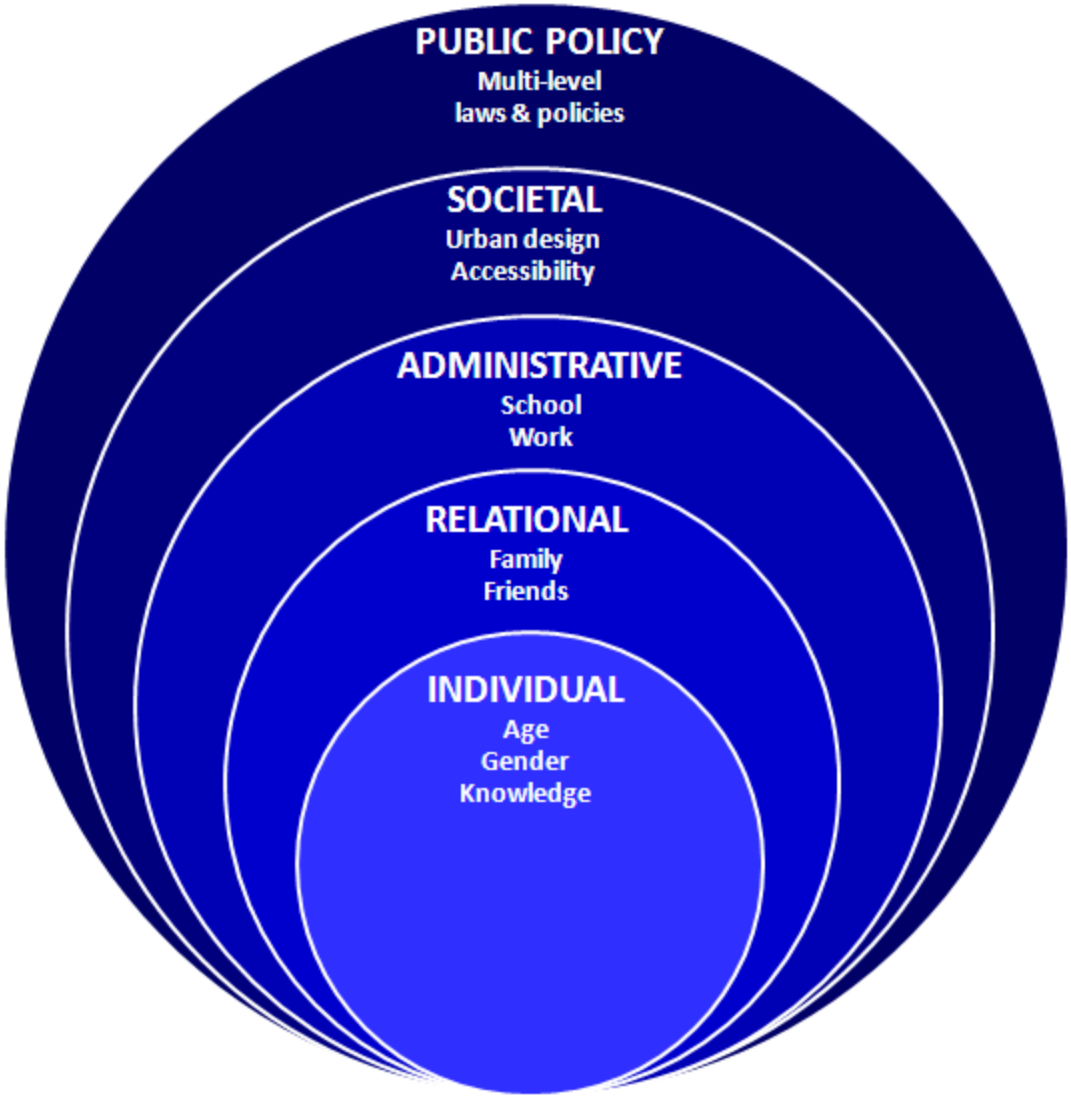


Figure 1 Social-ecologic conceptual framework

Adapted from: Active Canada 20/20 (2012)

In Sallis and colleagues' (2006) study of ecological approaches to creating active living communities, it was determined that ecological approaches were very well suited for studies of physical activity as they usually take place in a specific place. Ecological frameworks are also relevant for physical activity research due to the complex range of possible influencing factors (Giles-Corti, Timperio, Bull, & Pikora, 2005; Robertson-Wilson, Leatherdale, & Wong, 2008). There are several factors associated with physical activity, and AT more specifically, than solely a law or policy, a personal preference, the existence of supportive infrastructure, or whether a person is male or female. Glanz, Rimer, and Viswanath (2008), in their description of ecological frameworks, identified that not only can behavioural influences come from the individual, but they can also come from their social and physical environments. The levels and number of factors within each level of influence are so great that it is likely that all influences are not known at this time.

The most difficult task in conducting ecologically framed research is discerning what possible interactions are most important (Glanz, Rimer, & Viswanath, 2008). Previous studies, such as Trapp et al.'s (2012) study of physical activity levels attributed to walking to and from school, assessed individual, social, and environmental factors associated by gender. The four levels of their model included the objective environment, perceived environmental factors, social factors, and individual factors. Following their study, the use of an ecological approach for such studies was recommended for effective and comprehensive research and interventions. While gaining understanding of children's journeys to school is important, the end goal is to find ways to influence change so more children will access school through active MOT. Promotional programming and policy changes are common educational and habit changing outcomes and as Sallis et al. (2006) and Sallis and Owen (2002) reported, the most likely way to influence policy and programming is through the use of an ecological framework. An ecological framework allows for multi-level interventions that combine personal, environmental, and political factors that have been found to have the most positive effects on changing behaviour (Glanz, Rimer, & Viswanath, 2008; Sallis et al., 2006)

1.3 Objective of study

This thesis was completed using data generated through three research projects conducted by Dr. Jason Gilliland and his associates within the Human Environments Analysis Laboratory (HEAL). The overarching purposes of these studies were to understand the impacts of children's social and physical environments on health-related lifestyles and behaviours. The primary research question that was addressed in this thesis was: ***How do parents' and children's perceptions of their physical and social neighbourhood environments influence a child's mode of travel to and from school?***

In addition, the following was also assessed:

1) Which has more influence on a child's MOT to and from school: the built environment factors, parents' perceptions, or children's perceptions?
2) What differences, if any, are there between influences on a child's journey to school versus home from school?

This thesis will add to the current literature through the use of more advanced statistical analyses than has previously been conducted on perceptions and children's AT to and from school research. Influential objective factors will also be controlled for through a step-wise logistic regression model.

1.4 Outline of thesis

Chapter two will expand upon the conceptual background that has been started in this chapter. It will also review previous literature on children's AT to and from school, elements of walkable neighbourhoods, and methodologies and results of previous studies, focusing on the influence of objective and subjective neighbourhood factors, and children's journey to and from school. Chapter three will describe the methodologies used to answer the primary research question and associated sub-questions, while chapter four will state the results of data analysis. Chapter five will discuss implications of the results including recommendations for urban planners, researchers, and health promoters, and the effects they can have on improved public health policy and programming to increase the number of children using AT between home and school.

Chapter 2

2 Literature review

The purpose of this literature review was to build upon the foundation laid in the introduction, to discuss the current state of literature associated with children's use of active transportation (AT) to school, and to highlight the importance of the topic and why it needs to be studied further. The chapter will begin by describing an important social determinants of health element and how it can be aided through the promotion of AT. Previous research highlighting the many obstacles that prevent children from using AT will also be described. Environmental factors related to the built environment (BE) will also be described due to their relevance to children's AT to and from school. The literature pertaining to the BE is much greater that subjective influences due to the ease of measurement and study as they are objective and can be assessed through tools such as Geographic Information Systems (GIS), while perceptions are subjective and much more complex. While the primary focus of the study is on parents' and children's perceptions of their environment, it is important to understand the influence of these objective factors to fully understand the relationships between them and more importantly children's use of AT. The review will delve deeper into the current research, methodologies, and results of perceptions literature. Through this review, the previous literature will be built upon through the identification of strengths and weaknesses within the literature.

2.1 Social determinants of health – accessibility & equity

Active transportation not only has the ability to improve an individual's health through increased physical activity, but also improved health of society through increased accessibility (Merriam-Webster, 2012). Accessibility is an important factor within the social determinants of health, which the World Health Organization (WHO, 2012c) defines as:

> "the conditions in which people are born, grow, live, work and age, including the health system. These circumstances are shaped by the distribution of money, power and resources at global, national and local

> levels, which are themselves influenced by policy choices. The social determinants of health are mostly responsible for health inequities - the unfair and avoidable differences in health status seen within and between countries."

The social determinants of health include factors such as income, education, early childhood development, social exclusion, social support networks, social and physical environments, gender, race, and disability (The Canadian Facts, 2010). All of the social determinants can be viewed from a large-scale perspective, but local policies also have the ability to decrease disparities between individuals (Lock, 2000). While some determinants cannot be altered, such as gender and race, urban planners and public health workers have the ability and responsibility to create environments and policies that decrease burdens of social exclusion, lack of social support networks, and poorly planned social and physical environments.

Children are often at a disadvantage as they cannot control their position in life in the same way adults can. Children, along with other vulnerable populations, are also often burdened by the lack of transportation options in an automobile-oriented society (Litman, 2002). One of the aims of this study was to understand children's perceptions related to their neighbourhood environments. It is important for children's opinions to be heard and that key stakeholders listen to them in order to create environments conducive to facilitating personal growth and capacity, and to achieve their highest social, mental, and physical well-being. It is hypothesized that this can be obtained more fully through increased physical activity and accessibility gained by using AT.

Cost savings attributed to AT also increase accessibility. Walking is a100% free MOT as it does not require any special equipment or vehicle of any kind. The only cost would be shoes comfortable enough to walk in. The cost of cycling, or other wheeled methods, while requiring the price of owning or having access to a device for transport, is significantly lower than that of a personal automobile requiring high priced gasoline. Creating environments conducive to AT increases access to resources and amenities for vulnerable populations such as newcomers to Canada, residents in lower income brackets, children, and seniors. The ability for all people to have freedom without the dependence on automobile improves the health of a society overall and is a primary reason for the focus on AT in public health.

2.2 Children & active transportation

School is a child's primary destination as they normally attend it five out of seven days per week, with a total of ten trips between home and school each week. Creating an environment supportive of AT for children will increase the likelihood that they will use it, as well as increase their time spent engaging in physical activity (Davison & Lawson, 2006). Although the journey to and from school is unlikely to accomplish the necessary 60 minutes of moderate to vigorous physical activity (MVPA) that children require each day, using AT can contribute to their overall activity level (Cooper, Page, Foster, & Qahwaji, 2003). Children that use AT have been found to have higher levels of physical activity, energy expenditure, and increased likelihood of attaining physical activity guidelines than those who are driven to school (Pont, Ziviani, Wadley, Bennett, & Abbott, 2009; Rodriguez & Vogt, 2009; Timperio et al., 2006). Sjolie and Thuen (2002) also observed an increase in AT to destinations other than school when it was regularly used for the journey to school compared to their counterparts who passively travelled to and from school (Cooper et al., 2003). Unfortunately the number of children using AT continues to decline while the number of children passively traveling to school climbs (Buliung, Mitra, & Faulkner, 2009).

2.2.1 Travel to school by motor-vehicle

The number of Canadian children using AT to school has decreased 42-53% from 1986 to 2006 (Buliung, Mitra, & Faulkner, 2009). Gottdiener and Budd (2005) describe school zones when children are dropped off or picked up by their parents as having traffic flow reductions of 30% with two-way streets appearing as one-way due to traffic congestion. McDonald (2008) and Martin, Lee, and Lowry (2007) found that only 48% of students are walking to school when deemed "living within walking distance of their school". The Thames Valley District School Board (TVDSB) considers 1.6 km an acceptable distance for elementary school children to walk as they recently reduced busing eligibility distances from 2 km to 1.6 km (TVDSB, 2010). However, more than half of students within walking distance, who are not eligible for busing, choose not to use AT, instead they choose to be driven to school by their parents. Does this mean that 1.6 km is not a reasonable and effective walking distance for children? Or are there other contributing

factors inhibiting children from walking or cycling to school? Previous literature has found that the urban design of a community can be one of the negative impacts on the use of AT.

2.2.2 Modern Cities

The restructuring of the modern North American city in the 1950's and 1960's caused decentralization of cities and the development of suburbs, which had a negative impact on children's independent travel (Gottdiener & Budd, 2005). Post World War II economic growth and zoning law alterations created infrastructural investments for homes on larger lots, separated from business, industrial, and retail districts, causing a decreased urban density and furthering the distance to resources and amenities, making it increasingly difficult to use AT (Gottdiener & Budd, 2005; Yago, 1984). This time period also marked the beginning of a family's social status being represented by their ownership of a vehicle (Haughton & Hunter, 2003). Continued development of car-oriented cities, the increased social value of car ownership, and the North American economic importance provided by vehicles, has made it nearly impossible to be mobile in a city without one.

Approximately one-third of the average Canadian city's population is made up of children, the elderly, and disabled, who are unable to drive or use personal automobiles as their primary mode of transportation (Litman et al., 2009). This culture creates a dependency on adults who are capable of driving a personal vehicle to access amenities and resources by those who cannot. Saelens, Sallis, and Frank (2003) discussed how physical activity has been engineered out of daily lives, and that communities have been built to make walking and cycling both difficult and dangerous. Lack of well-connected and safe infrastructure currently hinders several residents from choosing AT as a viable transportation option. Urban planners, health professionals, and engineers are now trying to find ways to reverse social norms through urban form alterations that can make AT more available and accessible for all.

2.3 Built environment & active transportation

"Accessible design is good design." –Steve Ballmer

It has become increasingly evident that the environment people live in, both natural and built, encourages or hinders active behaviours (Giles-Corti & Donovan, 2002; Saelens, Sallis, Black, & Chen, 2003). The BE is anything created by humans, for humans, and includes things such as buildings, parks, and roads, as well as supportive infrastructure such as sewers, street lights, and hydro lines. Different aspects of the BE impact different types of activity. For example, in order for an individual to engage in group sports, recreational facilities or sport fields would have to exist and be accessible. With the current trend of sprawling cities, access to such amenities such as public schools, are becoming less accessible for children through AT due to the large distances between them. In order for children to use AT, it is necessary to have BEs that make it safe and convenient for them to do so. The BE factors influencing AT choices has led to the development of the term walkability.

2.3.1 "Walkability"

The term "walkability" has been created to define infrastructural characteristics most conducive to walking. Walkability indexes have been created to determine the level of a neighbourhood's walkability. Primary elements include higher dwelling and intersection densities and greater land-use mix (Maddison et al., 2009). They can also include aspects such as well-maintained sidewalks, good lighting, interesting things to look at, direct routes, and green space (Jane's Walk, 2010). More recently, bikeability indexes have been created to assess the characteristics that make cycling safer and more accessible. The University of British Columbia created the first known bikeability index, which identified bicycle facility quality, street connectivity, topography, and land use as influencing features (Canada Newswire, 2011). Other factors that have been identified as important for cycling-friendly neighbourhoods include places to store wet clothes, bike stands, hills, and neighbourhood aesthetics (Ahlport, Linnan, Vaughn, Evenson, & Ward, 2008; Kerr et al., 2006; Lorenc, Brunton, Oliver, Oliver, & Oakley, 2008). The problem with car oriented societies however, is that drivers prefer wider and smoother roads with fewer intersections for convenience of faster travel while pedestrians and cyclists are discouraged in such an environment due to the high speed of traffic and fewer intersections to cross at. Motor-vehicles, cyclists, and pedestrians all travel at different

speeds and require different types of supportive infrastructure. Due to these differences, the remainder of this review will focus primarily on factors associated with walking and children's AT.

2.4 Objective factors & children's active travel

The creation of walkability indexes most often considers the needs of adults. Higher intersection densities are most often associated with adult's use of AT, however, factors that have been found relevant for both adults and children include street connectedness, residential density, intersection density, and mixed land-use (Bungum, Lounsbery, Moonie, & Gast, 2009; Kerr, Frank, Sallis, & Chapman, 2007). Schlossberg et al. (2006) did find that intersection densities along with fewer dead-end streets were also associated with walking to school. Additional significant factors for children's AT to school have included street tree density, distance, transport infrastructure (number of roads to cross and traffic density/speed), having recreational facilities near to the home, and walk and bike paths present in the neighbourhood (Carson, Kuhle, Spence, & Veuglers, 2010; Larsen et al., 2009; Pont et al., 2009; Saelens & Handy, 2008; Tucker et al., 2009). Of all environmental factors found to be correlated to a child's journey to school, none have been identified to be as relevant as distance.

2.4.1 Distance

Distance is often presented as the most common and influential environmental barrier for AT to school (Handy, Boarnet, Ewing, & Killingsworth, 2002; Larsen et al., 2009; Pont et al., 2009; Saelens and Handy, 2008). In a review by Saelens and Handy (2008) on BE correlates of walking, proximity to destinations was consistently the most associated factor to AT. The walkability factors of mixed land-use and residential density also influence distance between destinations; the closer buildings and destinations are to each other, the less distance necessary to travel between them. What is considered an acceptable distance however, differs between individuals. As long as the distance is perceived as too far, the likelihood of using AT will be very small. The concept of perceptions of reasonable walking distances will be further discussed in the perceptions portion of this literature review. Distance between home and school can only change with

a relocation of a family's home or school, and with these changes being unlikely, the most important factors are those in between. Features such as well-lit paths and short cuts could be created to decrease the distance, especially in neighbourhoods with fewer street connections.

2.4.2 Socio-demographic

Several other objective factors exist that influence children's AT to school that are not related to the BE. For example, Kerr et al. (2007) found that urban form was only correlated for Caucasians and that it was not significant for non-whites, low-income groups, and those that did not own a motor-vehicle. Carlin et al. (1997) and Pont et al. (2009) found similar findings with race, social class, and number of owned vehicles. They found that families that owned fewer vehicles, were in lower occupational categories, did not speak English or were non-white were more likely to walk to school. Several additional studies have found higher levels of walking for lower socio-economic status (SES) indicators (Larsen et al., 2009).

Gender is also often found within the AT to school literature. Males have consistently been found to be more likely to use AT than females (Babey 2009; Bungum et al., 2009; Larsen et al., 2009). Hume et al. (2009) found no significant difference between genders, but when segregated, found that more girls walked to school, while boys were more likely to bike. Carlin et al. (1997) found very little difference in overall walking levels between boys and girls, but found that boys were significantly more likely to cross streets unaccompanied. For Page, Cooper, Griew, and Jago (2010), boys had increased local independent mobility that was related to increased participation in everyday play, structured exercise, and AT, while for girls it was more about perceptions. To increase play and structured exercise among girls, they had to have positive perceptions of traffic safety. Timperio, Crawford, Telford, and Salmon (2004) established that boys had higher rates of AT but that girls were more worried about strangers and unsure of the safety of roads in their neighbourhood than boys were.

Just as gender and different perceived distances can influence other determinants of AT, so too do objective factors versus subjective perceptions. For example, with the above findings where boys were more likely to cross the street unaccompanied, was it

because they were born with a Y chromosome? Or was it because boys often have fewer fears, or because parents trust them more? In the case of connectivity, is it an individual's perception of having multiple routes to locations? Or do they take the same route all the time and not even realize that their neighbourhood has greater connectivity or intersection density? These are the types of questions that will be explored through this study. Several studies only look at the BE or perceptions of children and parents individually. Kerr et al. (2006) found in their study that both parent concerns and BE factors were associated with children`s AT to school. Therefore, this study will aim to understand the influence of both parent's and child's perceptions and not just the objective factors such as the BE and socio-demographics. The remainder of this chapter will focus on methodologies and results previously used in this area of study.

2.5 Perceptions & children's active travel

Parents' and children's perceptions of their built and social environments do not necessarily reflect the objective counterpart. For example, parents may restrict their child from riding their bicycle in the neighbourhood due to a fear that they will be struck by a motor-vehicle. Meanwhile, motor-vehicle collision (MVC) databases may report zero bicycle-to-motor-vehicle collisions in that neighbourhood over the last 25 years. Regardless of the objective realities, parents may hold onto perceived fears that will still prevent their child from cycling in his or her neighbourhood. Several components can impact both parent and child perceptions including their objective neighbourhood environments, past experiences, media, personal interests, and fears. Interpreting objective data can sometimes be difficult because of the lack of background information. For example, with the case of zero MVCs in the neighbourhood mentioned above, it is unknown whether the number is so low because traffic in that neighbourhood is legitimately not a danger, or because it is so dangerous that no one has ever attempted to cycle there, never allowing for a statistic to be created. This example supports the use of an ecological approach in order to understand the plethora of factors contributing to a decision such as whether a child uses AT to school or not.

The current body of literature on parents' and children's perception's influence on MOT to school has taken multiple approaches. Some studies have looked at the influence

of both parents' and children's perceptions on AT in general (Alton, Adab, Roberts, & Barrett, 2007; Hume et al., 2009; Kerr et al., 2006; Panter, Jones, van Sluijs, & Griffin, 2010a; Panter, Jones, Van Sluijs, & Griffin, 2010b), the decisions behind MOT choices (Faulkner, Richichi, Buliung, Fusco, & Moola, 2010; McMillan, Day, Boarnet, Alfonzo, & Anderson, 2006), physical activity levels among those who use AT (Carver, Timperio, & Crawford, 2008a; Page et al., 2010), or perceptions' influence on childhood obesity (Duncan, Johnson, Molnar, & Azrael, 2009; Galvez, Pearl, & Yen, 2010). Some of the research is more exploratory, considering multiple factors related to perceptions of social (McDonald, Deakin, & Aalborg, 2010) and physical environments (Kerr et al., 2006; Page et al., 2010; Timperio et al., 2004), while others narrowed their research to assess particular associations previously found within the literature. For example, D'Haese, De Meester, De Bourdeaudhuij, Deforche, and Cardon (2011), among others, looked specifically at distance between home and school (McDonald & Aalborg, 2009; Panter et al., 2010a; Panter et al., 2010b). Some studies, such as Carver et al. (2008a) and Duncan et al. (2009), focused solely on perceptions of safety. Meyer and Astor (2002) examined children's understanding of danger and potential harm they face on their journey to and from school within a high-crime and violent neighbourhood. Some studies looked only within populations of interest such a gender (McMillan et al., 2006; Page et al., 2010) or ethnicity (Duncan et al., 2009). Others compare objective factors to subjective perceptions in order to determine what, if any, relationships or associations existed between the two, and whether either were predictive in children's AT or other forms of physical activity (Kerr et al., 2006; Panter et al., 2010b; Timperio et al., 2006). After gaining a better understanding of what this body of research entails, a further look will now be taken at the methodologies and limitations.

2.6 Methods used in previous literature

Previous researchers have used a variety of methods to try to understand the intricacies of how perceptions influence MOT. A variety of studies have been conducted on different sample sizes with different characteristics, have been conducted using multiple methods for data acquisition and analysis, and have tested diverse outcome variables. The most common method for testing parents' and children's perceptions has been the use of

surveys and questionnaires (Carson, Kuhle, Spence, & Veuglelers, 2010; Evenson et al., 2006; Napier, Brown, Werner, & Gallimore, 2011; Zhu & Lee, 2009). The second most common, which in some cases is used in combination with the first, are interviews and/or focus groups (Joshi, MacLean, & Carter, 1999; Eyler et al., 2008; Meyer & Astor, 2002). Other methods have included story writing in combination with small discussion groups (Mitchell, Kearns, & Collins, 2007), walk-homes with children as they describe their thoughts along the way (Joshi et al., 1999), and photovoice, i.e., interviews where photos are taken by the children and used as the documents/data with narratives being used for clarification (Fusco, Moola, Faulkner, Buliung, & Richichi, 2012).

The sample sizes of previous studies have greatly varied and typically depend on the chosen research method. Within the reviewed literature, sample sizes ranged from 10 to 2695 for parents (average = 525) and 18 to 3451 for children (average = 856). The average age of children participating in such research was 10 years of age, with a minimum of age of 4 and a maximum age of 17.

Some studies only looked at children's perceptions, some only at those of parents, and others used a combination of the two. Parents were often included in studies pertaining to children between the ages of 4 and 14, likely due to their increased presence in decision making among that age group (Ahlport et al., 2008; Gielen et al., 2004; Meyer & Astor, 2002). According to Slovic (1966), a child psychologist, surveying both parents and children is appropriate as children become braver and more likely to start making their own leisure-activity decisions around the ages of 9 to 11. Darley and Lim (1986) found a significant difference between the decision making abilities of young children (aged 6 to 12 years) and adolescents (13 to 17 years). It is well supported that the level of parent involvement in decision making is likely to be different depending on the age and gender of the child (Timsley, Holtgrave, Reise, Erdley, & Cupp, 1995; Ward & Wackman, 1972). Several studies have in fact found age and gender to alter perceptions and influence MOT.

The types of surveys and questions used in this nature of study have differed greatly. A set of open access surveys called the International Physical Activity Questionnaires (IPAQ) are popular amongst physical activity researchers and were used by some of the reviewed studies (Gebel, Bauman, Sugiyama, & Owen, 2011). However,

the study of physical activity through AT, or the perceptions influencing its use, requires more specific questions than are available on that questionnaire. To understand themes around perceptions, most studies ask a variety of questions pertaining to a single topic of interest. For example, Panter et al. (2010a) asked 7 different questions about social cohesion and trust.

Analysis of such surveys becomes difficult because the number of questions per topic and the weight of influence held by each question can be difficult to measure. For street connectivity, the number of intersections within a buffered area can be calculated through GIS and is trustworthy due to its objective nature, but to measure a person's perception of connectivity requires asking questions about the ease of access to local resources, the number of route options to get place to place, and their knowledge of different routes.

Mota, Santos, Pereira, Teixeira, and Santos (2011) conducted a study where a single question was asked to determine perceptions of connectivity, walking/cycling infrastructure, the social environment, aesthetics, and recreational facilities; while 2 questions were asked about access to destinations and neighbourhood safety. It is hard to believe that a thorough representation of the subject's perceptions could be achieved by only asking one question about some of these topics. However, knowing how many questions are suitable for a full understanding is also difficult. It is important for a survey to ask the right questions to achieve quality information without asking too many and overburdening the participant. Having different numbers of questions per topic would give additional weight to those topics during data analysis. Keeping all related questions could also cause a problem of multicollinearity when used within a statistical model. It is then necessary to systematically decrease the questions into single domains of understanding.

The method of data reduction differs throughout the literature. For some studies, whichever question appeared to be the most representative or statistically significant during bivariate analysis was used to represent the subject (Rubin, Amlot, Page, & Wessley, 2009). Giles-Corti and Donovan (2003) summarized survey questions into three classes of determinants based on the individual, social, and physical levels of the socio-economic model. Within the three determinants, multivariate summary scores were

created to group potentially confounding variables into categories to improve their ability for cross-classification. Panter et al. (2010a) combined all of their questions into one composite score to represent a scale of less to more favourable walking environments. Neither of these papers, however, gave further descriptions as to how the summary/composite scores were created. Carson et al. (2010) gave a good description of their data reduction protocol. They used principal components analysis with varimax rotation to reduce 8 questions of neighbourhood perceptions into 3 components as identified with an eigenvalue >1. The three created scores were then divided into tertiles before further analysis. Dividing the components into tertiles may have allowed for easier analysis, but could also be seen as reducing the data further than necessary.

Most previous research pertaining to the influence of perceptions on AT only focus on perceptions and do not combine it with the BE. Some studies that have incorporated the BE include Panter et al. (2010a) who included distance and an urban/rural classification as controlling objective factors in their study. Timperio et al. (2006) looked at distance, as well as a busy-road barrier, route along a busy road, connectivity, and a steep incline on the route to school. Gebel et al. (2011) created a composite walkability index from dwelling density, street connectivity, land use mix, and net retail area ratio. The composite score was then turned into a decile to control for walkability.

Common controlling factors besides the BE usually included age, gender, and SES (Carson et al., 2010; Giles-Corti & Donovan, 2003; Panter et al., 2010a; Timperio et al., 2006). SES is most often determined based on household income or parental education, or in several cases by the mother's education (Timperio et al., 2006; Mota et al., 2011; Timperio et al., 2004). Other controlling factors have included family's ownership and number of vehicles, maternal travel mode to work, number of children living at home, marital status, English as a primary language, and dog ownership (Panter et al., 2010a; Timperio et al., 2006; Giles-Corti & Donovan, 2003; Timperio et al., 2004; Carson et al., 2010). Several of these factors could be avoided as they are representative of SES. For example, the number of owned vehicles and ownership of a dog likely correspond with income or SES.

To combine and control for multiple types of variables requires certain statistical procedures and often the development of a model. Some examples of this practice include Panter et al. (2010a) who used a multilevel modeling approach that took into account the non-independence of observations. One of their models looked at the effect of factors independently, adjusting for several controlling factors, and a second "best-fit" model that adjusted for all factors in the model. Timperio et al. (2006) used a multiple regression model, keeping objective and subjective variables separate. Mota et al. (2011) used a stepwise logistic regression to test independent associations. Giles-Corti and Donovan (2003) used an unconditional logistic regression analysis, and Timperio et al. (2004) used multivariate logistic regression. McMillan (2007) examined the relative influence of parent's perceptions and urban form on a child's travel mode to school, using binomial logit regression probability models to answer their research question. All variables were tested, only those found to be significant were kept, and then urban form variables were added to see the effect they had on parent perceptions.

There are many ways that the topic has been approached and analyzed, and each method has certain strengths and weaknesses. It is the goal of this thesis to build upon the strengths to gain a better understanding of the influences on children's MOT to school in the London area. The following section will now describe the key findings found throughout the literature on parents' and children's perceptions.

2.7 Key findings from perceptions literature

2.7.1 Socio-demographic

Perceptions have been found to differ between socio-demographic variables such as age, gender, ethnicity, and SES. Many of the studies did not directly compare perceptions by age of children, but found that as children grew older, they were more likely to use AT (Lorenc et al., 2008; Meron, Tudor-Locke, Bauman, & Rissel, 2006; Mitchell et al., 2007; Rodriguez & Vogt, 2009). Joshi et al. (1999) found that as age increased, children's freedom increased and parent's references to stranger danger decreased. Several studies found that perceived fears of the environment were higher for parents of girls than boys (Carver et al., 2008a; McDonald et al., 2010; Timperio et al., 2004), which has led to some studies being conducted with girls only as they are also less likely

to acquire their daily recommended MVPA or to use AT (Evenson et al., 2006; McMillan et al., 2006).

SES has been found to be an important influencing factor on parents' and children's perceptions as well as the use of AT. It is also a social determinant of health meaning that it affects many aspects of people's lives and well-being in addition to AT. Babey, Hastert, Huang, and Brown (2009) and Lorenc et al. (2008) found that lower-income families had children more likely to actively commute to school while D'Haese et al. (2011) found no difference between SES groups. Gielen et al. (2004) found that children in lower income neighbourhoods with high safety and crime risks were less likely to walk while children in higher income neighbourhoods, also with high safety risks, were more likely to allow their children to walk alone. Kerr et al. (2006) found that more children in high-income neighbourhoods with a high walkability score were more likely to use AT, but found no different in low-income neighbourhoods, regardless of their walkability.

2.7.2 Safety

Being part of a lower SES often means living in a less safe environment (Evans & Kantrowitz, 2002). Safety, and the perceived lack of safety, has been found to be a leading inhibiting factor for children's use of AT between home and school (Galvez et al., 2010; Kerr et al., 2006; Timperio et al., 2004). Parents involved in a qualitative study by Ahlport et al. (2008) defined personal safety concerns including stranger danger, allowing the child to walk alone, the presence of bullies, and immature judgment abilities of their children as factors restricting their children from using AT to and from school. Safety as an independent variable is very broad, it includes factors related to but not limited to crime rates, fear of stranger danger, and traffic. The majority of safety topics divide well into two categories: safety related to crime or social security, and traffic safety. The results and influences of each are different and will now be discussed independently.

2.7.3 Crime – Stranger danger/social safety

Stranger danger is a term referred to as the fear of abduction or kidnapping of a child by a stranger, which according to the Royal Canadian Mounted Police (RCMP, 2008) can also include relatives and close friends. When Joshi et al. (1999) surveyed parents and children (*n*=93), 31% of children and 90% of parents mentioned stranger danger as a barrier to AT. The occurrence of kidnapping on the journey to school is very rare, but as one parent stated in a study by Ahlport et al. (2008), "it's just not something I can allow myself to worry about" (p. 230), meaning they would rather restrict their child from using AT than worry about the potential of an abduction. The RCMP also mentions that public awareness of abduction is greatly intensified by media responses. Each time there is an occurrence, although rare, it sets in a level of panic across society. As parents are more likely to observe the news, and have a heightened level of security over their child, it is not surprising that their level of fear is so much higher than their children's.

2.7.4 Traffic

Traffic is one of the most consistent safety concerns identified in the literature (Gielen et al., 2004; Ziviani et al., 2006). Studies have found that children are often restricted from walking and cycling due to a fear held by their parents of injury from traffic (Grant, MacKay, Manuel, & McHugh, 2010; Rodriguez & Vogt, 2009; Saelens & Handy, 2008; Yiannakoulias, Scott, Rowe, & Voaklander, 2011). According to Joshi et al. (1999) 68% of children and 64% of parents referred to traffic danger as a barrier to AT. Several factors influence fear of traffic, including the speed and attention of drivers, weather, and traffic infrastructure such as cross-walks and intersections. While most of these factors are beyond the parent's control, parents can dictate the level of interaction their child has with traffic as well as the child's attitudes, decisions, and responses to it. Parents have the responsibility to teach children traffic safety rules and to assist in safe travel between home and school. Unfortunately, as seen by Gielen et al. (2004), this is not always effective. The results of their study observed the majority of parents teaching their children street safety techniques with only 16% of the parents knowing basic pedestrian safety facts themselves. A study by Wen et al. (2008) found 21% to 34% of parents agreed to the statement "My child hasn't got the road safety skills needed to walk to

school." Those that agreed to that statement were also more likely to drive their children to school.

Parents who do not use AT are also more likely to possess a macro-level view of their environment and a lack of awareness for the realities of their surroundings and the skills required for AT between destinations. Parents who do not use AT to work are also less likely to have children that use AT for the journey between home and school (Meron et al., 2006). This is unfortunate as children who walk more have been found to be more aware of their traffic surroundings, unsafe streets around their home, and showed a higher preference for MOT that were better for their health (Alton et al., 2007).

Children who use AT have more of a micro focus and connection to their natural environment whereas non-active commuters are more detached from their environment (Fusco et al., 2012). The findings of Fusco et al.'s study were displayed through the types of photos taken of their journey between home and school. Pictures by children using AT were journey focused; pictures of nature, signs, etc. Non-active commuters often only took photographs related to traffic and their destinations; they were very car oriented.

Age has been found to influence perceptions of fear related to traffic safety. It has been found that as a child grows older, the fear of traffic diminishes, as does the risk of an accident (Warsh, Rothman, Slater, Steverango, & Howard, 2009). These results demonstrate that a parent's fear of traffic is reflective of both the age of the child and reality. While the cognitive processing and attention skills necessary for making safe decisions (e.g. how to approach traffic, scan for visual hazards, and how to judge and choose appropriate routes) are often tied to age, Barton and Morrongiello (2011) found that is not necessarily true, as such a skill-set must be taught and learned and can be done at any age.

Children are most likely to walk if both the parents' and children's perceived barriers to walking are few (Napier, Brown, Werner, & Gallimore, 2011). It is assumed that the fewer objective barriers, the fewer perceived barriers will also exist. Several BE factors can help lower the risk of traffic danger for children including adequate sidewalks, short distances, safe terrain, routes that avoid main roads, crossing guards, sufficient traffic lights, and pedestrian crossings (Ahlport et al., 2008; Hume et al., 2009). Gielen et al. (2004) found that ensuring safe routes for walking to and from school and

protecting children from risks of injury were necessary to increase walking among children. While parents may fear children being alone in their neighbourhood, several parents also state that friendly neighbourhoods with more active commuters and people they know, increased their likelihood of allowing their children to use AT between home and school (Fusco et al., 2012; Hume et al., 2009; Panter et al., 2010a; Timperio et al., 2006).

2.7.5 Perceptions of distance

Panter et al. (2010a) identified safety concerns as the most important factor for longer commutes, while personal attitudes were most important for short distances. As discussed previously, distance is the primary influencing objective factor on children's use of AT, however, it is also quite evident that perceptions of distance play a key role in children's MOT to school. The literature is consistent in stating that the shorter the distance between home to school, the more likely a child is to use AT (Babey et al., 2009; Galvez et al., 2010; Larsen et al., 2009; Meron et al., 2006; Napier et al., 2011; Rodriguez & Vogt, 2009; Zhu & Lee, 2009). Certain distances have been assigned as reasonable distances for young children to use AT such as the TVDSB's busing cut-off of 1.6km. Some children simply do not have an option to use AT because they live too far away from school. The difficultly, however, lies in knowing how far a "reasonable" walking distance is.

Timperio et al. (2004) found that parent's perceived 1.5km as an appropriate walking distance for children ages 5 to 6 years, and 1.6km for children 10 to 12 year olds. Oddly enough, this distance did not increase significantly by age. In a study by D'Haese et al. (2011), it was found that the number of students aged 11 to 12 that passively commuted to school did not exceed those using AT until 2.01-2.5km. Timperio et al. (2006) on the other hand found that children were more likely to actively commute to school if their route was less than 800 metres. It is apparent through the literature that parents' and children's perceptions of acceptable distances differ. Regardless of the specific distance between home and school, it is important to keep perceptions in mind and look into ways of decreasing this distance through the development of paths, or

making it appear shorter through improvements to the quality of the journey through aesthetic improvements such as planting street trees along the route.

Other factors that have been found to be associated with children's AT to school include time management or restraints, siblings with alternate schedules, convenience, seasonality/weather, neighbourhood aesthetics, peer pressure, school influences, personal preferences, children's independence level, and school bus availability (Ahlport et al., 2008; Lorenc et al., 2008; Meron et al., 2006; Zhu & Lee, 2009). Zhu and Lee (2009) found to increase children's AT would require positive attitudes by parents and children towards AT, regular walking behaviour, and supportive peer influences.

2.8 Conclusion

This chapter has examined the academic literature pertaining to factors influencing children's use of AT to school. While the research question pertaining to this thesis directly asks about the influence of parents' and children's perceptions of their environments, background information and objective BE factors were also discussed as they are all viewed as interrelated within an ecological framework. The lack of methodological cross-over between the study of perceptions and the objective environment generates a necessity to include both within a statistical model to fully understand the influence of parents' and children's perceptions on MOT to and from school. While some findings, such as distance, have been found to be consistent throughout the literature, many of the results are still in disagreement, and therefore more research on the topic is required to fully understand the role of parents' and children's perceptions on AT. It is the aim of this study to gain insight into how these perceptions influence children's MOT to and from school to build upon the current literature and help influence programs and policies at multiple levels to aid in the increase of children using AT to and from school.

Chapter 3

3 Methods

The subject of parents' and children's perceptions and environments' influence on children's journey to school has been examined through a variety of research methods. Several researchers have examined how the built environment (BE) influences children's journeys to and from school using Geographic Information Systems (GIS; Maddison et al., 2009; Larsen et al., 2009; McMillan, 2005). Qualitative research approaches have also been used to gain a better understanding of parents' and children's subjective views of their surroundings. It has been determined that both objective factors (such as distance, presence of sidewalks, and residential density) and environmental perceptions (such as perception of distance or presence of sidewalks) effect children's use of active transportation (AT; Kerr et al., 2006). Some studies have looked at the differences between perceptions set against objective realities. Other studies considered parents' versus children's perceptions. No studies, to our knowledge, have specifically reviewed how the differences between parents' and children's perceptions and objective factors effect children's mode of travel (MOT) to school (Bungum et al., 2009; Eyler et al., 2008; Galvez et al., 2010; Gielen et al., 2004; Kerr et al., 2006).

In order to answer the thesis question of *"how do parents' and children's perceptions of their built and social environments influence MOT to and from school?",* current methodologies were built upon by including significant BE variables, controlling factors, and factors associated with parents' and children's perceptions of their built and social environments into a single model. Two versions of a step-wise logistic regression were conducted to determine which aspects of those three influencers were most relevant in determining a child's choice to use AT on the journey to school versus home from school.

The first portion of this chapter, entitled *Data Acquisition & Management*, will discuss the research study conducted for data collection, the source and development of the youth and parent surveys, and the preparation and management of datasets. The second section, *Statistical Comparisons and Correlations*, will identify the statistical

analyses used to describe, compare, and assess for differences between perceptions of parents versus children, and correlations between perceptions and the child's MOT to and from school. The third and final segment of the chapter, *Objective vs. Subjective Model of Influence,* will introduce the controlling factors and objective variables of the BE analyzed in combination with the parents' and children's perceptions through a step-wise logistic regression model.

3.1 Data acquisition & management

3.1.1 The STEAM Project

The primary source of data obtained for this analysis was through the STEAM (Spatial and Temporal Environmental and Activity Monitoring) Project. STEAM is a study being conducted by the Human Environments Analysis Laboratory (HEAL) under the direction of Dr. Jason Gilliland in the Department of Geography at the University of Western Ontario (UWO), and jointly funded by the Heart & Stroke Foundation of Canada and the Canadian Institutes of Health Research. The overarching goal of STEAM is to gain a better understanding of the built environment's impact on children's health and well-being. The study works with children between grades five and seven to understand elements of neighbourhood environments that can help or prevent a child's family to engage in healthy lifestyles and other health-related behaviours.

The STEAM Project uses multiple observational tools to assess children's eating, physical activity, environmental perceptions, and travel patterns. These tools include portable Global Positioning System (GPS) units, accelerometers, parent and child surveys, and activity diaries. The STEAM study was instrumental in delivering and acquiring parent and youth surveys that included environmental and behavioural questions related to children's journeys to and from school.

3.1.2 Location

The studies were conducted in schools in the London, Ontario area in Spring of 2010, 2011, and 2012. The completion of surveys during the same time of year controlled for variations experienced within Canadian climates. London is a mid-sized Canadian city with a population just exceeding 350, 000 (Statistics Canada, 2012c), making it a

comparable city to other mid-sized cities within a Canadian context. There are two primary school boards in London and surrounding area: the public school board, Thames Valley District School Board (TVDSB); and, the catholic school board, London District Catholic School Board (LDCSB). The STEAM Project and preceding surveys conducted by the HEAL, which will be discussed later, have been conducted in both school boards and in a variety of locations across the city. The locations of participating schools represent a full variety of social environments in the city. Figure 2 displays the location of schools in the context of neighbourhood socioeconomic status (median household income) and level of urbanicity.

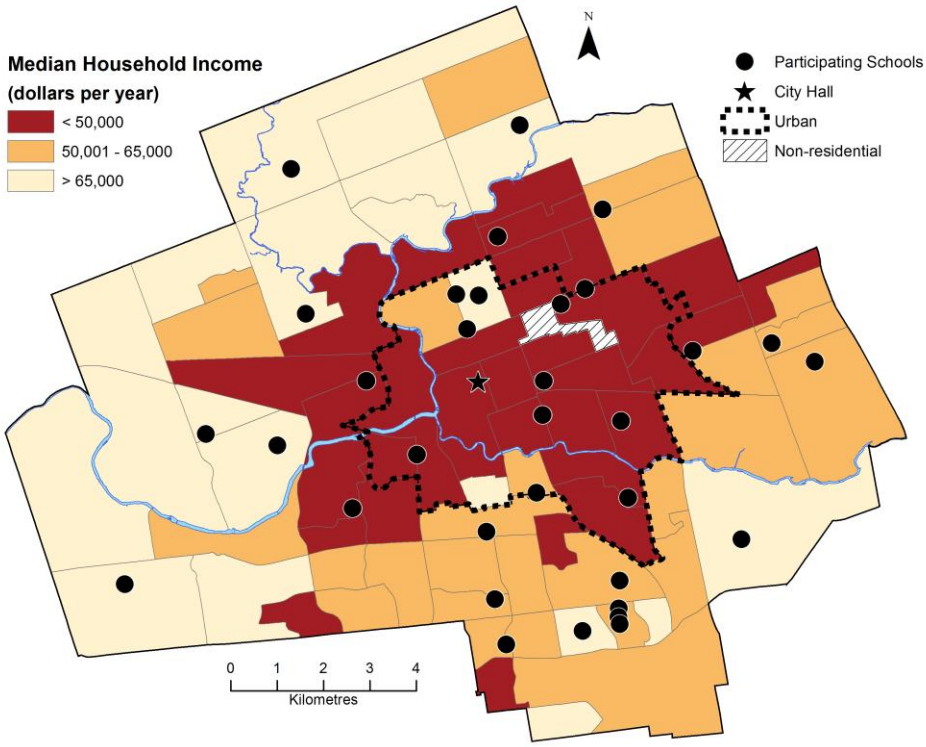


Figure 2 Study schools locations in the context of neighbourhood socioeconomic status and level of urbanicity

3.1.3 School recruitment

Before the study commenced, UWO ethics and authorizations from the two school boards were obtained (See Appendix A-C for UWO ethics approval). Following approval, the next step was to recruit schools for participation. A list of priority schools was created and school Principals were contacted by telephone by a HEAL member. Schools were identified as high preference or priority based on the following factors: grade in which the school ended, the enrollment numbers for children in grades 5 to 7, support or interest in the study by a Principal, the BE (urban vs. suburban), and the social environment (SES, ethnic diversity, access to amenities, etc.). When contact with a Principal failed after two attempts or after a Principal expressed interest, a follow-up email was sent including a description of the project, proof of ethics approval, a document entitled "What to Expect for Principals and Teachers", a copy of a media release in the Heart & Stroke Newsletter, and a letter of support from a Principal involved in the pilot study. Once a school committed to take part in the study, a presentation was made to students eligible for participation.

3.1.4 Student recruitment

The presentation made to students described the study and the steps involved in participation. Packages for parents were distributed including study information, a consent form, and a copy of a parent survey. Students were asked to bring back the consent form and survey sealed in the provided envelope within 4 days. Parental consent was required for student participation in any portion of the study. Children could decline participation, take part in the survey portion of the study only, or take part in the full study that included the use of the GPS units and accelerometers. The return of the parent survey was not mandatory for a student to participate in the study but was strongly encouraged.

3.1.5 Parent & youth survey development

Previous studies have used methods such as focus groups, interviews, and story writing, but the most common method, as well as the method best suited to acquire perceptions of a large audience, is that of surveys (Ahlport et al., 2008; Faulkner et al., 2010; Galvez et

al., 2010; Mitchell et al., 2007). The development of the parent and youth surveys for the STEAM project progressed from two earlier studies conducted by the HEAL in London, Ontario that were not as exhaustive. As the surveys evolved, questions were added, removed, and/or altered based on the quality of answers and their usefulness for answering research questions. The full survey included questions regarding the journey to school, perceptions of home and school environments (physical and social), eating and activity habits and rules, weather, safety, play, and individual-level social and demographic questions including postal code. The portions of the surveys from the most recent version of the parent and youth surveys used for this thesis can be found in Appendices D and E.

Questions were developed based on hypothesized relationships, their existence in prior literature, or their nature as necessary socio-demographic controls. The child's primary MOT was asked for the journey to and from school with the following provided options: walking, cycling/rollerblading, skateboarding/scooter, car, school bus, city bus. Other MOT questions included whether the child travelled with other children or adults to or from school, and what their preferred MOT would be if they could have their choice. Questions pertaining to perceptions were categorized by safety related to crime, safety related to traffic, built environment factors, or personal attitudes related to the journey to or from school.

More questions were asked than were previously found in the literature as a way to explore the possible range of barriers to children's AT. Several questions were asked specifically about barriers to AT to school including "I get too hot", "I have too much to carry", or "I find it boring." Multiple questions related to perceptions of the BE, traffic, and crime were asked to explore the specific concerns within each topic. For example, to examine perceptions of the BE, questions were asked related to 'connectivity' of the street/movement network (i.e., "There are multiple ways to get places in my neighbourhood") and walking and cycling infrastructure (i.e., "There are bicycle lanes or trails in or near my neighbourhood that are easy to get to," "there are enough sidewalks on streets in my neighbourhood"). For crime, questions were asked regarding a child being alone in the neighbourhood versus with friends, the level of trust that adults will watch out for children in the neighbourhood, the fear of stranger danger, and a general

perception of their neighbourhood crime rate. Traffic questions related to the speed and volume of traffic, as well as the fear of playing, walking, or biking in or near streets in their neighbourhood.

Earlier versions of the HEAL surveys lacked a large portion of perception questions as they only asked parents for socio-demographic information and a few crime related questions. After the initial studies where these were executed, it became clear how important it was to include parents' perceptions to compare with children's as well as understand their influence on children's decision to use AT to school. Several studies previously conducted only asked questions of parents or children independently. This would allow for a deeper understanding of that population group, but not allow for their interaction with each other (D'Haese et al., 2011; McDonald et al., 2010; Page et al., 2010; Zhu & Lee, 2009). For this reason, all STEAM parent surveys had the same perceptions questions as the youth survey used for the children. Table 1 can be referred to for the full list of questions retained from the surveys for analysis and whether they were asked of children, parents, or both.

Table 1 Parent and youth survey questions used for analysis

	Youth Survey	Parent Survey
General Information		
Gender	*	*
Age	*	*
My family is a 1) single-parent household, 2) two-parent household, 3) other	*	*
I 1) live in one home, 2) split my time equally between 2 homes, 3) life mostly at one, visit another, 4) other	*	*
Race	*	*
Mother's highest level of education		*
Father's highest level of education		*
Number of owned vehicles	*	*
Live within walking distance	*	*
Time it takes to get to/from school	*	*
Barriers to Active Travel to/from School		
Not allowed to walk	*	*
Not allowed to bike	*	*
It is too far or takes too much time	*	*
There are not enough sidewalks	*	*

There are not enough bike paths/lanes	*	*
The route is boring	*	*
It feels unsafe due to traffic on the route	*	*
There are too many busy streets to cross	*	*
Child gets too hot and sweaty	*	*
There is no one to walk with	*	*
It's not fun/cool to walk	*	
Child has too much stuff to carry	*	*
It is easier for someone to drive them there	*	*
It feels unsafe because of crime (example: strangers, gangs, drugs)	*	*
Child might get bullied or teased along the way	*	*
Child is too young		*
Streets in my Neighbourhood		
There are enough sidewalks on the streets in my neighbourhood	*	*
There are walking trails in or near my neighbourhood that are easy to get to	*	*
There are bicycle lanes or trails in or near my neighbourhood that are easy to get to	*	*
There are lots of trees along the streets in my neighbourhood	*	*
Neighbourhood Safety		
It is safe for my child to play outside in our neighbourhood		*
I am afraid of child being taken by a stranger when with friends or siblings		*
I can count on adults in the neighbourhood to make sure that children are safe and don't get into trouble		*
When I'm away from home, I know that neighbours will keep their eyes open for possible trouble		*
There is so much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street		*
Most drivers go too fast while driving in our neighbourhood	*	*
There is a lot of crime in my neighbourhood	*	*
It feels unsafe to walk by myself around my neighbourhood during the day	*	*
It feels unsafe to walk with friends or siblings around my neighbourhood during the day	*	*
I am worried about being or walking alone in my neighbourhood and local streets because I am afraid of being taken or hurt by a stranger	*	*
My parents are afraid I will be taken by a stranger if I'm alone	*	
Your or Your Child's Trip To and From School		
Do you live within walking distance?	*	*
How long does it usually take you to get to/from school each day	*	*

What is your primary mode of travel to school? (walk, bicycle/scooter, skateboard/rollerblade, car, school bus, city bus)	*	*
What is your primary mode of travel from school? (walk, bicycle/scooter, skateboard/rollerblade, car, school bus, city bus)	*	*
Who do you usually travel to and from school with? (nobody, parent(s), other adult(s), brother(s) or sister(s), friend(s), other student(s))	*	*
If you had your choice, how would you/your child most like to get to school each day?	*	*
When you were a child, how did you typically travel to school?		*

Notes:
Survey questions within Table are categorized by survey sections
Surveys located in Appendix D (children) and E (parents)

3.1.6 Data management

All surveys conducted by the HEAL were entered into Microsoft Excel and imported into STATA 11 for cleaning and merging into one dataset for analysis. Due to alterations between surveys, variables had to be matched and some recoded as the values representing answers could be different within similar questions. For example, the basic question of whether a child is allowed to bike to school was asked in two different ways across the surveys. In one case the question was posed as a 4-point Likert scale "I am/my child is not allowed to bike to school" where 0 equaled strongly disagree, 1 - disagree a little, 2 - agree a little, and 3 - strongly agree. In the final version of the survey it was a basic yes or no question as to whether the child was allowed to bike or not, with 0 representing no, and 1 indicating yes. This question therefore had to be recoded and merged as one question representing whether the child was allowed to bike or not. After all questions were compared and matched, wherever possible, all parent surveys were merged with the child data by survey and ID number to create a complete dataset with matching parent and child responses.

3.2 Statistical comparisons & correlations

Descriptive statistics and frequencies were obtained for each variable for both parents and children. The perceptions questions were primarily composed of 4-part Likert scales ranging from strongly disagree to strongly agree but were dichotomized into

agree/disagree for conducting bivariate analysis and chi-square analysis. The original question asking children's MOT to and from school included several modal options that were also broken down into active or passive MOT for the same purpose. Parents' and children's responses to mutual questions were matched to test for likeness of responses through chi-square. Tests were conducted in both directions between home and school to detect differences in the influences on their mode *to* school versus *from* school. P-values were obtained from each statistical test to identify those of statistical significance ($p<=0.05$).

A second assessment using the same statistical tests as above was conducted to include only those subjects living within walking distance of their school. Due to the significance distance plays as a factor inhibiting children's use of AT to school, all children living outside of walking distance were removed from the remainder of analysis. To determine which subjects were within walking distance of their school, any children residing further than 1.6km (measured 'as the crow flies') from their school were excluded. GIS was used to determine the distance between a child's home and school; for children participating in the STEAM project, the location of their home was determined by the spatial mean of their GPS tracks. Where GPS points were not available, the location of the child's home was designated as the centroid of their postal code listed on their survey. Postal code was used as a proxy for home address as the university research ethics board did not allow collection of full addresses. Nevertheless, previous research in London has shown that postal code centroids are a sufficiently accurate proxy for home location when exact civic address is not available (Healy & Gilliland, 2012); however, there may be some under- or over-estimation of distance between home and school based on this method.

The distance of 1.6km was chosen based on the busing cut off by the TVDSB of 1600m (i.e., bus service is provided to all kids who live beyond 1.6km from their school). A Euclidean distance was used instead of a network distance (i.e., shortest route along the road network) as this best approximates the method local school boards use to determine distance thresholds. To further improve the process of identifying children who live within walking distance, children that stated using a school bus for even one trip between home and school in a week were removed from the remaining sample while those that

reported an active mode even once were brought back into the sample if they had already been removed due to distance. Children who used a school bus were removed because it meant they were eligible for busing and therefore lived outside of 1.6km from the school. This allowed extra precision to correct for the slightly extended boundary caused by the use of postal codes. All subjects remaining in the sample were flagged as "within walking distance" and were used for the remainder of data analysis.

Frequency distribution tables of individual and socio-demographic variables were created and cross-tabulations were used to compare with children's MOT (active or passive). Socio-demographic variables under examination included the child's gender, age, and ethnicity, as well as family type, living arrangement, and number of owned vehicles in the family. Additional variables were created for analysis with MOT to and from school, including parent's education level and urbanicity (i.e., urban versus suburban) of each subject's home and school environment.

Parental education is one of the most important measures of SES (Backlund, Sorlie, & Johnson, 1999). Educational attainment is closely associated with lifestyles and behaviours as it influences knowledge acquisition and social skills attributed to earning potential (Matthews, Kelsey, Meilahn, Lewis, & Wing, 1989). Some studies will actually refer to parental education as "SES", but as this is not the only possible measurement, the variable will be referred to as "parental education" throughout this thesis. Maternal education is most commonly used as the measure of SES; however, this misses the importance of paternal education. Therefore, parental education was measured using both mother and father's highest level of education. Each mother and father was categorized based on maximum level of education: 1) high school or lower, or 2) high school plus additional qualifications (e.g., college or university). The two variables were then combined to create a three-category variable consisting of: 1) both parents with an educational attainment level greater than high school, 2) one parent with an above high school level education, and 3) two parents with high school or less.

Urbanicity of the child's home and school environment was identified by first determining location in GIS using the GPS spatial means or postal code centroids, as described above. Each location was identified as one of urban, suburban, or rural. Urban areas correspond to neighbourhoods in the City of London built primarily before World

War II; suburban neighbourhoods are areas built following World War II that fall within London's contemporary urban growth boundary; and rural areas are locations beyond the urban growth boundary (Healy & Gilliland, 2012).

3.3 An objective vs. subjective model of influence

The current literature comparing the differences between parents' and children's perceptions often lacks the connection with BE factors. The research question in this thesis asks how perceptions influence children's MOT to/from school; however, it is also argued that to truly understand the influence of perceptions on children's MOT, objective BE factors must be controlled for as they have also been found to be associated with children's use of AT to school. A step-wise logistic regression model was designed to control for statistically significant BE factors among this population. The model will assist in determining whether BE factors are stronger or weaker predictors of children's AT to school than parent and/or children's perceptions. The following paragraphs will describe the methods used to measure the objective BE factors and assess their associations with children's AT to and from school. The development of perception factors for use in factor analysis will be described as well as the process of the step-wise regression model used to determine the variables of greatest influence on children's MOT to and from school.

3.3.1 Measurement of objective variables

Objective factors were chosen based on their significance in previous literature and their existence as a question in the perceptions portion of the parent or youth surveys. A list of the objective variables can be found in Table 2. Objective counterparts to personal attitudes or crime were not available and therefore they were not included as objective factors within the model. Available complementary objective variables pertained to the BE and traffic.

Table 2 Measurements of objective variables

Variable	Method of Measurement
Network Distance	Shortest road network distance between child's home and school
Major road length	Length of roads with higher than average traffic volume (1100 cars/day)
Multiuse path area	Surface area of multiuse paths
Bike lane length	Total length of bike lanes / buffer area
Sidewalk to road ratio	Length of sidewalks / total road length
Street tree density	Number of street trees within 25m of street centre line / length of roads
Intersection density	Number of intersections / buffer area
Intersection ratio	Number of intersections / total road length
Traffic volume	Maximum traffic volume at any one location within the buffer at one time
Land use mix	Proportion of land classifications with 0 representing single land use and 1 being equal distribution of all land uses
Dwelling density	Number of private dwellings / buffer area
Residential density	Number of private dwellings / area of residential land use

Measurements of objective variables were conducted using ArcGIS10. Two buffers were used to calculate each variable for every child, which were 1) the child's immediate home location, and 2) their overall school environment. The child's home environment was determined by a 500m (Euclidean distance) circular buffer around the child's home location. A buffer distance of 500m was chosen to represent the child's neighbourhood due to previous use in similar research (Larsen et al., 2009). The school environment was calculated using a 1.6km Euclidean distance circular buffer around each school's address. The distance of 1.6km was chosen based on its use for identifying children who are within walking distance of their school.

It is understandable that the factors influencing walkability differ for adults and children; however, a review of studies focused on children's AT also reveal considerable disagreement on significant factors (Saelens & Handy, 1008). Kerr et al. (2007) found that residential density, mixed-land use, and distance influenced children's walkability, while Bungum et al. (2009) identified intersection density, Davison and Lawson (2006), sidewalk ratio, and Larsen et al. (2009), street tree density, mixed-land use, and distance. Due to the lack of agreement on which BE factors influence children's journey to school, a large number were measured to identify which were influential for this population.

Although children outside of 1.6km from the school were removed from the dataset, a more precise measurement of distance between the child's home and school

was obtained since it is one of the most commonly found deciding factors among the literature. The inclusion criteria for determining children within walking distance of school used a Euclidean distance; however, a network distance from home to school was calculated to determine the shortest road network between the child's home and school. While this does not account for possible off-road shortcuts or paths, it does account for different neighbourhood structures such as whether a child lives in a grid-patterned street neighbourhood (typically urban), or within a suburban community with an irregular shaped road network with poor connectivity or route options.

Intersection density, residential density, and mixed-land use are key components of several walkability indexes related to AT for adults (Owen, Humpel, Leslie, Bauman, & Sallis, 2004). They are often not as influential on children's AT, but since being found in at least one relevant study each, they were included in this study (Bungum et al., 2009; Kerr et al., 2007). Two measurements representing the number of intersections were calculated to include different methodologies. Intersection density was calculated by dividing the number of intersections by the buffer area, while intersection ratio was established through dividing the number of intersections by the total road length in kilometres.

Residential density and dwelling density are sometimes referred to synonymously, but at times their method of calculation differs between articles; therefore, two variables representing population within the buffer areas were also calculated. Dwelling density was defined as the total number of private dwellings divided by total area; whereas, residential density was defined as the total number of private dwellings divided by the total area of residential land use.

The land use mix variable was calculated first, by classifying each parcel of land into 6 broad classes as defined by the City of London (recreational, agricultural, residential, institutional, industrial, and commercial). The total area of each classification within the buffers was calculated, and the following entropy index was used to determine the land use mix within the children's home and school buffers (Frank, Andresen, & Schmid, 2004; Larsen et al., 2009; Leslie et al., 2007):

$$\text{Land use mix} = \sum_u (p_u \times \ln p_u) / \ln n$$

Within the formula, u represents the classification of land use, p is the proportion of land dedicated to a specific land use, and n is the number of land use classifications. The use of this equation results in a score between 0 and 1, with 0 signifying a single land use and 1 representing an equal distribution of all land use classifications. (Larsen et al., 2009)

The presence of sidewalks was measured by dividing the total length of sidewalks within the buffer area by the total road length. A maximum number of 2 represented sidewalks being present on both sides of all roads within the buffer area. The presence of bike lanes and multiuse paths have not been tested within the literature with regards to children's use of AT to school, but due to their increasing presence in the City of London (2012), they were included in the survey perceptions questions, and were included in this assessment. Bike lane lengths were measured by dividing the total length by the buffer area, while multiuse paths were represented by their surface area within the buffer.

A previous study conducted by the HEAL found street tree density to be positively correlated with children's AT to school (Larsen et al., 2009). Street trees are defined as any city-owned tree within 25m from the street centre line. Street tree density was calculated by dividing the number of street trees by the total length of all roads within the buffer to give a number of trees per 1km of road.

Major roads were identified and lengths measured to objectively reflect the survey question asking "it is difficult to walk/bike to school because there are too many busy streets to cross." Busy streets in this case were defined by major roads in the home and school buffer areas. Although an arterial road network exists for London, using them to represent "busy roads" would not capture many of the roads perceived as busy. The definition of a major road can be quite subjective and can also vary in different parts of the city. Therefore, for purpose of this paper, a major road is defined as any road segment which encompasses a higher than average traffic volume (1100 cars/day), according to City of London traffic volume data.

The maximum traffic volume was also measured for an objective comparison of busy roads and fear of traffic perceptions. This variable represents the maximum traffic volume at any one location within the buffer area at one time. The speed of traffic on the other hand could not be objectified as the majority of roads in London are posted at 50km/h and there is no efficient way to measure the level of speeding.

3.3.2 Controlling factors

The controlling factors included in the model were age and gender of the child, and parental education. Age and gender have been found to be relevant in previous literature and are common controlling factors. Children's ages were compressed into 3 age categories to include children 7-11, 12, and 13 to 16 years of age. The age categories were divided as such due to small number of children lying outside of the ages of 11 to 13. The ages of participants ranged from 7 to 16 years of age but only 10 children were age 7, 29 were 8 years old, and 2 were older than 14 years of age. The 3 category variable was used to control for age within the model. Parental education, while not statistically relevant within this sample against MOT, was significant when cross-tabulated with individual perception questions and was therefore retained as a controlling factor.

Other objective characteristics such as number of owned vehicles, family and living arrangement (e.g., single vs. dual parent household; one living location vs. split time between homes) were not included as controlling factors as they did not appear relevant to either the child's MOT or to responses to perception questions. While the number of family vehicles did come out as significant, it was not included since it was associated with SES, which was captured through parental education.

3.3.3 Creation of perception factors & model running

As previously discussed, more questions were asked within each category of perceptions than were necessary. Since multiple questions were asked to more fully understand the particular aspects of each grouping, multicollinearity would have resulted if entered into logistic regression simultaneously. Instead, factor analysis was used to distinguish the relationships and structure between variables and reduce the number of variables into one representing factor (StatSoft, 2012).

Confirmatory factor analysis was used to test the validity of the hypothesised categorization and interrelationships between variables (Onsi, 1973; Stern et al. 2012). Principal component factor analysis was conducted using a polychoric correlation matrix due to its identification as the ideal method of variable reduction amongst ordinal data (Holgado-Tello, Chacon-Moscoso, Barbero-Garcia, & Vila-Abad, 2008; Kolenikov & Angeles, 2004).

Kaiser's criterion was used to only retain factors with an eigenvalue greater than 1 (StatSoft, 2012). Cronbach's alpha was used to analyse the internal reliability of the hypothesised variables in each grouping and pairwise correlation coefficients were calculated between all variables within each group to display the level of correlations and statistical significance between each set of variables (Stern et al., 2012). Cronbach's alpha is presented as a number between 0 and 1 with a value closer to 1 meaning the items being measured are testing the same concept or construct to a greater extent (Tavakol & Dennick, 2011). A threshold of 0.7 was used to represent an acceptable internal consistency as supported by Nunnaly (1978). The only factors prevented from being established due to low Cronbach's alpha ($\alpha < 0.7$) were the BE perceptions for both parents and children. A single variable thought to best summarise the factors was chosen to be used in further analysis as suggested by Rubin, Amlo't, Page, and Wessley (2009).

Bivariate analysis and paired t-tests were used to calculate the associations between each of the objective BE variables and perception factors with children's MOT to and from school. Those that were found to be statistically significant, along with control factors, were entered into a stepwise multiple regression model to determine which factors were most influential in children's use of AT (So & brush, 2008).

Two separate models were run for the journey to school (Figure 3) and the journey from school to home (Figures 4). The process of running these two models was the same. Each model started by running each grouping of factors associated with 1) objective factors, 2) parents' perceptions, and 3) children's perceptions, independently. Odds ratios and p-values were obtained for each variable. Within each stage of the model, Pseudo R-squared, Akaike information criterion (AIC), and Bayesian information criterion (BIC) were calculated to determine the relative contribution of each step (Stern et al., 2012).

Each model combined the original stage of the model into pairings with each of the other two categories of factors to obtain the following pairs with the same calculations being conducted:

1) parent perceptions with child perceptions;

2) parent perceptions with objective variables; and

3) child perceptions with objective variables.

A final model was run to include factors from all three categories with variables eliminated if the Pseudo R-squared was not altered more than 0.0125. While this number is not supported in the literature, it was used as a threshold to eliminate a sufficient number of non-contributing variables from the model to function with the final sample size for both to and from school.

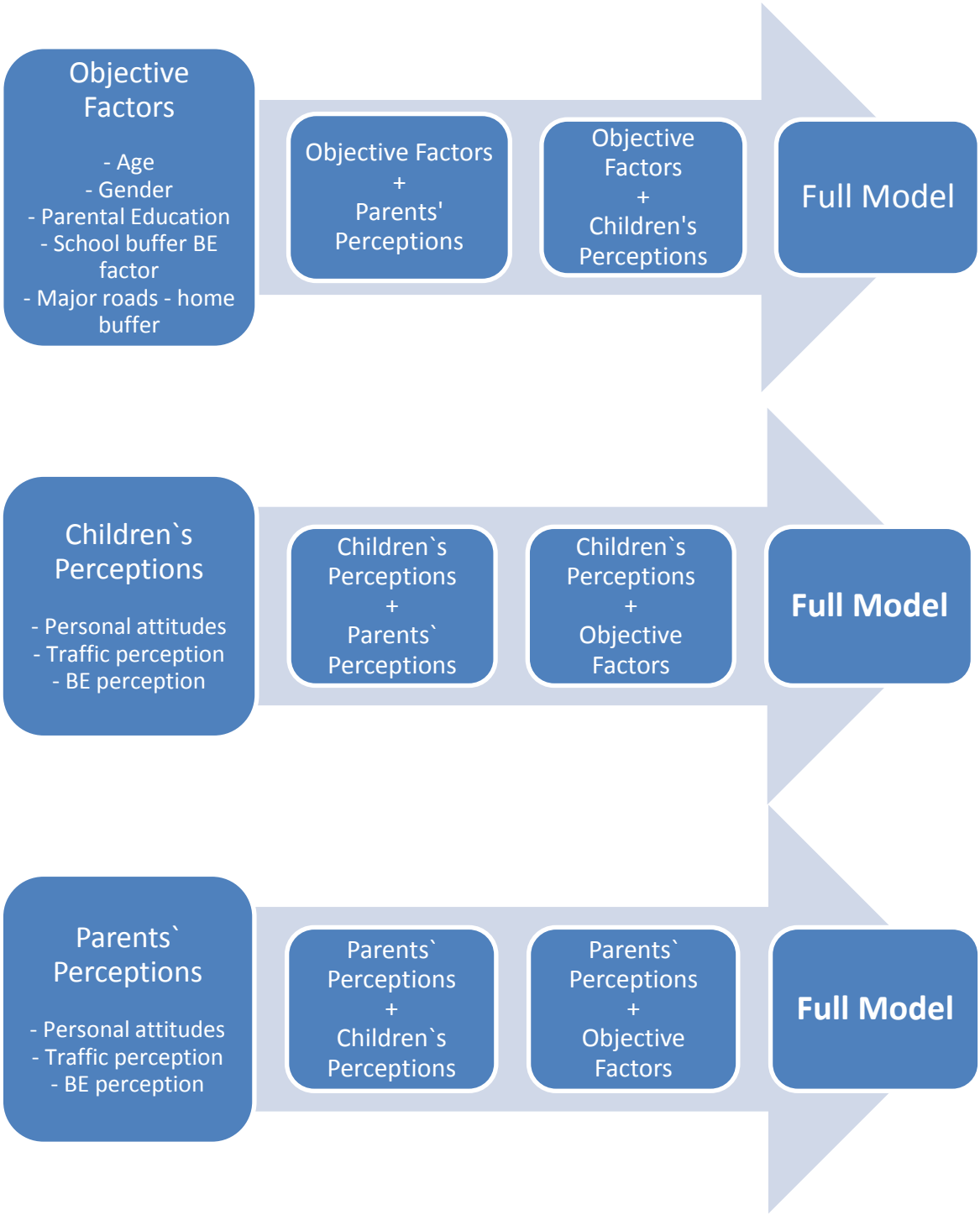


Figure 3 Step-wise logistic regression model diagram for journey *to* school

Step-wise Logistic Regression Models for Journey *FROM* School

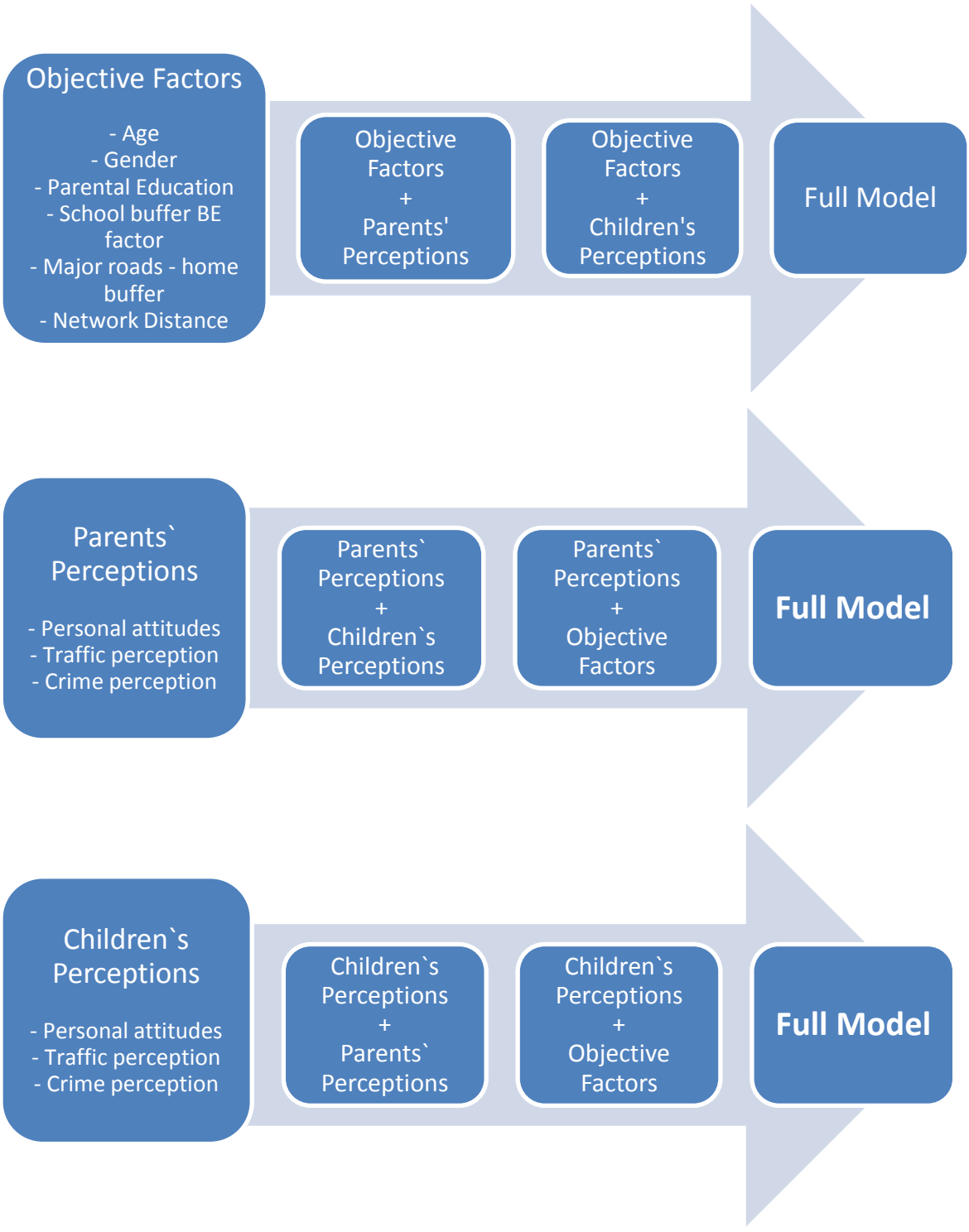


Figure 4 Step-wise logistic regression model diagram for journey *from* school

3.4 Conclusion

No study to date has combined all three of parents' perceptions, children's perceptions, and objective BE factors in one model, particularly taking into account the possible difference in influencers on the journey to versus from school. The use of factor analysis has also allowed for the representation of all perception questions to be included in the model. Calculating BE variables within both home and school buffers also allowed the influence of both environments to be captured within analysis. The use of these mixed-methods will add to the current literature and be useful for urban planners and health professionals to know what aspects of the environment, built and/or social, to focus on when conducting policy and program development.

Chapter 4

4 Results

This chapter will discuss the results of the analyses described in the previous chapter, which aimed to uncover how parents' and children's perceptions of their built and social environments influence children's mode of travel (MOT) to and from school. The chapter begins with a description of sample characteristics and then is followed by a report of descriptive statistics of survey responses, including the differences between parents' and children's responses, and an examination of the associations among parents' and children's responses with children's active travel (AT). The second portion of the chapter will examine the results of the step-wise logistic regression model used to assess the level of influence each category of objective factors, parents' perceptions, and children's perceptions, had on children's use of AT.

4.1 Sample characteristics

Thirty-two schools took part in "healthy neighbourhoods" surveys conducted by the Human Environments Analysis Laboratory (HEAL). Of the participating schools, 11 (34.5%) were located in urban neighbourhoods, 19 (59.4%) within suburban neighbourhoods, and 2 (6.3%) from rural areas outside the city limits. Fifteen (46.9%) schools came from the catholic school board (LDCSB) and 17 (53.1%) from the public school board (TVDSB).

More public school students in our sample lived within walking distance of their schools than those attending Catholic schools. A total of 1,623 parent and child survey responses were acquired, with 1,058 being deemed as "within walking distance". A comparison of the sample characteristics between the full and reduced (i.e., 'walking distance') samples can be found in Table 3. The gender ratio between the two groups stayed relatively the same with approximately 45% of both samples being male. This number is not perfectly representative of the City of London, but is comparable as the number of males between the ages of 0 and 14 in London is 51% (Statistics Canada, 2012). The age breakdown of children was also relatively consistent between the two

samples; of those within walking distance, 32.0% of the children were 7 to 11 years of age, 29.0% were 12 years old, and the remaining 39.0% of students were between the ages of 13 and 15 years old.

Family characteristics included 76.7% of children in the reduced sample coming from two-parent family households (77.7% of full sample). The 2006 census of Canada states that 18% of families with children in London are single-parent households, compared to a slightly higher (19.8%) proportion of households in our full study sample and 20.7% for the sample within walking distance (City of London Community Profile, 2012). When parent education was calculated by adding the maternal and paternal education levels within the reduced sample, 21.2% of participating children had parent(s) with a high school education or less (low), 28.5% had at least one parent with higher than a high school education (medium), and 50.2% had two parents' with levels of educational attainment beyond high school (high). These figures are representative of the population of London as a whole, as 52% of adults over the age of 15 years of age in London have a greater-than high school education (City of London Community Profile, 2012).

Table 3 **Sample characteristics**

	% of full sample	% of children within walking distance
Gender (n)	(1590)	(1032)
Boys	44.59	45.06
Age (n)	(1380)	(894)
≤ 11 years old	32.03	32.00
12 years old	30.58	29.00
≥ 13 years old	37.39	39.00
Parental Education (n)	(1313)	(862)
Low	19.19	21.23
Medium	27.42	28.54
High	53.39	50.23
Family type (n)	(551)	(352)
Two parent	77.68	76.70
Single parent	19.78	20.74
Other	2.54	2.56
Race (n)	(1473)	(975)
Caucasian	72.57	73.95
Home Urbanicity (n)	(1455)	(944)

Urban	16.15	20.87
Suburban	77.53	74.89
Rural	6.32	4.24
School Urbanicity (n)	(1525)	(983)
Urban	29.97	25.53
Suburban	66.69	70.40
Rural	3.34	4.07
School Board (n)	(1525)	(983)
Catholic	56.07	50.15
Public	43.93	49.85
Mode of Travel *TO* School (n)	(1407)	(908)
Active (total)	48.54	73.35
Active (school minimum)	0.00	48.28
Active (school maximum)	100.00	100.00
Mode of Travel FROM School (n)	(1334)	(875)
Active (total)	55.47	82.63
Active (school minimum)	0.00	60.00
Active (school maximum)	95.12	100.00

Notes:
Children within walking distance = reduced sample through removal of any subjects residing further than 1.6km (measured 'as the crow flies') from their school.

4.2 Journeys to & from school

The proportion of children who traveled to school through active means (AT) was only 48.5% within the full survey sample, but rose to 73.4% amongst those who lived within walking distance. Minimum and maximum rates of AT within a single school are also listed in Table 3 to represent the level of variation. Rates rose even higher for the journey home from school, with 55.5% of the full survey sample, and 82.6% of children living within walking distance using AT. These findings are consistent with previous research that reported that the number of children using AT from school to home is higher than those using it on the journey to school in the morning (Green Communities, 2010; Larsen et al., 2009). These findings support the decision to divide all analysis between the journeys to school versus home from school, in order to determine the factors causing the change in mode. A nearly 10% increase in active travellers from morning (73.4%) to afternoon (82.6%) demonstrates a group of children who live within walking distance of their school and who have the ability to use AT, but are only doing so in one direction.

The aim through dividing the analysis by these two categories is to understand the aspects of the environment and/or parents' and children's perceptions that could motivate this 10% of children to use AT in both directions. Dividing the results by to school and from school will also give more insight into the breadth of possible barriers preventing the other 17.4% to 26.6% from using AT at all.

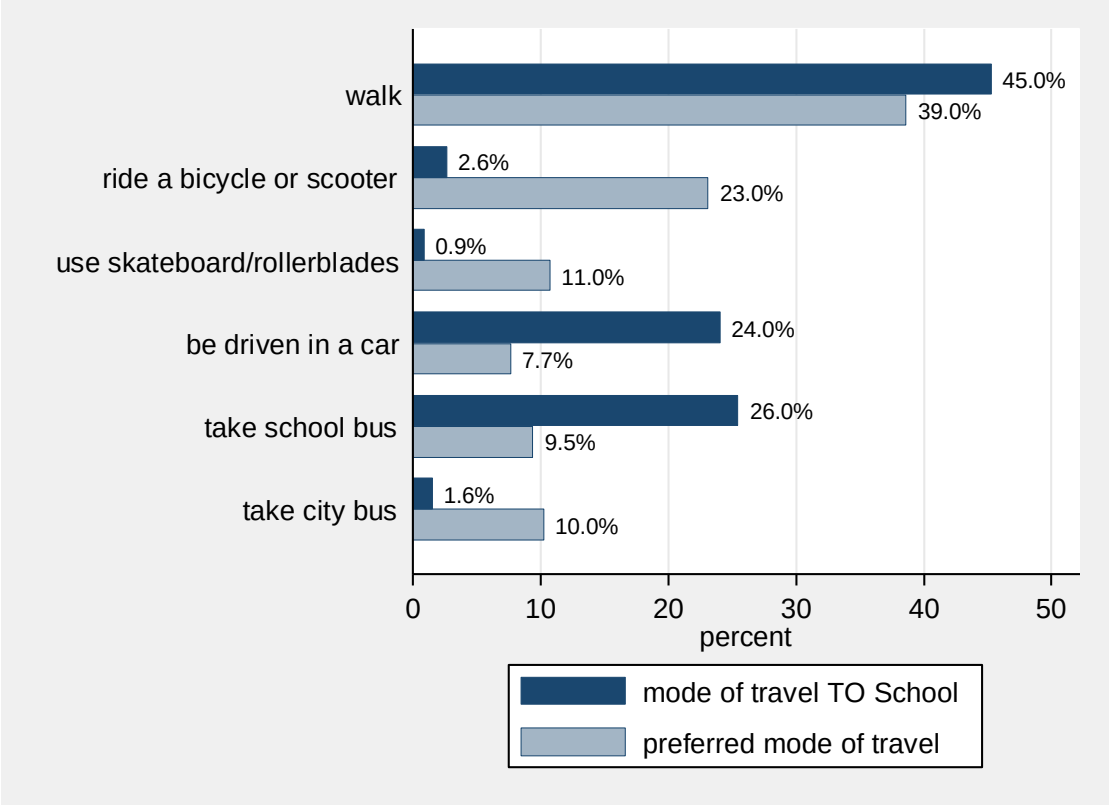
Some questions were asked on the surveys related to the journey between home and school that were not included in the statistical models. These questions were: how long it takes to go to/from school; who the child travels with; and what would be their preferred mode of travel (MOT). Of those within walking distance, 92.3% of children and 95.1% of parents stated living "within walking distance". The high frequency of agreement supports the method used to determine the walking flag that was used to segregate those within walking distance for statistical analysis. Parents and children had a high level of agreement for how long the journey takes between home and school, with 68% to 69% stating that the journey takes between 1 and 10 minutes and 4% to 6% stating it takes longer than 20 minutes.

The person(s) the child travels with between home and school showed a significant correlation to children's use of AT. Unfortunately, this factor was not included in the model due to its high level of complexity. Parents and children reported 37.5% to 38.6% of children travelling to school only with other children, and 45.1% to 46.7% travelling with children only for the journey home from school. Parents reported that 46.7% of children travelled with an adult to school and 40.9% on the way home, while only 37.4% of children stated travelling with an adult to school and 35.2% home from school. While these numbers do not represent anything independently, when cross-tabulated and chi-square values calculated, an association of $p < 0.001$ in both directions showed that children who travel with adults are more likely to use passive MOT. These results however, must be interpreted with caution. Through strict interpretation of the data it would say that children travelling with an adult will increase their likelihood of using a passive MOT, and therefore, the accompaniment of an adult would be discouraged. However, it is likely that within this sample, the results of children travelling with adults primarily represent those being driven to school. Instead of discouraging adults from travelling with children, it shows a need for AT education

among adults as well. This variable was not carried through into further analysis due to the multiple levels of influence making it too difficult to interpret.

The question asking what the parents' and children's preferred MOT to school would be if they had their choice was also analyzed, but not carried through to further analysis. The choices provided were walking, biking/scootering, skateboarding/ rollerblading, riding in a car, school bus, or city bus. Parents greatly preferred walking with 83.0% choosing it as their first choice, while only 49.6% of children chose the same. Conversely, children had higher preferences for 'active wheels', such as biking and scootering (23.2%), and skateboarding or rollerblading (10.8%). The results of children's preferred versus actual modes of travel are displayed in Figure 5. These results clearly show that children would prefer to use an active MOT over their current passive modes.

Figure 5 Children's preferred vs. actual mode of travel to school



The MOT preferences were dichotomized into active versus passive modes for bivariate analysis with children's MOT, with 92.0% of parents and 80.9% of children choosing active modes. The percent of children living within walking distance who actually use an active MOT to school is 73.4%. This means that nearly 20% of parents and less than 10% of children prefer an active mode but are not using it. These results demonstrate that there are children who are able to use AT that are not, regardless of the desires of both parents and children to have the child use an active MOT between home and school. The remainder of analysis was conducted in order to delve deeper into the reasons why these children are not using AT.

4.3 Parents' & children's perceptions

Table 4 displays the percentage of agreement of children and parents' (columns 2 and 3 respectively) responses to each of the survey questions relating to environmental perceptions and the journey between home and school. In these columns, the original four-category Likert scale (i.e., I strongly agree, I agree a little bit, I disagree a little bit, I strongly disagree) responses were dichotomized into agree/disagree for these calculations. The fourth column in the table displays the p-value when the parent and child response rates were cross-tabulated using chi-square analysis. A p-value of < 0.05 was used as the threshold for statistical significance for all analyses in this study, and in this instance represents a statistical difference between the parents' and children's responses. For some questions, the percentage of children and parents agreeing to a statement appears relatively similar, yet it has a p-value <0.05, which means they are statistically different. In these cases, the frequencies of responses are similar between parents and children, but the parent/child pairings are giving opposite responses. As can be seen in the Table 4, statistically significant differences were found between parent and child responses to 24 out of 31 questions. The disagreements between parents and children cross all of the topic areas including the BE, traffic safety, crime-related safety, personal attitudes, and specific questions regarding the journey to and from school. These findings support the need to survey both parents and children when researching behaviours and perceptions among this age group due to the significant differences in their views and opinions.

Children were more likely to agree with statements related to barriers regarding the BE and personal attitudes, while parents agreed more with statements pertaining to traffic and crime-safety barriers. For example, children agreed more to the statements that the route to school is boring, that they have no one to walk with, have too much stuff to carry, and that it is simply easier for someone to drive them. Parents had much higher rates of agreement towards statements such as the journey to/from school is unsafe due to traffic, there are too many busy streets to cross, too much traffic, or traffic is too fast in the neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street. Parents' fear of crime also far surpassed that of their children's. For instance, 70.1% of parents feared their child being taken by a stranger when walking alone in their neighbourhood versus only 23.4% of children. While each of these perceptions will be discussed according to their individual correlation to AT to and from school, we will first consider how responses were altered when controlled for by gender, age, and parent education.

Table 4 Self-reported attitudes and perceptions categorized by topic for parents and children living within walking distance, and their level of agreement using agree/disagree

	Children	Parent	p-value
Survey Questions	**% agree (n)**	**% agree (n)**	
Personal Attitudes			
Allowed to walk	94.5 (181)	91.2 (147)	0.706
Allowed to bike	75.6 (172)	72.2 (144)	0.022
Too far or takes too much time	8.0 (351)	10.5 (351)	0.014
Route is boring	29.3 (351)	9.7 (349)	0.349
Child gets too hot and sweaty	16.4 (353)	7.4 (350)	0.000
No one to walk with	22.9 (349)	17.7 (351)	0.002
Too much stuff to carry	20.5 (352)	23.16 (354)	0.019
Easier for someone to drive them	37.9 (351)	26.3 (354)	0.000
Built Environment			
Barrier to AT to school: Not enough sidewalks/bike lanes	22.5 (349)	16.9 (307)	0.005
There are enough sidewalks on the streets in my neighbourhood	83.4 (873)	76.2 (365)	0.074
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	71.3 (872)	60.2 (364)	0.000

There are lots of trees along the streets in my neighbourhood	87.3 (877)	87.9 (363)	0.001
Safety: Traffic			
Barrier to AT to school: It feels unsafe due to traffic on the route	16.9 (349)	33.8 (355)	0.000
Barrier to AT to school: There are too many busy streets to cross	16.8 (351)	23.5 (353)	0.000
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	22.0 (874)	47.4 (365)	0.785
Most drivers go too fast while driving in our neighbourhood	41.4 (874)	73.3 (367)	0.367
Safety: Crime			
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	19.1 (351)	34.4 (352)	0.000
Barrier to AT to school: Child might get bullied or teased along the way	10.2 (352)	27.4 (354)	0.001
There is a lot of crime in my neighbourhood	15.8 (869)	20.6 (875)	0.000
It feels unsafe to walk by myself around my neighbourhood during the day	15.9 (345)	39.6 (366)	0.011
It feels unsafe to walk with friends or siblings around my neighbourhood during the day	6.7 (823)	34.3 (364)	0.001
I am worried about being or walking alone in my neighbourhood and being taken by a stranger	23.4 (346)	70.1 (365)	0.163
Journey to/from School			
Primary mode of travel TO school = active	73.4 (908)	72.1 (347)	0.000
Primary mode of travel FROM school = active	82.6 (875)	79.3 (347)	0.000
Travel TO school with children only	38.6 (179)	37.5 (152)	0.000
Travel FROM school with children only	46.7 (182)	45.1 (142)	0.000
Travel TO school with an adult present	37.4 (179)	46.7 (152)	0.000
Travel FROM school with an adult present	35.2 (182)	40.9 (142)	0.000
Do you live within walking distance?	92.3 (874)	95.1 (352)	0.000
First choice of mode of travel to school = active	80.9 (901)	92.0 (364)	0.500

Notes:
Survey Questions categorized by topic area (later combined to create factors)
n = sample size of children and parents living within walking distance of their school (1.6km)
% agree = the percent of children and parents that either stated “I agree a bit” or “I strongly agree” to the survey question
p-value < 0.05 = statistically significant difference between parent and child responses

4.3.1 Gender

Few significant differences existed between children's responses when controlled for by gender (Table 5). Those that did exist included more boys stating that the journey to/from school is not fun (12.3% of girls and 23.4% of boys agree, $p = 0.048$). Girls had a significantly higher fear of crime in their neighbourhood and being taken by a stranger (19.5% of girls agreed with the statement "It feels unsafe to walk by myself around my neighbourhood during the day" compared to only 11.3% of boys, $p = 0.040$). Also, 29.3% of girls agreed to the statement "I am worried about being or walking alone in my neighbourhood and being taken by a stranger", compared to 15.9% of boys ($p = 0.004$).

For the journey to school, 78.5% of boys reported using AT versus 69.1% of girls ($p = 0.002$). The difference is reduced for the journey home from school with 84.9% of boys and 80.8% of girls using AT. Gender differences for parent's responses (Table 6) were hypothesized to be much greater than they were as it is often assumed that parents are more protective over female children than males. However, none of the parent responses were statistically different based on their child's gender.

Table 5 Children's perceptions by gender

	Children		
	Female	**Male**	**p-value (n)**
Survey Questions	**% agree**	**% agree**	
Personal Attitudes			
Allowed to walk	92.4	97.4	0.147 (181)
Allowed to bike	73.0	79.2	0.353 (172)
Too far or takes too much time	5.7	10.8	0.076 (351)
Route is boring	29.7	28.9	0.854 (351)
Child gets too hot and sweaty	18.9	13.4	0.166 (353)
No one to walk with	23.3	22.4	0.846 (349)
It's not cool	11.2	6.3	0.255 (169)
It's not fun	12.3	23.4	0.048 (183)
Too much stuff to carry	24.0	16.0	0.066 (352)
Easier for someone to drive them	39.7	35.7	0.440 (351)
Built Environment			
Barrier to AT to school: Not enough sidewalks/bike lanes	22.7	21.9	0.868 (349)
There are enough sidewalks on the streets in my neighbourhood	82.6	83.7	0.659 (858)

There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	72.0	70.8	0.704 (857)
There are lots of trees along the streets in my neighbourhood	88.9	85.3	0.114 (862)
Safety: Traffic			
Barrier to AT to school: It feels unsafe due to traffic on the route	18.7	14.7	0.333 (349)
Barrier to AT to school: There are too many busy streets to cross	17.4	16.0	0.726 (351)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	21.8	23.0	0.695 (859)
Most drivers go too fast while driving in our neighbourhood	41.4	41.7	0.926 (859)
Safety: Crime			
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	21.0	16.7	0.302 (351)
Barrier to AT to school: Child might get bullied or teased along the way	12.8	7.0	0.074 (352)
There is a lot of crime in my neighbourhood	14.9	16.9	0.430 (854)
It feels unsafe to walk by myself around my neighbourhood during the day	19.5	11.3	0.040 (345)
It feels unsafe to walk with friends or siblings around my neighbourhood during the day	5.8	8.0	0.196 (808)
I am worried about being or walking alone in my neighbourhood and being taken by a stranger	29.2	15.9	0.004 (346)
Journey to/from School			
Primary mode of travel TO school = active	69.1	78.5	0.002 (893)
Primary mode of travel FROM school = active	80.8	84.9	0.105 (860)
Travel TO school with children only	41.8	34.2	0.306 (179)
Travel FROM school with children only	46.7	46.8	0.991 (182)
Travel TO school with an adult present	42.7	30.3	0.089 (179)
Travel FROM school with an adult present	38.1	31.2	0.334 (182)
Do you live within walking distance? = Yes	92.0	92.7	0.067 (181)
First choice of mode of travel to school = active	79.7	82.4	0.298 (886)

Notes:
Survey Questions categorized by topic area (later combined to create factors)
% agree = the percent of children that stated “I agree a bit” or “I strongly agree” to the survey question
p-value < 0.05 = statistically significant association between the child’s response to the question and their gender
n = sample size of children living within walking distance of their school (1.6km)

Table 6 Parents' perceptions by child's gender

	Parents		
	Female	**Male**	**p-value (n)**
Survey Questions	**% agree**	**% agree**	
Personal Attitudes			
Allowed to walk	88.6	94.1	0.241 (147)
Allowed to bike	65.8	80.0	0.059 (144)
Too far or takes too much time	9.6	11.8	0.488 (351)
Route is boring	9.6	9.9	0.944 (349)
Child gets too hot and sweaty	7.6	9.2	0.881 (350)
No one to walk with	18.7	16.3	0.567 (351)
Too much stuff to carry	23.4	22.9	0.911 (354)
Easier for someone to drive them	25.0	27.9	0.536 (354)
Child is too young	20.3	18.0	0.645 (260)
Built Environment			
Barrier to AT to school: Not enough sidewalks/bike lanes	13.8	20.7	0.106 (307)
There are enough sidewalks on the streets in my neighbourhood	78.6	72.9	0.209 (365)
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	58.4	62.6	0.417 (364)
There are lots of trees along the streets in my neighbourhood	88.0	87.7	0.914 (363)
Safety: Traffic			
Barrier to AT to school: It feels unsafe due to traffic on the route	33.2	34.6	0.772 (355)
Barrier to AT to school: There are too many busy streets to cross	24.5	22.2	0.617 (353)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	46.7	48.4	0.745 (365)
Most drivers go too fast while driving in our neighbourhood	72.4	74.5	0.646 (367)
Safety: Crime			
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	36.5	31.6	0.336 (352)
Barrier to AT to school: Child might get bullied or teased along the way	26.9	28.1	0.796 (354)
There is a lot of crime in my neighbourhood	20.1	21.2	0.694 (860)
It feels unsafe for my child to walk by themselves around my neighbourhood during the day	42.1	36.3	0.262 (366)
I am afraid of my child being taken by a stranger when with friends/siblings	34.8	33.8	0.838 (364)
Journey to/from School			
Primary mode of travel TO school = active	71.0	73.5	0.613 (347)
Primary mode of travel FROM school = active	79.0	79.6	0.893 (347)
Travel TO school with children only	39.3	35.3	0.613 (152)

Travel FROM school with children only	44.2	46.2	0.812 (142)
Travel TO school with an adult present	51.2	41.2	0.219 (152)
Travel FROM school with an adult present	45.5	35.4	0.224 (142)
Do you live within walking distance? =Yes	95.8	94.3	0.521 (370)
First choice of mode of travel to school = active	91.4	92.9	0.597 (364)

Notes:
Survey Questions categorized by topic area (later combined to create factors)
% agree = the percent of parents that stated "I agree a bit" or "I strongly agree" to the survey question
p-value < 0.05 = statistically significant association between the parents' response to the question and their child's gender
n = sample size of children living within walking distance of their school (1.6km)

4.3.2 Age

The age of the child appeared to have a significant influence on their survey responses, travel behaviours, and perceptions of their environments (Table 7). Older children reported being more likely to be "allowed to bike" to school ($p = 0.050$), had a reduced fear of traffic ("there is so much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street": $p = 0.053$), and were less likely to view crossing busy streets as a barrier to AT ("Barrier to walking/biking to school: there are too many busy streets to cross": $p = 0.038$). Older children were also less likely to agree to the barrier of "there is no one to walk with" ($p = 0.031$), "I might get bullied or teased" ($p = 0.022$), and reported more supportive infrastructure for AT than younger children ("there are enough sidewalks on the streets in my neighbourhood": $p = 0.000$, "there are lots of trees along the streets in my neighbourhood": $p = 0.000$). Younger children more often agreed that "it is easier for someone else to drive me" ($p = 0.003$), and had a greater fear of being taken by a stranger ("I am worried about being or walking alone in my neighbourhood and being taken by a stranger": $p = 0.020$).

Parents were asked if they felt their children were too young to walk or cycle to school. Responses varied significantly ($p = 0.007$) by child's age, with parents reporting 25.5% of children between 7 and 11 years old, 13.0% of 12 year olds, and 5.6% of 13 year olds and higher being considered too young. Parents of younger children were also more likely to agree to "there is a lot of crime in my neighbourhood" ($p = 0.001$), "it feels unsafe for my child to walk by themselves around my neighbourhood during the day"

(p = 0.050), and "I am afraid of my child being taken by a stranger when with friends/siblings" (p = 0.009) (Table 8). As for the actual journey to and from school, age was associated with AT for parent-reported MOT in both directions, but was not for child-reported MOT. Children's report of MOT to and from school is what was used for analysis because there were 908 cases compared to 347 parents who answered this question. Therefore, controlling for age did not alter the effect on AT.

Table 7 Children's perceptions by age

	Children			
	7-11 y.o.	**12 y.o.**	**13+ y.o.**	**p-value (n)**
Characteristic	**% agree**	**% agree**	**% agree**	
Personal Attitudes				
Allowed to walk	94.8	94.0	94.4	0.978 (181)
Allowed to bike	80.2	65.6	88.2	0.050 (172)
Too far or takes too much time	9.2	8.7	3.2	0.310 (351)
Route is boring	25.9	35.7	27.4	0.189 (351)
Child gets too hot and sweaty	18.3	18.3	7.9	0.133 (353)
No one to walk with	20.9	30.7	14.3	0.031 (349)
It's not cool	12.7	8.9	2.2	0.145 (169)
It's not fun	16.7	20.3	5.6	0.331 (183)
Too much stuff to carry	21.7	22.8	12.7	0.236 (352)
Easier for someone to drive them	44.8	36.8	20.6	0.003 (351)
Built Environment				
Barrier to AT to school: Not enough sidewalks/bike lanes	25.3	24.4	10.0	0.041 (349)
There are enough sidewalks on the streets in my neighbourhood	74.6	79.8	88.1	0.000 (730)
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	72.2	69.9	70.2	0.869 (731)
There are lots of trees along the streets in my neighbourhood	76.7	86.9	91.0	0.000 (734)
Safety: Traffic				
Barrier to AT to school: It feels unsafe due to traffic on the route	19.1	19.3	6.5	0.053 (349)
Barrier to AT to school: There are too many busy streets to cross	20.6	16.7	6.5	0.038 (351)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	25.4	27.4	17.6	0.015 (732)
Most drivers go too fast while driving in our neighbourhood	34.5	43.0	41.4	0.183 (733)
Safety: Crime				

Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	23.4	16.7	11.3	0.082 (351)
Barrier to AT to school: Child might get bullied or teased along the way	10.3	14.8	1.6	0.022 (352)
There is a lot of crime in my neighbourhood	16.6	17.8	16.0	0.858 (729)
It feels unsafe to walk by myself around my neighbourhood during the day	18.7	17.1	6.4	0.067 (345)
It feels unsafe to walk with friends or siblings around my neighbourhood during the day	7.6	7.3	6.6	0.898 (682)
I am worried about being or walking alone in my neighbourhood and being taken by a stranger	29.8	17.9	15.9	0.020 (346)
Journey to/from School				
Primary mode of travel TO school = active	64.2	78.9	76.0	0.001 (765)
Primary mode of travel FROM school = active	72.6	82.3	89.6	0.000 (732)
Travel TO school with children only	38.0	43.5	22.2	0.254 (179)
Travel FROM school with children only	46.3	46.4	50.0	0.957 (182)
Travel TO school with an adult present	43.5	29.0	38.9	0.169 (179)
Travel FROM school with an adult present	35.8	36.2	27.8	0.786 (182)
Do you live within walking distance? = Yes	94.9	92.0	92.8	0.519 (731)
First choice of mode of travel to school = active	81.7	84.5	79.3	0.280 (759)

Notes:
Survey Questions categorized by topic area (later combined to create factors)
% agree = the percent of children that stated “I agree a bit” or “I strongly agree” to the survey question
p-value < 0.05 = statistically significant association between the child’s response to the question and their age
n = sample size of children living within walking distance of their school (1.6km)

Table 8 Parents’ perceptions by child's age

	Parents			
	7-11 y.o.	**12 y.o.**	**13+ y.o.**	p-value (n)
Characteristic	**% agree**	**% agree**	**% agree**	
Personal Attitudes				
Allowed to walk	88.2	92.6	100.0	0.268 (147)
Allowed to bike	75.0	65.4	81.3	0.341 (144)
Too far or takes too much time	10.8	9.5	7.4	0.747 (341)
Route is boring	9.3	8.5	7.6	0.916 (339)
Child gets too hot and sweaty	4.4	15.7	1.9	0.001 (340)
No one to walk with	14.6	23.8	13.2	0.125 (342)
Too much stuff to carry	22.3	24.7	18.9	0.726 (344)
Easier for someone to drive them	25.7	27.1	20.8	0.691 (344)
Child is too young	25.5	13.0	5.6	0.007 (258)
Built Environment				
Barrier to AT to school: Not enough sidewalks/bike lanes	14.4	22.2	15.6	0.313 (304)

There are enough sidewalks on the streets in my neighbourhood	76.3	70.3	83.6	0.186 (357)
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	61.9	51.7	65.5	0.162 (356)
There are lots of trees along the streets in my neighbourhood	88.1	84.4	94.6	0.188 (355)
Safety: Traffic				
Barrier to AT to school: It feels unsafe due to traffic on the route	32.9	37.7	28.3	0.512 (345)
Barrier to AT to school: There are too many busy streets to cross	23.9	22.4	18.9	0.734 (343)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	48.3	51.7	36.4	0.181 (357)
Most drivers go too fast while driving in our neighbourhood	75.1	73.6	65.5	0.351 (359)
Safety: Crime				
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	35.4	34.9	26.4	0.453 (342)
Barrier to AT to school: Child might get bullied or teased along the way	27.1	33.3	15.1	0.063 (344)
There is a lot of crime in my neighbourhood	30.1	23.1	16.1	0.001 (732)
It feels unsafe for my child to walk by themselves around my neighbourhood during the day	75.0	65.6	60.0	0.050 (357)
I am afraid of my child being taken by a stranger when with friends/siblings	38.2	34.8	16.4	0.009 (356)
Journey to/from School				
Primary mode of travel TO school = active	69.8	73.5	77.6	0.511 (337)
Primary mode of travel FROM school = active	77.1	73.5	93.9	0.015 (337)
Travel TO school with children only	30.4	45.6	43.8	0.167 (152)
Travel FROM school with children only	41.6	51.9	38.5	0.449 (142)
Travel TO school with an adult present	55.7	38.6	31.3	0.061 (152)
Travel FROM school with an adult present	46.8	30.8	46.2	0.178 (142)
Do you live within walking distance? =Yes	94.9	95.6	94.4	0.946 (360)
First choice of mode of travel to school = active	89.7	95.4	98.2	0.052 (354)

Notes:
Sample = parents living within walking distance of their school (1.6km)
Survey Questions categorized by topic area (later combined to create factors)
% agree = the percent of parents that stated “I agree a bit” or “I strongly agree” to the survey question
p-value < 0.05 = statistically significant association between the parents’ response to the question and their child’s age
n = sample size of children living within walking distance of their school (1.6km)

4.3.3 Parental education

When parents' and children's perceptions were controlled by parental education, parents (Table 10) with higher levels of education were more likely to report children traveling to school with an adult (p = 0.029), agreeing to the barrier of "it feels unsafe due to traffic on the route" (p = 0.010), and having children less likely to use AT to school (p = 0.067). Additionally, responses of children (Table 9) of more highly educated parents were also more likely to agree to the barrier of "it feels unsafe due to traffic on the route" (p = 0.028). While parental education was associated with perceptions to a lesser extent than age and gender, it remained in the model due to its influence on AT to school, and also to represent a controlling factor for SES.

Table 9 Children's perceptions by parental education

	Children			
	Low	**Mid**	**High**	**p-value (n)**
Survey Questions	**% agree**	**% agree**	**% agree**	
Personal Attitudes				
Allowed to walk	84.2	95.4	95.7	0.162 (131)
Allowed to bike	68.4	85.0	74.2	0.287 (121)
Too far or takes too much time	5.3	8.2	8.8	0.780 (248)
Route is boring	23.7	28.2	29.6	0.777 (248)
Child gets too hot and sweaty	10.3	16.5	16.0	0.636 (249)
No one to walk with	12.8	27.1	25.2	0.200 (247)
It's not cool	10.0	7.3	8.9	0.931 (117)
It's not fun	10.5	27.9	13.0	0.091 (131)
Too much stuff to carry	12.8	19.1	20.8	0.540 (248)
Easier for someone to drive them	28.2	41.2	37.9	0.380 (248)
Built Environment				
Barrier to AT to school: Not enough sidewalks/bike lanes	15.8	27.1	19.2	0.260 (248)
There are enough sidewalks on the streets in my neighbourhood	82.8	86.5	84.4	0.605 (750)
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	75.6	71.8	71.4	0.586 (749)
There are lots of trees along the streets in my neighbourhood	87.9	88.1	90.0	0.686 (754)
Safety: Traffic				
Barrier to AT to school: It feels unsafe due to traffic on the route	5.4	14.3	23.2	0.028 (246)

Barrier to AT to school: There are too many busy streets to cross	5.3	17.9	22.4	0.056 (247)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	26.1	23.5	16.8	0.025 (750)
Most drivers go too fast while driving in our neighbourhood	45.5	39.6	40.3	0.463 (750)
Safety: Crime				
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	15.4	17.7	20.8	0.706 (249)
Barrier to AT to school: Child might get bullied or teased along the way	12.8	9.4	10.4	0.847 (249)
There is a lot of crime in my neighbourhood	16.1	17.2	13.1	0.353 (745)
It feels unsafe to walk by myself around my neighbourhood during the day	10.3	14.3	21.3	0.194 (245)
It feels unsafe to walk with friends or siblings around my neighbourhood during the day	7.3	6.8	7.0	0.982 (714)
I am worried about being or walking alone in my neighbourhood and being taken by a stranger	20.5	18.1	30.1	0.119 (254)
Journey to/from School				
Primary mode of travel TO school = active	75.0	79.4	71.9	0.127 (747)
Primary mode of travel FROM school = active	85.5	87.6	82.4	0.250 (723)
Travel TO school with children only	44.4	38.1	38.2	0.880 (128)
Travel FROM school with children only	52.6	41.9	47.8	0.702 (131)
Travel TO school with an adult present	27.8	31.0	41.2	0.410 (128)
Travel FROM school with an adult present	26.3	39.5	33.3	0.580 (131)
Do you live within walking distance? = Yes	91.8	93.5	91.8	0.720 (751)
First choice of mode of travel to school = active	84.4	84.1	79.7	0.272 (737)

Notes:
Parental Education categorization:
Low = parent(s) with a high school education or less
Mid = at least one parent with higher than a high school education
High = two parents' with levels of educational attainment beyond high school
Survey Questions categorized by topic area (later combined to create factors)
% agree = the percent of children that stated "I agree a bit" or "I strongly agree" to the survey question
p-value < 0.05 = statistically significant association between the child's response to the question and parental education
n = sample size of children living within walking distance of their school (1.6km)

Table 10 Parents' perceptions by parental education

	Parents			
	Low	**Mid**	**High**	**p-value (n)**
Survey Questions	**% agree**	**% agree**	**% agree**	
Personal Attitudes				
Allowed to walk	100.0	86.7	93.2	0.173 (137)
Allowed to bike	77.8	75.0	72.2	0.872 (134)
Too far or takes too much time	3.6	14.4	8.8	0.078 (329)
Route is boring	11.1	9.6	7.1	0.580 (328)
Child gets too hot and sweaty	7.1	6.7	7.7	0.950 (330)
No one to walk with	13.0	19.2	17.0	0.610 (329)
Too much stuff to carry	26.8	27.6	19.3	0.221 (332)
Easier for someone to drive them	18.2	26.4	26.9	0.411 (332)
Child is too young	10.3	23.1	18.6	0.245 (246)
Built Environment				
Barrier to AT to school: Not enough sidewalks/bike lanes	4.2	21.6	15.0	0.026 (289)
There are enough sidewalks on the streets in my neighbourhood	75.4	79.8	73.8	0.516 (342)
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	63.9	61.5	59.9	0.852 (342)
There are lots of trees along the streets in my neighbourhood	90.2	89.9	88.3	0.880 (341)
Safety: Traffic				
Barrier to AT to school: It feels unsafe due to traffic on the route	17.9	30.2	39.2	0.010 (333)
Barrier to AT to school: There are too many busy streets to cross	14.3	22.9	27.1	0.145 (331)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	45.9	46.4	49.4	0.835 (343)
Most drivers go too fast while driving in our neighbourhood	73.8	73.6	74.7	0.976 (345)
Safety: Crime				
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	32.7	31.4	37.1	0.605 (330)
Barrier to AT to school: Child might get bullied or teased along the way	21.8	31.4	26.7	0.416 (332)
There is a lot of crime in my neighbourhood	24.3	23.1	17.8	0.115 (846)
It feels unsafe for my child to walk by themselves around my neighbourhood during the day	73.8	68.2	71.1	0.731 (344)
I am afraid of my child being taken by a stranger when with friends/siblings	33.3	36.4	33.5	0.871 (343)
Journey to/from School				
Primary mode of travel TO school = active	84.2	72.4	68.2	0.067 (319)
Primary mode of travel FROM school = active	80.7	80.0	79.6	0.985 (319)
Travel TO school with children only	65.0	32.6	34.7	0.029 (141)

Travel FROM school with children only	52.6	37.2	50.0	0.346 (132)
Travel TO school with an adult present	25.0	50.0	49.3	0.124 (141)
Travel FROM school with an adult present	36.8	48.8	35.7	0.366 (132)
Do you live within walking distance? =Yes	96.7	94.5	95.5	0.811 (345)
First choice of mode of travel to school = active	90.0	96.3	91.4	0.206 (342)

Notes:
Parental Education categorization:
Low = parent(s) with a high school education or less
Mid = at least one parent with higher than a high school education
High = two parents' with levels of educational attainment beyond high school
Sample = parents living within walking distance of their school (1.6km)
Survey Questions categorized by topic area (later combined to create factors)
% agree = the percent of parents that stated "I agree a bit" or "I strongly agree" to the survey question
p-value < 0.05 = statistically significant association between the parents' response to the question and parental education
n = sample size of children living within walking distance of their school (1.6km)

4.4 Bivariate analysis of children's use of AT

4.4.1 Individual perception variables

Tables 11 and 12 display the results of bivariate analysis between parents' and children's survey questions and children's AT to and from school. The first column exhibits the direction of the question's response that led to the effect on AT. This column will assist in interpretation of the results as some of the questions were phrased as negatives while others were phrased as positives. The questions are categorized according to the factors they were combined with for the model which appears later, in section 4.5. The direction of the effect on AT is only displayed when the correlation was found to be statistically significant. The results of bivariate analysis will now be discussed according to these groupings.

Children's personal attitudes towards having "no one to walk with" inhibited AT to and from school, while "having too much stuff to carry" was negatively associated with AT for the journey home only. For parents, having "too much stuff to carry" and the journey is "too far or takes too much time" were negatively correlated with AT to and from school, and having "no one to walk with" negatively impacted the journey home from school. Parents and children were both asked whether the child was allowed to walk or bike to school and the only association was found between parent's statements of the

child being allowed to walk and increased AT in both directions. Only one variable was associated with AT in both directions for both parents and children, and that was the stated belief that it is "easier for someone to drive them".

Table 11 Children's perceptions' of their environments and the impact on children's use of AT to and from school

			Children		
Survey Question	**Variable Direction**	**Effect on AT *to* school**	**p-value (n)**	**Effect on AT *from* school**	**p-value (n)**
Personal Attitudes					
Allowed to walk			0.104 (177)		0.514 (144)
Allowed to bike			0.237 (168)		0.864 (138)
Barrier to AT to school: Too far or takes too much time			0.686 (333)		0.337 (298)
Barrier to AT to school: Route is boring			0.825 (333)		0.963 (298)
Barrier to AT to school: Child gets too hot and sweaty			0.993 (334)		0.145 (299)
Barrier to AT to school: No one to walk with	^ Agree	- AT	0.000 (330)	- AT	0.000 (296)
Barrier to AT to school: It's not fun/cool to walk			0.325 (333)		0.973 (298)
Barrier to AT to school: Too much stuff to carry	^ Agree		0.455 (333)	- AT	0.008 (298)
Barrier to AT to school: Easier for someone to drive them	^ Agree	- AT	0.000 (332)	- AT	0.000 (297)
Barrier to AT to school: Child is too young					
Built Environment					
Barrier to AT to school: Not enough sidewalks/bike lanes	^ Agree		0.212 (332)	- AT	0.033 (297)
There are enough sidewalks on the streets in my neighbourhood			0.649 (853)		0.946 (819)
There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	^ Agree	+ AT	0.005 (852)		0.578 (818)
There are lots of trees along the streets in my neighbourhood			0.350 (857)		0.713 (823)
Safety: Traffic					

Barrier to AT to school: It feels unsafe due to traffic on the route	^ Agree	- AT	0.000 (331)	- AT	0.000 (296)
Barrier to AT to school: There are too many busy streets to cross	^ Agree	- AT	0.000 (333)	- AT	0.000 (298)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street	^ Agree		0.469 (854)	- AT	0.023 (820)
Most drivers go too fast while driving in our neighbourhood			0.629 (854)		0.730 (820)
Safety: Crime					
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	^ Agree		0.126 (333)	- AT	0.001 (298)
Barrier to AT to school: Child might get bullied or teased along the way	^ Agree		0.485 (334)	- AT	0.022 (299
It is safe for my child to play outside in our neighbourhood					
I can count on adults in the neighbourhood to keep watch					
There is a lot of crime in my neighbourhood			0.405 (845)		0.189 (815)
It feels unsafe to walk by myself around my neighbourhood during the day			0.260 (327)		0.155 (292)
It feels unsafe to walk with friends or siblings around my neighbourhood during the day			0.241 (817)		0.702 (785)
I am worried about being or walking alone in my neighbourhood and being taken by a stranger because I am afraid of being taken or hurt by a stranger			0.302 (328)		0.814 (293)
My parents are afraid I will be taken by a stranger if I'm alone	^ Agree			- AT	0.040 (293)
Journey to/from School					
Live within walking distance	^ Yes	+ AT	0.000 (855)	+ AT	0.000 (822)
Time it takes to get to/from school	^ Travel time	- AT	0.001 (895)	- AT	0.008 *865)
Primary mode of travel TO school = active	^ Active To			+ AT	0.000 (870)
Primary mode of travel FROM school = active	^ Active From	+ AT	0.000 (870)		
Travel TO school with children only	^ children only	+ AT	0.000 (176)	+ AT	0.003 (143)
Travel FROM school with children only	^ children only	+ AT	0.000 (178)	+ AT	0.000 (145)
Travel TO school with an adult present	^ adult	- AT	0.000 (176)	- AT	0.000 (143)

Travel FROM school with an adult present	^ adult	- AT	0.000 (178)	- AT	0.000 (145)
First choice of mode of travel to school = active	^ Active choice	+AT	0.000 (882)	+AT	0.000 (850)

Notes:
Variable direction = direction of the question's response that led to the effect on AT
Effect on AT = '+' represents an statistically significant increase in AT due to the direction of the variable, and '-' represents a statistically significant decrease in AT due to the variable direction
n = sample size of children living within walking distance of their school (1.6km)
p-value < 0.05 = statistically significant association between the children's response to the question and children's use of AT

Table 12 Parents' perceptions' of their environments and the impact on children's use of AT to and from school

			Parents		
Survey Question	**Variable Direction**	**Effect on AT *to* school**	**p-value (n)**	**Effect on AT *from* school**	**p-value (n)**
Personal Attitudes					
Allowed to walk	^ Allowed	+ AT	0.001 (134)	+ AT	0.001 (112)
Allowed to bike			0.096 (131)		0.963 (110)
Barrier to AT to school: Too far or takes too much time	^ Agree	- AT	0.000 (236)	- AT	0.001 (214)
Barrier to AT to school: Route is boring			0.775 (234)		0.234 (211)
Barrier to AT to school: Child gets too hot and sweaty			0.675 (234)		0.823 (210)
Barrier to AT to school: No one to walk with	^ Agree		0.000 (237)	- AT	0.000 (214)
Barrier to AT to school: It's not fun/cool to walk					
Barrier to AT to school: Too much stuff to carry	^ Agree	- AT	0.000 (238)	- AT	0.000 (214)
Barrier to AT to school: Easier for someone to drive them	^ Agree	- AT	0.000 (239)	- AT	0.000 (215)
Barrier to AT to school: Child is too young	^ Agree		0.219 (188)	- AT	0.002 (165)
Built Environment					
Barrier to AT to school: Not enough sidewalks/bike lanes			0.993 (212)		0.394 (191)
There are enough sidewalks on the streets in my neighbourhood			0.922 (250)		0.527 (226)

There are walking/biking lanes or trails in or near my neighbourhood that are easy to get to	^ Agree	+ AT	0.003 (249)		0.134 (225)
There are lots of trees along the streets in my neighbourhood			0.204 (248)		0.179 (224)
Safety: Traffic					
Barrier to AT to school: It feels unsafe due to traffic on the route	^ Agree	- AT	0.004 (239)	- AT	0.029 (215)
Barrier to AT to school: There are too many busy streets to cross	^ Agree	- AT	0.000 (237)	- AT	0.000 (213)
So much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street			0.231 (249)		0.685 (225)
Most drivers go too fast while driving in our neighbourhood			0.323 (251)		0.526 (227)
Safety: Crime					
Barrier to AT to school: It feels unsafe because of crime (example: strangers, gangs, drugs)	^ Agree	- AT	0.000 (237)	- AT	0.000 (213)
Barrier to AT to school: Child might get bullied or teased along the way	^ Agree	- AT	0.032 (239)	- AT	0.060 (215)
It is safe for my child to play outside in our neighbourhood			0.431 (405)		0.242 (405)
I can count on adults in the neighbourhood to keep watch			0.862 (425)		0.682 (425)
There is a lot of crime in my neighbourhood			0.099 (758)		0.791 (734)
It feels unsafe to walk by myself around my neighbourhood during the day	^ Agree	- AT	0.006 (251)		0.123 (227)
It feels unsafe to walk with friends or siblings around my neighbourhood during the day					
I am worried about my child being or walking alone in my neighbourhood and being taken by a stranger	^ Agree	- AT	0.000 (250)	- AT	0.038 (226)
Journey to/from School					
Live within walking distance	^ Yes	+ AT	0.008 (250)		0.267 (227)
Time it takes to get to/from school			0.089 (250)		0.643 (227)
Primary mode of travel TO school = active	^ Active To			+ AT	0.000 (215)
Primary mode of travel FROM school = active	^ Active From	+ AT	0.000 (228)		
Travel TO school with children only	^ children only	+ AT	0.000 (138)		0.007 (115)
Travel FROM school with children only	^ children only	+ AT	0.017 (129)		0.000 (109)

Travel TO school with an adult present	^ adult	- AT	0.000 (138)	0.000 (115)
Travel FROM school with an adult present	^ adult	- AT	0.000 (129)	0.000 (109)
First choice of mode of travel to school = active	^ Active choice	+ AT	0.000 (245)	0.065 (222)
Parent's mode of travel as a child			0.941 (123)	0.285 (102)

Notes:
Variable direction = direction of the question's response that led to the effect on AT
Effect on AT = '+' represents an statistically significant increase in AT due to the direction of the variable, and '-' represents a statistically significant decrease in AT due to the variable direction
n = sample size of parents living within walking distance of their school (1.6km)
p-value < 0.05 = statistically significant association between the parents' response to the question and children's use of AT

The results of the bivariate analyses of perceptions of the BE with reported AT behaviours revealed that both children's and parents' perceptions of there being "walking/biking lanes or trails in or near my neighbourhood that are easy to get to" were positively correlated with children's use of AT on the way to school, but not for the journey home. The lack of sidewalks and bike lanes, as perceived by children, was negatively associated with AT for the journey home. More questions related to perceptions of the BE were asked in the surveys, but were not included in the analysis for this thesis, because the questions did not fit exactly with the focus of the analysis. Four BE questions remained in the final analysis.

Perceptions of barriers related to traffic were negatively correlated with children's AT. Children's perceptions of the barriers of "there are too many busy streets to cross" and "it feels unsafe due to traffic on the route" were negatively associated with AT to and from school. The same variables were found to be negatively correlated from the parents' perspective as well, but only in relation to the journey home. The only other reported traffic barrier that reduced the likelihood of AT was children's perceptions of "there is so much traffic along streets in my neighbourhood that it makes it difficult or unpleasant to walk, bike, or play on the street". Children who held this perception of the BE were less likely to use AT on the journey home from school.

Parents' and children's perceptions of "it feels unsafe due to crime", or that "the child might get bullied or teased along the way", were both negatively associated with

children's use of AT on the way home from school. Additionally, parents' perceptions of safety from crime and bullying were also negatively associated with their children's use of AT on the way to school. Parents' perceptions of it "feeling unsafe for my child to walk around the neighbourhood alone during the day" was also negatively associated with their child's use of AT for the journey to school, while the fear of their child "being or walking alone in my neighbourhood and being taken by a stranger" had a negative impact on their child's use of AT both to and from school. Children were also asked if they feared being alone or taken by a stranger; however, their responses were not significantly associated with their use of AT. On the other hand, if children thought their parents were afraid of them being taken by a stranger ("my parents are afraid I will be taken by a stranger if I'm alone"), this had a negative impact on their use of AT on the journey home from school.

A review of the statistics presented in Tables 11 and 12 indicates that parents' and children's perceptions do not always coincide, and different perceptions have differing impacts on children's MOT for the journeys to and from school. While individual questions were not used within the final statistical models described below, the results will be of use to interpret the final factors found to impact children's use of AT.

4.4.2 Built environment variables

Each of the BE variables, objectively-measured using GIS for buffers around both the home and school, were independently tested for correlations between the journeys to and from school using bivariate analysis and two-tailed, paired t-tests (Results in Table 13). Greater intersection densities (a.k.a. "connectivity") within home buffers of 500m were positively associated with the use of AT for the journey to school, while greater lengths of major roads in the buffer were negatively associated with AT. Within the school buffer (1.6km), greater total area of multiuse paths, greater lengths of bike lanes, higher ratios of sidewalks to roads, and higher densities of dwellings were all positively correlated with children's use of AT to school.

Table 13 Objective built environment variables' influence on children's AT to and from school

		***TO* School**		***FROM* School**	
	Variable Direction	**Effect on AT *to* school**	**p-value (n)**	**Effect on AT *from* school**	**p-value (n)**
Built Environment Variable					
Network Distance	^ distance		0.089 (849)	- AT	0.0003 (822)
Home Environment					
Major road length	^ length	- AT	0.031 (854)	- AT	0.009 (826)
Multiuse path area			0.774 (851)		0.685 (823)
Bike lane length			0.783 (854)		0.691 (826)
Sidewalk to road ratio			0.992 (853)		0.210 (825)
Street tree density			0.180 (853)		0.213 (825)
Intersection density	^ density	+ AT	0.0341 (853)		0.255 (825)
Intersection ratio	^ density	+ AT	0.035 (853)		0.382 (825)
Traffic volume			0.590 (852)		0.874 (824)
Landuse mix			0.832 (854)		0.331 (826)
Dwelling density			0.111 (854)		0.580 (826)
Residential density			0.287 (854)		0.542 (826)
School Environment					
Major road length			0.347 (853)		0.090 (825)
Multiuse path area	^ area	+ AT	0.015 (853)		0.083 (825)
Bikelane length	^ length	+ AT	0.027 (853)	+ AT	0.029 (825)
Sidewalk to road ratio	^ ratio	+ AT	0.048 (853)		0.068 (825)
Street tree density			0.231 (853)		0.677 (825)
Intersection density			0.404 (853)		0.182 (825)

Intersection ratio			0.150 (853)		0.334 (825)
Traffic volume			0.629 (853)		0.411 (825)
Land-use mix			0.100 (853)		0.985 (825)
Dwelling density	^ density	+ AT	0.042 (853)		0.063 (825)
Residential density	^ density		0.078 (853)	+ AT	0.043 (825)

Notes:

Variable direction = direction of the variables change that led to the effect on AT
Effect on AT = '+' represents an statistically significant increase in AT due to the direction of the variable, and '-' represents a statistically significant decrease in AT due to the variables direction
n = sample size of children living within walking distance of their school (1.6km)
p-value < 0.05 = statistically significant association between the objective built environment variables and children's use of AT

Fewer BE variables were significantly associated with the journey home from school, compared to the journey to school. Major road length within the home buffer was negatively correlated with use of AT from school, while bike lane length and residential density within the school buffers were positively correlated with use of AT. Additionally, longer network distances between school and home decreased the likelihood of children using AT on the journey home from school. Variables that were found statistically significant in this stage of analysis were retained for the first step of the statistical model that included all objective factors.

4.5 Creation of perception factors & bivariate analysis

Individual variables of related themes were reduced into single factors through Polychoric Correlation matrixes and Principal Component factor analysis. Polychoric Correlations were used because it is the most common and appropriate method when working with ordinal values. The resulting Cronbach's alpha scores and Eigenvalues were measured for each of the factors and can be found in Table 14. Only factors with Cronbach alphas >0.7 and an Eigenvalue >1.0 were kept for analysis within the model. Pairwise correlations were conducted to confirm the level of agreement and statistical significance between each of the variables being combined.

Table 14 Factor analysis results

Factor	Number of items	Chronbach's alpha	Eigenvalue	Proportion explained
Parents' personal attitudes	7	0.764	3.742	0.533
Parents' perception of crime	3	0.772	2.271	0.757
Parents' perception of traffic	3	0.715	2.058	0.686
Children's personal attitudes	7	0.736	3.313	0.473
Children's perception of crime	6	0.789	3.345	0.558
Children's perception of traffic	4	0.712	2.201	0.550
School buffer BE:				
To school	4	0.931	3.250	0.813
From school	2	0.807	1.652	0.826

The factor related to parent's perceptions of traffic included the variable representing the statement "most drivers go too fast while driving in our neighbourhood", but it was poorly correlated with the other three variables as determined through pairwise correlation; after removing it, the Cronbach's alpha improved from 0.68 to 0.71. In this instance, the variable was permanently removed from the creation of the factor. For the remainder of factors related to personal attitudes, traffic, and crime, the Cronbach's alpha and Eigenvalues for the hypothesized combinations of variables were sufficient and confirmed through pairwise correlation.

Regardless of the combination of variables for the factors related to perceptions of the BE, the necessary alpha threshold could not be achieved for either parents or children. The tests showed that the variables were not related to a high enough degree to be combined into a single factor. In order to not have over-representation of BE perception factors within the model, we used the most statistically significant variable from bivariate analysis (i.e., "there are nearby walking/bike lanes or trails in or near my neighbourhood that are easy to get to") to represent parents' and children's perceptions of the BE.

Due to the multicolinearity of the objective BE variables within the school buffers, factors were also created to capture the significant variables for the journey to and from school. The results of these factors can also be found in Table 14.

Once the factors were created, associations were tested for between the factors and children's AT to and from school using bivariate analysis and paired t-tests (Table 15). The personal attitudes and traffic factors of both parents and children were

statistically associated with both the journey to and from school. As the personal attitudes towards AT became more negative and as the fear of traffic rose, the likelihood of a child using AT to and from school decreased.

Parents' and children's perceptions of safety related to crime was only associated with AT on the journey home from school; whereas the BE perception variable was only associated with AT for the journey to school in the morning. For the final model, the two factors of crime and the BE were only entered into the model related to the journey between home and school for which they were found to be statistically correlated.

Table 15 Parents' and children's perception factors' influence on AT to and from school

		***TO* School**		***FROM* School**	
Factor	**Variable Direction**	**Effect on AT *to* school**	**p-value (n)**	**Effect on AT *from* school**	**p-value (n)**
Children Perceptions					
Personal attitudes	^ negative attitude	- AT	0.0001 (324)	- AT	0.0000 (290)
Safety: traffic related	^ fear of traffic	- AT	0.0060 (324)	- AT	0.0000 (289)
Safety: crime related	^ fear of crime		0.3489 (288)	- AT	0.0115 (255)
BE: Nearby bike lanes and paths	^ number of paths	+ AT	0.039 (852)		0.667 (818)
Parents Perceptions					
Personal attitudes	^ negative attitude	- AT	0.0001 (123)	- AT	0.0017 (103)
Safety: traffic related	^ fear of traffic	- AT	0.0003 (233)	- AT	0.0266 (209)
Safety: crime related	^ fear of crime		0.1243 (603)	- AT	0.0374 (579)
BE: Nearby bike lanes and paths	^ number of paths	+ AT	0.012 (249)		0.270 (225)

Notes:
Variable direction = direction of the variables change that led to the effect on AT
Effect on AT = '+' represents an statistically significant increase in AT due to the direction of the variable, and '-' represents a statistically significant decrease in AT due to the variables direction
n = sample size of children living within walking distance of their school (1.6km)
p-value < 0.05 = statistically significant association between the objective built environment variables and children's use of AT

4.6 Logistic regression models: overall influence of factors on children's use of AT to and from school

The step-wise logistic regression models were used to test the level of significance and goodness of fit for each step of the models when factors related to objective variables, parents' perceptions, and children's perceptions were combined. Two separate models were created; one for the journey *to* school and the other for the journey *from* school. The first step of each model ran three individual models related to the aforementioned categories for the journey to and the journey from school. The first stage of each model ran objective variables, which BE variables of statistical significance, age, gender, and parental education. The second stage was comprised of significant parents' perceptions variables, and the third stage consisted of the children's perceptions of significance.

Once each stage was run independently, they were combined into pairs with each of the other factor categories. For example, the individual model containing objective variables was run a second time with the addition of the parent's perception factors, and again with the children's perception factors. Each stage of the model went through pairings with each of the other categories before being combined into a final full model comprised of all three categories. The results of each pairing and the final model do not always contain all factors as those that did not contribute to an improved Pseudo R-square were removed to achieve the greatest fit of the model.

Each step of the models were run through logistic regression testing for the Pseudo R2, Akaike information criterion (AIC), and Bayesian information criterion (BIC) to measure their relative goodness of fit. The closer Pseudo R2 approached the number 1, the better the fit of the model. For AIC and BIC the lower the number the more improved the fit of the statistical model. Tables 17-19 display the results of the models for the journey *to* school, while Tables 20-22 represent the journey *from* school. Each table begins with the results of one of the three factor categories, followed by its pairing to the other two, and completed with the full model in the final column. Therefore, the final column of each table contains the same results. The result of each stage of the models will now be discussed.

4.6.1 Models for journey to school

Most previous studies in this field only look at one direction of student's travel between home and school; however, due to the finding that more children use AT in the afternoon than in the morning, the model was conducted twice to include the relevant factors for both the journey from home to school, and from school to home. The following results describe the findings of the model measuring influences on the journey *to* school.

Table 16 Progression of model *to* school beginning with Objective Factors

Travel TO School	Step 1	Step 2	Step 3	Full Model
Factors	OR/(SE)	OR/(SE)	OR/(SE)	OR/(SE)
Built Environment Factor - school buffer	1.237+	1.542	1.583*	1.837+
	(0.14)	(0.45)	(0.36)	(0.61)
Major Road- home buffer	0.740**		0.597*	
	(0.08)		(0.12)	
Age	1.058		1.138	
	(0.11)		(0.20)	
Gender	1.438+	2.615+	0.790	2.787
	(0.29)	(1.52)	(0.27)	(1.78)
Parental Education	0.887	0.758	0.738	0.850
	(0.12)	(0.33)	(0.18)	(0.41)
Personal Attitudes-Parent Factor		0.522*		0.680
		(0.15)		(0.22)
Built Environment Perception-Parent Factor		1.581+		1.554
		(0.43)		(0.47)
Personal Attitudes-Child Factor			0.468**	0.268**
			(0.11)	(0.12)
Traffic Perception-Child Factor			1.428	2.758*
			(0.36)	(1.38)
Built Environment Perception-Child Factor			1.175	
			(0.22)	
Adj. R-Squared	0.030	0.174	0.111	0.274
Bayesian Information Criterion	641.609	110.858	262.096	106.648
Akaike Information Criterion	615.663	96.132	232.593	87.492
Sample Size	558	86	196	81

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes:
OR = Odds Ratio SE = Standard Error
Step 1 = Objective factors
Step 2 = Objective factors + parents' perceptions
Step 3 = Objective factors + children's perceptions

Table 17 Progression of model *to* school beginning with Parents' Perceptions

Travel TO School	Step 1	Step 2	Step 3	Full Model
Factors	OR/(SE)	OR/(SE)	OR/(SE)	OR/(SE)
Personal Attitudes-Parent Factor	0.446*	0.525+	0.522*	0.680
	(0.15)	(0.19)	(0.15)	(0.22)
Traffic Perception-Parent Factor	0.953	1.192		
	(0.33)	(0.47)		
Built Environment Perception-Parent Factor	1.457+	1.487	1.581+	1.554
	(0.32)	(0.39)	(0.43)	(0.47)
Personal Attitudes-Child Factor		0.537*		0.268**
		(0.16)		(0.12)
Traffic Perception-Child Factor		1.301		2.758*
		(0.43)		(1.38)
Built Environment Perception-Child Factor		1.046		
		(0.30)		
Built Environment Factor - school buffer			1.542	1.837+
			(0.45)	(0.61)
Gender			2.615+	2.787
			(1.52)	(1.78)
Parental Education			0.758	0.850
			(0.33)	(0.41)
Adj. R-Squared	0.117	0.145	0.174	0.274
Bayesian Information Criterion	144.434	146.563	110.858	106.648
Akaike Information Criterion	133.251	127.471	96.132	87.492
Sample Size	121	113	86	81

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes:
OR = Odds Ratio SE = Standard Error
Step 1 = Parents' perceptions
Step 2 = Parents' perceptions + children's perceptions
Step 3 = Parents' perceptions + objective factors

Table 18 Progression of model *to* school beginning with Children's Perceptions

Travel TO School	Step 1	Step 2	Step 3	Full Model
Factors	OR/(SE)	OR/(SE)	OR/(SE)	OR/(SE)
Personal Attitudes-Child Factor	0.621**	0.537*	0.468**	0.268**
	(0.10)	(0.16)	(0.11)	(0.12)
Traffic Perception-Child Factor	0.899	1.301	1.428	2.758*
	(0.16)	(0.43)	(0.36)	(1.38)
Built Environment Perception-Child Factor	1.229	1.046	1.175	
	(0.17)	(0.30)	(0.22)	
Personal Attitudes-Parent Factor		0.525+		0.680
		(0.19)		(0.22)
Traffic Perception-Parent Factor		1.192		
		(0.47)		
Built Environment Perception-Parent Factor		1.487		1.554
		(0.39)		(0.47)
Built Environment Factor - school buffer			1.583*	1.837+
			(0.36)	(0.61)
Major Road- home buffer			0.597*	
			(0.12)	
Age			1.138	
			(0.20)	
Gender			0.790	2.787
			(0.27)	(1.78)
Parental Education			0.738	0.850
			(0.18)	(0.41)
Adj. R-Squared	0.049	0.145	0.111	0.274
Bayesian Information Criterion	382.673	146.563	262.096	106.648
Akaike Information Criterion	367.675	127.471	232.593	87.492
Sample Size	314	113	196	81

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes:
OR = Odds Ratio SE = Standard Error
Step 1 = Children's perceptions
Step 2 = Children's perceptions + parents' perceptions
Step 3 = Children's perceptions + objective factors

When the first stage of the model measuring objective BE variables was run independently, the only statistically significant variable was the total length of major roads within the home buffer (greater length decreased the odds of a child using AT to school: $OR = 0.740$, $p < 0.01$). Personal attitudes towards AT to school came out as the most important factor for both the parents' ($OR = 0.446$, $p < 0.05$) and children's ($OR = 0.621$, $p < 0.01$) perception models. The more negative the personal attitudes towards AT, the greater the odds that children would not use AT. Of the three independent models, parents' perceptions showed the greatest goodness of fit, followed by children's perceptions and then objective factors.

The next step of the model involved the combination of stages. Variables were removed to achieve the best fit of each of the combined models. When the objective variables were combined with parents' perceptions, the only statistically significant variable was parents' personal attitudes where the odds of using AT decreased as parents' poor attitudes increased ($OR = 0.522$, $p < 0.05$). The goodness of fit was greatly improved for objective variables but only slightly improved for the parents' perceptions.

The combination of objective variables and children's perception factors improved the goodness of fit for both models. The school buffer BE factor ($OR = 1.583$, $p < 0.05$), major roads within the home buffer ($OR = 0.597$, $p < 0.05$), and children's personal attitudes ($OR = 0.468$, $p < 0.01$) came out as significant factors influencing children's AT to school. This means that more area within a school buffer attributed to multiuse paths, lengths of bike lanes and sidewalks, and higher dwelling densities increases the odds of a child using AT. Greater lengths of major roads within the home buffer and children's increased perception of barriers through poor personal attitudes conversely reduce the odds of a child using AT.

Combining parents' and children's perceptions greatly improved the fit of the children's perceptions model, but barely changed that of the parents' perceptions model. This shows an importance for inclusion of parents' perceptions in a model of children's use of AT; however, the only significant variable out of the six in this combined model was children's personal attitudes ($OR = 0.537$, $p < 0.05$). The odds of children using AT based on children's negative personal attitudes towards AT decreased even further with the addition of parental attitudes. This finding indicates that while the addition of

children's perceptions hardly improves the parent's perception model, the addition of children's variables is necessary as they are more influential on the final outcome of children's MOT.

When all three models were combined into one, adding a third model increased the goodness of fit for all of the already combined pairs of models. Children's personal attitudes was again negatively correlated with AT with the odds of not using AT more than doubling from the independent model of children's perception factors ($OR = 0.268$, $p < 0.01$). As children's perceptions of traffic danger increases, the odds of using AT more than doubles ($OR = 2.758$, $p < 0.05$), but again in the opposite direction as expected. However, the standard error is much greater than all of the other variables in the model, showing it is not as reliable of a statistic.

As can be seen in Table 19, the final model for the journey to school that achieved the greatest fit included: the school buffer BE factor, gender, parental education, parents' personal attitudes, parents' perception of the BE, children's personal attitudes, and children's perception of traffic danger. This combination of factors showed the greatest strength for determining the influences on children's use of AT to school, with children's personal attitudes towards AT being the greatest inhibiting factor.

4.6.2 Models for journey from school

In the independent model of objective variables, the variable of network distance between home and school ($OR = 1.000$, $p < 0.01$) and major road length within the home buffer ($OR = 0.679$, $p < 0.01$) came out as significant factors determining children's use of AT home from school. However, with network distance having an odds ratio of 1, it becomes null. For the independent models of parents' and children's perceptions, personal attitudes (children's: $OR = 0.652$, $p < 0.05$; parent's: $OR = 0.333$, $p < 0.01$) towards the journey home came out as significant. This was also the case for the journey to school, but the odds of children using AT based on parents' perception factors was even lower than for the journey to school. Also similar to the models for AT on the journey to school, parents' perceptions again had the greatest goodness of fit, followed by children's perceptions and objective variables.

When parents' perceptions were combined with objective variables, parents' personal attitudes ($OR = 0.390$, $p < 0.05$) came out as a significant barrier to the use of AT and the goodness of fit was improved from both individual models. The goodness of fit was also improved through the combination of children's perceptions to objective variables where children's personal attitudes ($OR = 0.507$, $p < 0.01$) reduced the odds of using AT, and increasing age ($OR = 2.176$, $p < 0.001$) led to two times the odds of children using AT. Combining children's and parents' perceptions led to parent's personal attitudes ($OR = 0.390$, $p < 0.05$) being the only significant contributing factor to using AT, which is different from the journey to school where children's attitudes were more significant. The effect on the goodness of fit was similar to that of the journey to school, whereby the children's perceptions model was greatly improved while the variable for parents' perceptions was not improved to the same extent.

When all three stages were combined for the final model, parent's personal attitudes, age, and, all BE variables lost their influence on children's use of AT as children's personal attitudes ($OR = 0.388$, $p < 0.05$) was the only resulting statistically significant factor. The odds of a child using AT based on their personal attitudes doubled from the independent children's perceptions model to the final model showing that it is not only statistically significant, but also quite influential.

The factors within the final model for the journey home from school included the school buffer BE factor, major road length within the home buffer, network distance between home and school, age, and personal attitudes of parents and children. This combination of variables showed the greatest goodness of fit for determining influences on the journey home from school.

Table 19 Progression of model *from* school beginning with Objective Factors

Travel FROM School	Step 1	Step 2	Step 3	Full Model
Factors	OR/(SE)	OR/(SE)	OR/(SE)	OR/(SE)
Built Environment Factor - school buffer	1.289+	1.490		1.316
	(0.18)	(0.55)		(0.63)
Major Road Length - home buffer	0.679**		0.769	1.491
	(0.09)		(0.16)	(0.89)
Network Distance	1.000**	0.999	1.000+	1.000
	(0.00)	(0.00)	(0.00)	(0.00)
Age	1.290+	1.562	2.176***	1.985+
	(0.17)	(0.56)	(0.47)	(0.81)
Gender	1.094		0.757	
	(0.29)		(0.32)	
Parental Education	0.970	1.304		
	(0.17)	(0.65)		
Personal Attitudes-Parent Factor		0.504*		0.709
		(0.18)		(0.25)
Perception of Crime-Parent Factor		1.231		
		(0.46)		
Personal Attitudes-Child Factor			0.507**	0.388*
			(0.11)	(0.15)
Perception of Crime-Child Factor			0.754	
			(0.18)	
Adj. R-Squared	0.061	0.181	0.185	0.280
Bayesian Information Criterion	452.242	88.308	201.336	83.459
Akaike Information Criterion	422.227	72.771	177.940	67.426
Sample Size	538	68	209	73

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes:
OR = Odds Ratio SE = Standard Error
Step 1 = Objective factors
Step 2 = Objective factors + parents' perceptions
Step 3 = Objective factors + children's perceptions

Table 20 Progression of model *from* school beginning with Parents' Perceptions

Travel FROM School	Step 1	Step 2	Step 3	Full Model
Parents' Perceptions Models	OR/(SE)	OR/(SE)	OR/(SE)	OR/(SE)
Personal Attitudes-Parent Factor	0.333**	0.390*	0.504*	0.709
	(0.14)	(0.17)	(0.18)	(0.25)
Traffic Perception-Parent Factor	1.166	1.396		
	(0.45)	(0.63)		
Crime Perception-Parent Factor	1.539	1.752+	1.231	
	(0.43)	(0.59)	(0.46)	
Personal Attitudes-Child Factor		0.571		0.388*
		(0.21)		(0.15)
c_traffic_fullpol1		0.915		
		(0.39)		
Perception of Crime-Child Factor		0.679		
		(0.26)		
Built Environment Factor - school buffer			1.490	1.316
			(0.55)	(0.63)
Network Distance			0.999	1.000
			(0.00)	(0.00)
Age			1.562	1.985+
			(0.56)	(0.81)
Parental Education			1.304	
			(0.65)	
Major Road Length - home buffer				1.491
				(0.89)
Pseudo R-Squared	0.101	0.183	0.181	0.280
Bayesian Information Criterion	117.488	109.855	88.308	83.459
Akaike Information Criterion	107.067	92.279	72.771	67.426
Sample Size	100	91	68	73

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes:
OR = Odds Ratio SE = Standard Error
Step 1 = Parents' perceptions
Step 2 = Parents' perceptions + children's perceptions
Step 3 = Parents' perceptions + objective factors

Table 21 Progression of model *from* school beginning with Children's Perceptions

Travel FROM School	Step 1	Step 2	Step 3	Full Model
Factors	OR/(SE)	OR/(SE)	OR/(SE)	OR/(SE)
Personal Attitudes-Child Factor	0.652*	0.571	0.507**	0.388*
	(0.13)	(0.21)	(0.11)	(0.15)
Traffic Perception-Child Factor	0.671	0.915		
	(0.17)	(0.39)		
Perception of Crime-Child Factor	0.830	0.679	0.754	
	(0.18)	(0.26)	(0.18)	
Personal Attitudes-Parent Factor		0.390*		0.709
		(0.17)		(0.25)
Traffic Perception-Parent Factor		1.396		
		(0.63)		
Crime Perception-Parent Factor		1.752+		
		(0.59)		
Major Road Length - home buffer			0.769	1.491
			(0.16)	(0.89)
Network Distance			1.000+	1.000
			(0.00)	(0.00)
Age			2.176***	1.985+
			(0.47)	(0.81)
Gender			0.757	
			(0.32)	
Built Environment Factor - school buffer				1.316
				(0.63)
Adj. R-Squared	0.079	0.183	0.185	0.280
Bayesian Information Criterion	239.956	109.855	201.336	83.459
Akaike Information Criterion	225.951	92.279	177.940	67.426
Sample Size	245	91	209	73

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes:
OR = Odds Ratio SE = Standard Error
Step 1 = Children's perceptions
Step 2 = Children's perceptions + parents' perceptions
Step 3 = Children's perceptions + objective factors

4.6.3 Key Variables

The factors found to be significant changed slightly based on which step of the model was being conducted. When objective variables were run independently, major road length was the only significant variable to school. Parents' and children's personal attitudes each came out as significant when run in the independent models including perceptions of traffic and their local BE. The final model, however, is what shows the overall most important factor(s) when controlling for all others, and for the journey to school, children's personal attitudes was determined to be the most important factor.

The journey home from school had more influential objective variables when they were run independently, including major road length, network distance, and age. Personal attitudes of parents and children were once again the most important factors within their independent perceptions models with age also appearing as an important factor during the pairing of models. Age, however, lost its influence when all three models were combined in the final step of the model. The final outcome of the model for the journey home from school resulted with children's personal attitudes being the sole contributing factor to their decision to use AT.

Children's personal attitudes resulted as the most influential factor in their decision to use AT in both directions between home and school. The variables that were combined to create the factors for both parents and children included responses to the statements: the distance is too far; the route is boring; the child gets too hot; they have no one to walk with; it is not fun/cool; they have too much stuff to carry; it's easier for someone else to drive them; and whether or not they are allowed to walk/bike to school. When bivariate analysis of the individual variables is referred back to, having no one to walk with ($p = 0.000$) and it being easier for someone to drive them ($p = 0.000$) were the two significant variables associated with AT for the journey to school for children. For the journey home from school, no one to walk with ($p = 0.000$), it being easier for someone to drive them ($p = 0.000$), and having too much to carry ($p = 0.008$) were significant variables according to the children's responses.

For parents, the perception that the journey is too far ($p = 0.000$), the child has too much to carry ($p = 0.000$), and it being easier for someone to drive them ($p = 0.000$) were negatively associated with children's AT to school. The same three variables along with

having no one to walk with (p = 0.000) and the child being too young (p = 0.002), were found to be associated barriers for the child's use of AT home from school.

4.7 Conclusion

A statistical analysis of children's and parents' perceptions related to children's MOT to school has produced several layers of results including comparisons of parents' and children's perceptions, the effect of age, gender, and parental education, associations of parents' and children' perceptions to children's use of AT, as well as their association when controlled for through logistic regression models. It is important to interpret and understand the meaning of the results to recognize the subsequent implications. The wide array of methods used for this study, including GIS-based analyses to derive objective measures of the built environment, as well as statistical analyses of data from parent and child surveys to derive environmental perceptions, allows for growth within fields related to both the BE as well as education and programming. Studying the perceptions of both children and parents also allows a better understanding of what aspects to include for different populations, which aids in an ecological approach towards health promotion. The key findings from this chapter will now be addressed in the following chapter and applied to new and existing programs and policies whose aims are to increase the number of children using AT between home and school.

Chapter 5

5 Discussion & Conclusion

According to Colley et al. (2011), less than 10% of Canadian children achieve the recommended levels of daily physical activity. The increase of sedentary lifestyles and caloric intake by children in today's society has led to childhood obesity rates nearly tripling in Canada over the last 25 years (Roberts et al., 2012). The journey to school for children has gained increased attention from academics and public health professionals in recent years as it potentially offers a regular opportunity for children to be physically active by walking, biking and other active modes of travel (MOT).

Increasing children's physical activity levels are not only beneficial for decreasing obesity rates, but also for aiding in the prevention of the early onset of certain illnesses normally associated with adults, such as cardiovascular disease, diabetes, asthma, certain types of cancer, and even premature death (Guh et al. 2009). If more children use active transportation (AT) to school, there should be fewer numbers of motorized vehicles around the school at the start and end of the school day; fewer cars will further benefit children's health by lowering the levels of air pollutants that can irritate breathing problems and by decreasing traffic safety concerns.

Unfortunately, the number of children using AT to school within Canada over the last 20 years has decreased by nearly 50%, and this has sparked an interest among a growing body of researchers who are trying to understand the barriers preventing children from using AT (Buliung, Mitra, & Faulkner, 2009). AT researchers from the field of geography have focused largely on built environment (BE) factors such as distance, walking and cycling infrastructures (sidewalks, bike paths, etc.), street lighting, intersection density, etc. On the other hand, AT researchers from public health have tended to study the social barriers, beliefs and perceptions of parents and children, and how these issues influence children's MOT to and from school. A contribution of this research is that it combines both traditional approaches, analysis of both BE factors and perceptions, within a single analytical model, which has rarely been done in previous studies.

Another contribution of this research is that it separately considers what elements influence the journey from home to school, versus the journey home from school. Other studies that have divided the journeys between to home and school are unknown. The decision to divide the analysis was based on previous literature and supported by the findings that reveal more children use AT home from school in the afternoon than use AT to school in the morning. The finding that both parents and children stated higher preferences for AT compared to those actually using it, indicates the existence of barriers surrounding AT, outside of a lack of desire preventing them from using AT.

This study builds upon previous methodologies from the disciplines of public health and geography, and combines sample characteristics, objective BE variables within home and school environments, and perceptions of both parents and children, in order to determine what factors significantly influence the number of children using AT to and from school. The current chapter will discuss implications of the results for researchers, urban planners, and health promoters, including how BE alterations and public health programs, initiatives, and policies can be used to increase the number of children using AT. This chapter will also address the benefits and limitations of the methods employed, and recommendations for future research in the field of children's AT to school.

5.1 Key findings & implications

5.1.1 Children's personal attitudes

The factor of greatest influence on children's use of AT as identified by the step-wise logistic regression model, in both direction between home and school, was that of children's personal attitudes. The factor was comprised of 8 perception questions from the children's survey. Bivariate analysis of each question independently identified: having no one to walk with and it being easier for someone to drive them, as statistically associated with the journey to school, while the same two variables, plus having too much to carry, were significant variables for the journey home from school.

Previous studies have found that the fewer perceived barriers of parents and children towards the journey to school, the more likely they were to walk (Napier et al., 2011). Zhu and Lee (2009) found that positive attitudes towards AT and supportive peer

influences were positively correlated with children's use of AT. Based on the findings of this study, it is recommended that to remove the barriers associated with children's personal attitudes, programs, policies, educational initiatives, or environmental alterations would have to be conducted that: 1) provide other people for children to walk with, 2) make AT a more convenient option than driving, and/or 3) lighten children's physical loads on their journey home.

It is difficult to lighten child's physical load through programs or policies; however, incorporating an educational component to instruct children and teachers on techniques to give children less to carry in the afternoon could help make AT a more pleasant option. Homework that consists of minimal books and paper, and avoids heavy items such as textbooks, are ways in which this could be accomplished.

The statement that "it is easier for someone to drive" was the only perception question of both parents and children that was negatively associated with AT in both directions between home and school. Making AT to and from school a more convenient option than being driven is a challenge. Motor vehicles are a fundamental part of North American culture; an entire societal shift would be required in order for this to change. Practically, it makes sense that driving a child to school would be convenient for parents if they are going somewhere afterwards such as work or to run errands. Having fewer children being driven in the afternoon could be attributed to mid-day being less convenient.

Similarly, practical reasons could be used to explain why more children use AT in the afternoon due to the fact that they may have other children with whom to walk. When children go to school in the morning, they are leaving from various locations. Alternatively, when they are leaving school in the afternoon, they are leaving from the same location at the same time and therefore, likely have more options for travel partners for at least part of the journey. When "who a child travels with" was cross tabulated using chi-square for the journey to and from school, children who traveled with other children were more likely to use AT. They were less likely to use AT if accompanied by an adult. Based on the necessity to travel with an adult when being driven in a motor vehicle, this finding makes sense.

In order to reduce the convenience of driving children to school, either the active choice would have to be made more convenient or driving would have to become less convenient. Methods to decrease the convenience of driving could include having a "no-car zone" at a certain distance from the school to make children walk the last portion of their journey. Other techniques could be to find ways that make driving cost more money or take more time. The opposite approach would include making AT more convenient by removing the onus on parents while maintaining the element of safety to ease their concerns. Children traveling together should also be promoted as it has been shown to increase the number of children using AT. The ideal, however, would be for adults to accompany children actively rather than in a vehicle. This would require educating parents on the value of AT to school.

One initiative that has already been practiced in several countries is that of the Walking School Bus. Kingham and Ussher (2007) describe the Walking School Bus as involving "parents or other adults escorting a group of children on a set route to school" (p. 502). A Walking School Bus can be as simple as a couple families taking turns walking their children to school or as structured as having a timetable with a planned route, meeting points, and trained volunteers (Walking School Bus, 2012). The goal of a Walking School Bus is to make the active choice more fun as well as provide adult supervision to make it safer.

Some barriers preventing schools from using Walking School Buses include liability and lack of parent volunteers. If recruiting parent volunteers becomes too onerous, other options could include training older students or utilizing retirees from within the community. If these barriers can be overcome, the benefits greatly outweigh the difficulties. Kingham and Ussher (2007), in their evaluation of Walking School Buses in Christchurch, New Zealand found that the Walking School Bus had numerous advantages. Benefits included social gains such as new friendships for children and parents, health benefits in the form of increased physical activity, and time benefits for parents who originally expected it to be time consuming but found it resulted in saving time due to rotating days. Children's independent mobility also increased as they began to broaden their walking habits to more destinations other than school. While the

Walking School Bus does not remove all barriers, it does help to address several of the key problems discovered through this study.

5.1.2 Age

Bivariate analysis revealed that age was significantly associated with children's AT both to and from school (which was consistent with previous literature that has found as children grow older, they are more likely to use AT; Lorenc et al., 2008; Rodriguez & Vogt, 2009). Age as a controlling factor in the model was more influential for the journey home from school than to school, but did not remain significant in later stages of either model.

Although age did not remain as a statistically significant factor to the end stage of the models, its existence increased the fit of the models and therefore remained relevant. Age was also correlated to several independent variables of children's and parents' perceptions. For instance, older children reported being more likely to be allowed to bike to school; they had lower fears of traffic or being bullied or teased, and they did not need someone to travel with. Younger children possessed greater fears of traffic, of being taken by a stranger, and were more likely to find it more convenient to have someone drive them to school.

Parents of younger children were more fearful of crime and of their child being taken by a stranger. These results show that the younger the child, the more important it is to provide initiatives where an adult is present to give a sense of safety. Although age was not found to be a significant factor in the final models, it still impacted other elements of parents' and children's perceptions and should therefore be considered in program planning.

5.1.3 Gender

Boys were more likely to use AT to school than girls, but there was no perceived gender difference with respect to the journey home. The literature on children's AT is inconclusive regarding the significance of gender; however, more studies find that males are more likely to use AT than females (Babey et al., 2009). The influence of gender appeared to be less influential when incorporated into the logistic regression models. The

removal of gender from the model for the journey from school improved the fit of the model, which means it is not a contributing variable in determining the likelihood of a child using AT. It did, however, remain in the model for the journey to school, but was insignificant at all stages.

The differences between genders were more apparent and statistically significant during bivariate analysis of the responses to the perceptions questions. For example, boys were more likely to feel that the journey to/from school was not fun. Girls were more likely to have fears related to crime and being taken by a stranger, a finding which has been identified in previous studies (Timperio et al., 2004). These findings suggest that there is a need for girls of this age to have someone to travel with, particularly an adult, as they have significant fears of being alone. This does not mean that girls are at a greater risk of being abducted, but if girls are left to travel alone, they are less likely to choose the active option. These results also demonstrate a need to make travelling by AT more entertaining for boys, which may be attained through travelling with peers.

5.1.4 Parents' vs. children's perceptions

Children's personal attitudes were the only significant factors in the final models, however, parents' perceptions were also important to include as their existence improved the overall fit of all models. This demonstrates the need to include both parents' and children's perceptions in studies and strategies regarding children' use of AT.

Based on their responses to several questions, significant differences existed between parents' and children's perceptions. Differences included children stating more barriers related to the BE and personal attitudes, while parents were more likely to fear crime and traffic. The most significant disparity was between the fear of crime and the child being taken by a stranger. Parents had a much greater fear than their children, which is consistent with previous literature (Ahlport et al., 2008). These results highlight the necessity to identify the particular concerns for whichever population is specifically being targeted in a promotional program or policy. In order to improve the likelihood of a parent allowing a child to use AT, for example, issues related to safety must be addressed; whereas for a child to more readily use AT, policymakers must address their personal attitudes towards AT, such as making it appear fun and an ideal option.

5.1.5 Safety

Based on previous literature and the results of factor analysis, the general issue of 'safety' was divided into societal crime and traffic safety. According to the bivariate analysis, the fear of crime, as perceived both by parents and children, was only relevant to AT for the journey home, and this variable lost its significance when added into the overall model. Traffic safety is one of the most consistently identified safety concerns in the academic literature on children's AT (Gielen et al., 2004; Ziviani et al., 2006); but even though it was associated with AT in both directions for parents and children, its influence diminished when combined with other factors within the logistic regression models.

Safety may not have been found to be the primary barrier in children's use of AT, but bivariate analysis exhibited associations that should nevertheless be considered during the development of AT promotional initiatives. There are several ways to decrease concerns about safety, whether based on objective assessments or child/parent perceptions. For example, traffic danger can be reduced through BE alterations such as providing more and better quality sidewalks, shortening travel distances through the creation of more direct pathways, creating safer terrain, offering pedestrian routes that avoid major roads, providing pedestrian-friendly traffic signals and pedestrian crossings, and various traffic calming measures such as speed bumps, narrower streets, and extended curbs (Ahlport et al., 2008; Hume et al., 2009; Retting, Ferguson, & McCartt, 2003).

Creating safe environments alone, however, will not remove all dangers associated with traffic. Children must also acquire better safety skills and habits when interacting with traffic; these skills should be taught in school and at home. Gielen et al. (2004) found that many parents lack the basic pedestrian safety facts, therefore arguing a need for consistent messaging within the school systems through curriculum. Educating parents would have to be done with care however, as instructing parents on basic traffic skills may be perceived as insulting or demeaning. Parents are often a difficult population to reach through public health education (Finders & Lewis, 2009). A possible solution could be to create a curriculum that requires children to take home traffic safety homework to be conducted with a parent or guardian. The curriculum would involve practicing traffic safety skills and identifying areas within their neighbourhood that either

promote or inhibit traffic safety. Getting a school involved in a local Active & Safe Routes to School (2012) program could also help to identify specific safety concerns and projects to aid in their removal.

5.1.6 Built environment

While BE variables were not the sole focus of this study, it was necessary to examine the BE to acquire a comprehensive understanding of the level of influence parents' and children's perceptions have on AT. Regardless of whether they were the focus or not, recommendations for future initiatives can still be made based on the results of the findings to promote children's use of AT.

The objectively-measured variable pertaining to total lengths of major roads within the home neighbourhood buffer was statistically associated with the journey to and from school, but when combined with other steps of the model, it lost its level of influence to parents' and children's personal attitudes. Having major roads to cross was another perception barrier negatively associated with AT to school for parents, and to and from school for children. The existence of major roads, while not the most influential factor found through the statistical modeling, still showed a negative correlation to children's use of AT both objectively and subjectively, as the barrier of "there being too many busy streets to cross" was significantly correlated with more children using passive MOT according to both parents' and children's responses.

The ideal method to reduce the barriers attributed with major roads would be to build schools at least 1.6km from any major road so children within walking distance could reach school without having to cross a major road. Unfortunately, most schools and roads are already built and their locations cannot be altered. Alternatively, routes could be mapped that direct children away from major roads. This may unfortunately increase the distance children need to travel between home and school (which has been found as a key deterrent to children's use of AT in previous literature). If major roads cannot be avoided, or avoiding them increases the travel distance so much that it decreases children's likelihood of using AT, then traffic calming measures or crossing aids such as cross-walk signals and crossing guards should be implemented at major roads to make crossing safer, both in actuality and perceptively.

5.1.7 Distance

Distance is the most consistently-identified environmental factor associated with children's use of AT for the journey between home and school. The sample for analysis within this study was reduced to exclude all students living outside of 1.6km ('as the crow flies') to only include those who are deemed as "within walking distance" according to school board policies for bussing cut-offs, to help control for distance. Studies are inconclusive on what distance is perceived as "walkable", but 1.6km appears to be an appropriate cut-off for this study as 92.3% of children and 95.1% of parents living within this buffer stated that they lived "within walking distance" of their school. Network distances between each subject's school and home locations were also calculated to test the level of association between a more precise distance and their use of AT. Surprisingly, network distance was only associated with the journey home from school and lost that level of influence as parents' and children's perception factors were added into the model. It may be that distance appeared to be more influential for the journey home from school than the journey to school because the timing of parents' work schedules typically allow them to drop their children off at school in the morning, whereas the typical school day ends before the typical adult work day, making it too difficult for many parents to drive their children home from school. The results of this study do not support previous research that identifies distance as the most influential factor, but does show how important it is to combine objective variables with perceptions.

5.2 Perceptions vs. reality

Studying BE variables and perceptions simultaneously can raise many new questions around how the objective characteristics influence perceptions of the same features. For example, when subjects are asked whether or not there are enough sidewalks in their neighbourhood, it is interesting to know if their perceptions reflect reality. Understanding this phenomenon however is outside of the scope of this thesis. The purpose of this study is to understand the influence of perceptions while controlling for more objective measures. Applying parents' and children's perceptions are vital because perceptions *are* real to the person who holds them. It does not matter how safe a neighbourhood actually

is, for if it is perceived as dangerous, the level of interaction and trust within it will be lower due to the perceived danger. For example, the number of children abducted by strangers within Canada every year may be very low; however, parent's fear of possible child abduction is high and results in a child's independence being restricted. Parents could be educated on the realities of child abduction; however, they could take offence if they feel they are being told their perceptions are irrational. It therefore becomes more important to approach their perceptions as reality and create innovative ways to remove perceived barriers. In the case of stranger danger, initiatives could be implemented that promote travelling together or having an adult present to ease parents' concerns.

While it is important to consider perceptions as reality, people's perceptions are often influenced by reality and can therefore be altered through objective changes. In the case of stranger danger, parents' fear is not based on reality. However, if there was a general fear of crime in the neighbourhood, perhaps a reduction in petty crimes associated with increased police presence could possibly reduce the overall perceptions and fear of crime.

A similar approach can be taken with respect to several topics related to perceptions. For example, the perception of distance can be objectively altered by building a path to reduce the distance from point A to B. It can also be subjectively altered by creating aesthetic improvements such as street trees and less open space making the journey more appealing and causing it to feel shorter (Sinnett, William, Chatterjee, & Cavill, 2011). Although it is assumed that fewer objective barriers will result in fewer perceived barriers, it remains important to take both into consideration for an ecological approach to programming.

5.3 Ecological framework

The framework of this study allowed for a more holistic understanding of the topic area of children's AT to and from school, and for an ecological approach to be implemented during promotional initiatives. The surveys used in this study were developed to acquire information on perceptions of parents and children, family composition, and personal characteristics such as parental education and income level. Environmental factors were also generated through the analysis of BE data using Geographic Information Systems

(GIS). Several studies in the past have only focused on one area of influence: environmental or behavioural. By expanding the study to include both topic areas, knowledge was obtained for application to a broader range of interventions. While additional variables could have been beneficial for a more complete ecological model, several levels of influence were obtained through this study that allow for the development of holistic applications.

Ecological frameworks allow for multi-level interventions that combine personal, environmental, and political factors, to have the greatest impact on changing behaviours (Sallis et al. 2006; Sallis & Owen, 2002). Application of results through an ecological framework allow for impacts on the BE through planning, education and programming through public health promotion, and policy development on a multitude of levels. Individual behaviours and perceptions can be the focus of these initiatives, or disparities between populations can be reduced through the direction of programs towards specific sub-populations such as certain SES groups, ethnicities, ages, or genders.

Not every barrier can be targeted through multiple avenues, but the topic of children's AT to and from school has multiple levels and types of barriers that prevent its use. It has been shown that several levels of initiatives that target multiple barriers will have the greatest impact (Sallis et al. 2006). Even if only one barrier can be targeted, it should be addressed from many angles. For instance, in targeting children's personal attitudes, the following means could be utilized: encompassing an educational component in the school and sending it home for parents, doing promotional activities such as International Walk to School Day or Walking Club, creating car-free zones surrounding the school to make driving a less convenient option, and advocating for monies to be allocated towards a Walking School Bus leader (Active & Safe Routes to School, 2012). A multi-pronged approach targets promotion, education, community involvement, and policy. There are several options for every tactic, but the key is to consider all angles when approaching promotion of AT.

5.4 Limitations

As with any study, there are limitations that must be considered during the interpretation of the results of this study before implementing recommendations based on them, or

using them to build upon for further research. Conducting the survey under the STEAM project had several benefits such as increased staff and resources to conduct a large-scale survey, but using a previously established survey and methodology also resulted in study limitations. While several steps were taken to maintain the quality of data and analysis, it is important to understand the limitations of the study to fully grasp the meaning of the results.

The use of a previously created survey allowed for a much larger sample size to be obtained due to two previous surveys being conducted through the Human Environments Analysis Laboratory (HEAL) that could be joined with the primary dataset. However, this also meant that there was less control in the creation of the surveys. The parent surveys from the two previous studies only consisted of socio-demographic questions; this led to a much lower response rate among parents' perceptions and MOT questions. However, to have not used the previous surveys at all would have resulted in losing all of the rich data from the children's surveys.

An additional difficulty was experienced through the process of combining multiple datasets. Small changes were made to questions in the surveys that required careful attention during data merging. Steps were taken to decrease the error by often times having two people working on the dataset simultaneously, using Stata 'do-files' to keep a record of all changes so if an error was identified, the data could be corrected by re-running the entire 'do-file'. However, this process opened up the possibility for human error.

The different surveys also had different levels of geographic precision with respect to the locations of each respondent's "home". Earlier surveys asked for children's postal codes rather than precise address (as dictated by the UWO-REB), while most STEAM participants had a spatial mean from their Global Positioning Systems (GPS) tracks that represented the exact location of their home. If a survey was missing the postal code, it resulted in the child being removed from analysis. For children who we only had a postal code and no GPS tracks, the centroid of that postal code was used to represent the location of their home. The ideal would have been to have GPS spatial means for all children, but most previous studies in this field still only use address proxies such as postal codes, and therefore even though two different measurements of children's homes

were used, the methodology was improved upon through the precision obtained for some students.

5.5 Recommendations for future research

The results of this study established children's personal attitudes towards AT between home and school as the most influential barrier to AT. Eight questions were combined to compose that factor, but this does not mean there are no other possible influences yet to be explored. Further research should be conducted to determine what aspects of attitudes are most influential, while controlling for the ease of driving, as that appears to be a leading barrier. Controlling for driving may remove it as a barrier to allow additional barriers to surface that can be implemented into current programs and policies to reduce their effect, so they are not as restricting when the time comes that driving is no longer the most convenient travel option.

The rates of children using AT within this sample were higher than in other Canadian city contexts. A study of AT in the Greater Toronto Area (GTA) found rates of AT to school ranging from 36.1-48.1% (Buliung, Mitra, & Faulkner, 2009). A pilot study conducted in the Region of Peel and the City of Hamilton found 38% of children using AT to school versus 41% using it on the journey home from school (Metrolinx, 2011). The rates of AT within this thesis found 48.5% of children using AT for the journey to school and 55.5% for the journey home. London is a smaller city than those located in and around the GTA, which may better represent other similar cities across Canada. However, this shows a need for further research to be conducted in different contexts to determine generalizable AT rates and contributing factors.

The use of an ecological framework allowed for representation of personal characteristics, family composition, parents' and children's perceptions, and environmental factors. To gain a broader understanding of the influences involved in children's journeys between home and school, it is recommended that these three topic areas continue to be combined, but in addition to societal and individual rules/policies and more objective variables.

Within this study, objective variables and counterparts of perceptions questions were only acquired for the BE and traffic. Analyzing the comparisons between objective

and subjective values was outside of the scope of this study; however, understanding these comparisons would be a good next step to fully understanding the intricacies of the influencing factors. For example, no objective variable was obtained for crime for this study, but it could be valuable in future research. Crime was not used in this study due to the lack of an appropriate and measurable variable for a multi-dimensional factor such as crime, as well as the City of London, Ontario having a relatively low crime rate.

Lastly, Figure 5 in chapter 4 displayed the difference between parents' and children's preferred MOT and their actual modes. Children had much higher preferences for wheeled methods such as biking, skateboarding, and scootering, showing a need for additional research to be conducted to identify the barriers preventing children from using these modes. This depth of understanding was not possible through this study as the sample size of children using wheeled modes was statistically too small. Therefore, once a larger sample size is acquired, the way to motivate children to use wheeled MOT should be explored, as it would be an excellent way to increase the number of children using AT between home and school.

5.6 Conclusion

The purpose of this study was to determine how parents' and children's perceptions of their built and social environments influence children's MOT to and from school. The results found that children's personal attitudes towards AT, including the ease of being driven, having too much to carry, and having no one to walk with, were primary barriers to their use of AT to and from school. These findings demonstrate the need for AT promotion programs and policies to provide children with other people to walk with (that includes at least one adult), to make driving a less convenient option, and to reduce the load children have to carry home.

The rates of children using AT in Canada continue to decline, even though children and parents were found to prefer active MOT. Children that use AT have been found to have higher levels of physical activity, energy expenditure, and increased likelihood of attaining physical activity guidelines than those who are driven to school (Pont, Ziviani, Wadley, Bennett, & Abbott, 2009; Rodriguez & Vogt, 2009; Timperio et

al., 2006). Therefore, it is important to find ways to remove barriers preventing children from using the healthy option of AT.

Increasing the use of AT and physical activity among children has the possibility of improving the health of society, as health habits and conditions such as heart disease and obesity have been shown to carry on into adulthood. Creating environments conducive to children using AT also make society more accessible for all people including other disadvantaged individuals such as the elderly and those with disabilities. The results of this study display how important it is to acquire children's opinions and perceptions when researching a topic related to them, and developing evidence-based interventions. This study also gives examples of how public health professionals, policy makers, and urban planners can work together from an ecological approach to create the greatest impact upon children's AT behaviours. The importance of children's perceptions and opinions should also be valued by these disciplines because if they create a community that is safe and accessible for children, it will be safe and accessible for all.

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Appendices

Appendix A Ethics Approval for STEAM 1

Office of Research Ethics

The University of Western Ontario
Room 4180 Support Services Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

COPY

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. J. Gilliland
Review Number: 16455S **Review Level:** Full Board
Review Date: August 11, 2009
Protocol Title: Emerging Methodologies for Examining Environmental Influences on Children's Exposure to Air Pollution
Department and Institution: Geography, University of Western Ontario
Sponsor:
Ethics Approval Date: December 01, 2009 **Expiry Date:** August 31, 2010
Documents Reviewed and Approved: UWO Protocol, Letter of Information and Consent, Assent.
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the study or consent form may be initiated without prior written approval from the NMREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the NMREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the NMREB.

Chair of NMREB: Dr. Jerry Paquette

Ethics Officer to Contact for Further Information			
Grace Kelly	☐ Janice Sutherland	☐ Elizabeth Wambolt	☐ Denise Grafton

cc: ORE File

This is an official document. Please retain the original in your files.

Appendix B Ethics Approval for STEAM 2

Research Western

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Jason Gilliland
Review Number: 17918S
Review Level: Delegated
Approved Local Adult Participants: 1200
Approved Local Minor Participants: 1200
Protocol Title: Identifying casual effects on the built environment on physical activity, diet, and obesity among children.
Department & Institution: Social Science\Geography, University of Western Ontario
Sponsor: Canadian Institutes of Health Research
Heart and Stroke Foundation of Canada

Ethics Approval Date: June 08, 2011 **Expiry Date:** August 31, 2014

Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
Other	Revised Healthy Neighbourhood Survey for Parents.	
Other	Revised Health Neighbourhoods Survey for Youth	
Other	Revised Activity and Travel Diary for School Days and Weekend Days.	

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussions related to, nor vote on, such studies when they are presented to the NMREB.

The Chair of the NMREB is Dr. Riley Hinson. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer to Contact for Further Information

Grace Kelly | Janice Sutherland

This is an official document. Please retain the original in your files.

The **University** *of* **Western Ontario**
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Appendix C Ethics Approval for CIHR study conducted by the HEAL

Western

Office of Research Ethics

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Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. J.A. Gilliland
Review Number: 11971E **Review Date:** January 17, 2007 **Revision Number: 4**
Protocol Title: Assessing the influence of environmental factors on obesity-related behaviours in youth.
Department and Institution: Geography, University of Western Ontario
Sponsor:
Ethics Approval Date: January 17, 2007 **Expiry Date:** December 31, 2007
Documents Reviewed and Approved: Revised study end date
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted expedited approval to the above named research study on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the HSREB:
a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

Chair of HSREB: Dr. John W. McDonald
Deputy Chair: Susan Hoddinott

Ethics Officer to Contact for Further Information

Denise Grafton ☐ Janice Sutherland ☐ Jennifer McEwen

cc: ORE File

This is an official document. Please retain the original in your files.

Appendix D Children's Survey (reduced STEAM 2 survey to provide relevant questions)

Healthy Neighbourhoods Survey for Youth

We need your help to make our study a success. Your honest answers to the items in this survey are very important to us. This will not take too long to complete. Remember….

- we want to know what you think,
- there are no right or wrong answers, and
- everything you tell us will be kept strictly confidential (secret).
- try to answer all the questions

Please answer these questions thinking about the house and neighborhood that you live in the most.

A. General information

Today's date? _____

1. I am O female O male 1a. My current age is _____ years old.

1b. Please circle the month in which you were born

Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

2. My primary home (where you sleep most or all nights) is a :

O single-parent household O two-parent household O other _____

3. My home:
   - O I live in one home (sleep all nights in the same home)
   - O I split my time equally between 2 homes / parents
   - O I live in mostly one home but regularly visit/live in a second home / parent
   - O I have another home arrangement _____

4. How many people live (including yourself AND other children) in your primary household?

O 2 O 3 O 4 O 5 O 6 or more

5. How many other children (NOT including yourself) live in your primary household

O 1 O 2 O 3 O 4 O 5 or more

6. Postal code at your primary home_____

7. How many days a week do you live at this address?

1 2 3 4 5 6 7

8. What kind of housing is your primary home?

O a single family house (not attached to any others)
O a semi-detached house (a house attached to just ONE other house)
O a townhouse or row house (a house attached to several other houses)
O an apartment building
O other _____

9. If you have a secondary home (where you sleep some nights), what is its Postal Code:

_____

10. What is your primary race / ethnic background (Check ONE or TWO)?:

O White
O Chinese
O Black
O Latin American
O Arab
O Japanese
O other _____
O North American Indian, Metis or Inuit
O South Asian (e.g. East Indian, Pakistani, Sri Lankan)
O Filipino
O Southeast Asian (e.g. Cambodian, Vietnamese)
O West Asian (e.g. Afghan, Iranian)
O Korean
O I prefer not to answer

11. My current height is: _____ cm OR _____ ft _____ in

12. My current weight is: _____ kg OR _____ pounds *(If you're not sure, please give us your best guess)*

13. Do you have asthma or regularly have breathing problems?

O Yes O No 13a. If so, do you use an inhaler? O Yes O No

14. How many smokers are there in your (main/primary) home?

O none O 1 O 2 or more

15. Do you have a dog? O Yes O No

15a. If Yes, on how many days <u>last week</u> did **YOU** walk your dog?

0 days 1 2 3 4 5 or more days

16. Have you and your family moved homes within the last 2 years? O Yes O No

17. What grade are you currently in? _____

C. Your Trip To and From School

The following questions are about how you get to and from school each day. Please <u>circle or fill in the best answer</u> for you and your school.

1. Do you live within walking distance of your school?

O Yes O No

2. NUMBER OF DAYS PER WEEK YOU **<u>USUALLY</u>** TRAVEL **<u>TO</u>** SCHOOL BY:

Ex: if you always ride the bus TO school, circle 5 in the row "school bus". Total should ADD to 5

a.	Walking	0	1	2	3
b.	Bicycle /Scooter	0	1	2	3
c.	Skateboard/ Rollerblade	0	1	2	3
d.	Car	0	1	2	3
e.	School bus	0	1	2	3
f.	City bus	0	1	2	3

4 5
4 5
4 5
4 5
4 5
4 5

ck **ALL** that apply)

O other adult(s)

O other student(s)

2a. Who do you usually travel **<u>TO</u>** SCHOOL with? (Che

O nobody O parent(s)

O brother(s) or sister(s) O friend(s)

ROM SCHOOL BY: ***(Total should ADD to 5)***

4 5
4 5
4 5
4 5
4 5
5

3. NUMBER OF DAYS PER WEEK YOU **<u>USUALLY</u>** TRAVEL F

a.	Walking	0	1	2	3
b.	Bicycle /Scooter	0	1	2	3
c.	Skateboard/ Rollerblade	0	1	2	3
d.	Car	0	1	2	3
e.	School bus	0	1	2	3
f.	City bus	0	1	2	3

Check **ALL** that apply)

O other adult(s)

O other student(s)

3a. Who do you usually travel **<u>FROM SCHOOL</u>** with? (

O nobody O parent(s)

O brother(s) or sister(s) O friend(s)

USUALLY takes you?

4. If you walk or bike to or from school, how long does it

() Between 1 – 10 minutes
() 11 – 20 minutes

3

O more than 20 minutes

5. If you had **YOUR** choice, how would you **MOST** like to get to school each day? **(Choose 1)**

O walk	O be driven in a car
O ride a bicycle or scooter	O take school bus
O use skateboard or rollerblades	O take city bus

6. Do you have your OWN bike? O Yes O No

D. Barriers to walking and biking to school

1. Are you allowed to walk to school (some or all days)? O Yes O No

2. Are you allowed to bike to school (some or all days)? O Yes O No

Please tell us whether you <u>agree or disagree</u> with the following... fill in the circle that best applies:

It is difficult or unpleasant to walk or bike to school because...

	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
3. It is too far or takes too much time	O	O	O	O
4. There are not enough sidewalks	O	O	O	O
5. There are not enough bike paths / lanes	O	O	O	O
6. The route is boring	O	O	O	O
7. It feels unsafe due to traffic on the route	O	O	O	O
8. There are too many busy streets to cross	O	O	O	O
9. I get too hot and sweaty	O	O	O	O
10. There is no one to walk with	O	O	O	O
	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
11. It's not fun to walk	O	O	O	O
12. I have too much stuff to carry	O	O	O	O
13. It is easier for someone to drive me there	O	O	O	O
14. It feels unsafe because of crime	O	O	O	O

(example: strangers, gangs, drugs)

15. I might get bullied or teased along the way	O	O	O	O
16. There is nowhere to safely leave a bike at school	O	O	O	O
17. Other reasons?_____	O	O	O	O

18. Do you often stop somewhere on the way to school? O Yes O No

18a. **If you answered yes**, where do you usually stop? (ex. Variety store, friend's house)

_____

K. Streets in my neighborhood

Please circle the answer that <u>best applies</u> to you and your neighborhood.

1. There are enough sidewalks on the streets in my neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

2. There are walking trails in or near my neighborhood that are easy to get to.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

3. There are bicycle lanes or trails in or near my neighborhood that are easy to get to.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

4. There are lots of trees along the streets in my neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

5. I know a lot of people in my neighbourhood

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

L. Neighborhood safety

Please circle the answer that best applies to you and your neighbourhood.

1. There is so much traffic along the streets near my home that it is difficult or unpleasant to walk .

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

2. There is so much traffic along the streets near my home that it is difficult to ride my bike or play on the street

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

3. Most drivers go too fast while driving in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

4. There is a lot of crime in my neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

5. It feels unsafe to walk by myself around my neighbourhood during the day.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

6. It feels unsafe to walk with friends or siblings around my neighbourhood during the day.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

7. I am worried about being or walking by myself in my neighborhood and local streets because I am afraid of being taken or hurt by a stranger.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

8. My parents or guardians are afraid that I will be taken or hurt by a stranger if I am out walking alone in my neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

Appendix E Parent Survey (reduced STEAM 2 survey to provide relevant questions)

Healthy Neighbourhoods Survey for Parents

We need your help to make our study a success. Your honest answers to the items in this survey are very important to us. This will not take too long to complete.

Note: If you have more than one child bringing home a survey – we'd very much appreciate you filling out a survey for <u>each child</u> since many answers will be specific to each child.

Thank you!

A. General information

What is today's date? _____month _____day _____year

1. My child is: O female O male 1a. Current age of my child: _____ yrs old

2. What is your relationship to the child (taking part in the study)?

   O mother O father O primary caregiver/guardian O other _____

3. My child lives primarily in a :

   O single-parent household O two-parent household O other _____

4. My child:
   - O lives in a single household
   - O splits their time equally between 2 households
   - O lives in one household but regularly visits/lives in a second household
   - O has another household arrangement _____

5. Postal code of your child's primary home_____

   5a. How many days a week do they live at this address?

   1 2 3 4 5 6 7

6. Nearest street intersection to primary home: _____ & _____

7. Postal Code at your child's secondary home (if they have one): _____

8. What kind of housing do you live in?
   - O a single family house (not attached to any others)
   - O a semi-detached house (a house attached to one other house)
   - O a townhouse or row house (a house attached to several other houses)
   - O an apartment or a condo in a building that is four stories tall or less
   - O an apartment or a condo in a building that is more than four stories tall
   - O other

9. Have you and your family moved homes within the last 2 years? O Yes O No

10. How many motor vehicles in working order (cars, vans, trucks, motorcycles) are there at your household?

O none O 1 O 2 O 3 O 4 or more

11. Please **check and circle** the highest level of education the **child's mother** has completed.

O Grade 1 2 3 4 5 6 7 8 9 10 11 12 13
O College / University
O Graduate School
O N/A

12. Please **check and circle** the highest level of education the **child's father** has completed.

O Grade 1 2 3 4 5 6 7 8 9 10 11 12 13
O College / University
O Graduate School
O N/A

13. Which of the following best describes the current work status of the **child's mother**?

O employed full time	O employed part time
O at home with children	O unemployed
O student	O other _____
O I prefer not to answer	O not applicable

14. Which of the following best describes the current work status of the **child's father's**?

O employed full time	O employed part time
O at home with children	O unemployed
O student	O other _____
O I prefer not to answer	O not applicable

15. Which of the following best describes the current work status of the **child's primary caregiver/guardian if different than above**?

O employed full time	O employed part time
O at home with children	O unemployed
O student	O other _____
O I prefer not to answer	O not applicable

16. Please indicate the total income from all sources that you and other members of your household received in the last year (Jan-Dec) before taxes. The total income from all sources was:

O Less than $20,000	O $20,000 - $29,999	O $30,000 - $39,999
O $40,000 - $49,999	O $50,000 - $59,999	O $60,000 - $69,999
O $70,000 - $79,999	O $80,000 - $89,999	O $90,000 - $99,999
O $100,000 - $109,999	O $109,000 - $119,999	O $120,000 - $129,999
O $130,000 - $139,999	O $140,000 - $149,999	O $150,000 or more
O I don't know	O I prefer not to answer	

17. What is your child's primary race / ethnic background?:

O White	O North American Indian, Metis or Inuit
O Chinese	O South Asian (e.g. East Indian, Pakistani, Sri Lankan)
O Black	O Filipino
O Latin American	O Southeast Asian (e.g. Cambodian, Vietnamese)
O Arab	O West Asian (e.g. Afghan, Iranian)
O Japanese	O Korean
O other _____	O I prefer not to answer

18. Does your child have any medical or physical limitation which prevents them from engaging in physical activity?

Yes No

19. My child's current height is: _____ cm OR ____ ft _____ in *(If you're not sure, please*

20. My child's current weight is: _____ kg OR _____ pounds *give us your best guess)*

21. Does your child have asthma or regularly have breathing problems?

O Yes O No

21a. If so, do they use an inhaler? O Yes O No

22. How many smokers are in your household?

O none O 1 O 2 O 3 or more

23. What is the name of your child's school? _____

24. What grade is your child currently in? ----------

C. Your Child's Trip To and From School

The following questions are about how your child gets to and from school each day. Please circle the best answer for your child and his/her school.

In an average school week, how many days does your child use the following types of transportation to get to and from school?

1. NUMBER OF DAYS PER WEEK HE/SHE TRAVELS TO SCHOOL BY: (Total should ADD to 5)

a.	Walking	0	1	2	3	4	5
b.	Bicycle /Scooter	0	1	2	3	4	5
c.	Skateboard/ Rollerblades	0	1	2	3	4	5
d.	Car	0	1	2	3	4	5
e.	School bus	0	1	2	3	4	5
f.	City bus	0	1	2	3	4	5

1a. Who does your child usually travel TO SCHOOL with? (Check **ALL** that apply)

O nobody O parent(s) O other adult(s)

O brother(s) or sister(s) O friend(s) O other student(s)

2. NUMBER OF DAYS PER WEEK HE/SHE TRAVELS **FROM** SCHOOL BY:

a.	Walking	0	1	2	3	4	5
b.	Bicycle /Scooter	0	1	2	3	4	5
c.	Skateboard/ Rollerblade	0	1	2	3	4	5
d.	Car	0	1	2	3	4	5
e.	School bus	0	1	2	3	4	5
f.	City bus	0	1	2	3	4	5

2a. Who does your child usually travel **FROM** SCHOOL with? (Check **ALL** that apply)

O nobody O parent(s) O other adult(s)

O brother(s) or sister(s) O friend(s) O other student(s)

3. Does your child live within walking distance of their school (from their primary residence)?

O Yes O No

4. How long does it USUALLY take your child to get to/from school each day?

O Between 1 – 10 minutes
O 11 – 20 minutes
O more than 20 minutes

5. If you had **YOUR** ideal choice, how would you most like your child to get to school each day?

O walk
O ride a bicycle or scooter
O use skateboard or rollerblades
O be driven in a car
O take school bus
O take city bus

6. If you typically drive your child to school, after you drop them off do you usually:

O go back home O go on to work O go on to other destinations

7. When you were a child, how did you typically travel to school?

O I walked
O I rode a bicycle or scooter
O I used a skateboard or rollerblades
O drove in a car
O took school bus
O took city bus

D. Barriers to walking and biking to school

Please tell us whether you agree or disagree with the following… fill in the circle that best applies:

It is difficult for my child to walk or bike to school because…

	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
1. They are not allowed to walk	O	O	O	O
2. They are not allowed to bike	O	O	O	O
3. It is too far or takes too much time	O	O	O	O
4. There are not enough sidewalks	O	O	O	O
5. There are not enough bike paths / lanes	O	O	O	O
6. The route is boring	O	O	O	O
7. It feels unsafe due to traffic on the route	O	O	O	O
8. There are too many busy streets to cross	O	O	O	O
9. They get too hot and sweaty	O	O	O	O
10. There is no one to walk with	O	O	O	O
11. It's not fun for them to walk	O	O	O	O
12. They have too much stuff to carry	O	O	O	O
13. It is easier to drive them there	O	O	O	O
14. It feels unsafe because of crime (example: strangers, gangs, drugs)	O	O	O	O
15. They might get bullied or teased along the way	O	O	O	O
16. There is nowhere to leave a bike safely at school	O	O	O	O
17. They are too young to walk/bike to school	O	O	O	O
18. Other reasons?_____	O	O	O	O

H. Barriers to activity in neighborhood parks

Please tell us whether you agree or disagree with the following … Fill in or check the circle that best applies

It is difficult/unpleasant for my child to to play or do activities AT the parks / playgrounds in our neighbourhood because…

	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
1. It is too far from our house or takes too much time to get there	O	O	O	O
2. There is no or not enough equipment or activities they like	O	O	O	O
3. There is not enough room for the activities they like to do	O	O	O	O
4. There are no other kids to play with there	O	O	O	O
5. There are no adults there to supervise	O	O	O	O
6. It feels unsafe there of crime (example: strangers, gangs, drugs)	O	O	O	O
7. They get bullied or teased when they go	O	O	O	O
8. They have noone to go there with	O	O	O	O
9. There are too many people there / is too crowded	O	O	O	O
10. There is too much garbage or graffiti	O	O	O	O
11. It does not have good lighting at night	O	O	O	O
12. Other reason? _____	O	O	O	O

I. Streets in our neighborhood

Please circle the answer that best applies to you and your neighborhood.

1. There are enough sidewalks on the streets in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

2. There are many different routes for getting from place to place in our neighborhood (i.e. we don't have to go the same way every time).

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

3. There are walking trails in or near our neighborhood that are easy to get to.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

4. There are bicycle lanes or trails in or near our neighborhood that are easy to get to.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

5. There are lots of trees along the streets in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

6. There are many interesting things to look at or do while walking in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

7. We know a lot of people in our neighbourhood

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

J. Neighborhood safety

Please circle the answer that <u>best applies</u> to you, your child and your neighborhood.

1. There is so much traffic along <u>the street we live on</u> that it makes it difficult or unpleasant for my child to walk along our street.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

2. There is so much traffic along other streets near our home that it makes it difficult or unpleasant for my child to walk to places in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

3. There is so much traffic along the street we live on that it makes it difficult for my child to ride their bike or play on the street

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

4. There is so much traffic along other streets near our home that it makes it difficult or unpleasant for my child to ride their bike or play on the streets in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

5. Most drivers go too fast while driving in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

6. There is a lot of crime in our neighborhood.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

7. It feels unsafe to let my child walk alone around our neighbourhood during the day.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

8. I am worried about my child walking around with friends or siblings in our neighbourhood and local streets during the day.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

9. I am worried about my child being or walking alone in my neighborhood and local streets because I am afraid of them being taken or hurt by a stranger.

O	O	O	O
I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree

Curriculum Vitae

Name:	Emily Hill
Post-secondary Education and Degrees:	University of Western Ontario London, Ontario, Canada 2010-Present M.A. Candidate The University of Western Ontario London, Ontario, Canada 2004-2008 B.Sc.N.
Honours and Awards:	Jean Winnifred Forest Scholarship 2008 Dean's Honour List 2004, 2005, 2006, 2007, 2008
Related Work Experience:	Teaching Assistant – Geography 2011a, 2430a, 3415b The University of Western Ontario 2010-2012 Research Assistant – Dr. Jason Gilliland, Geography The University of Western Ontario 2010-2012 Research Assistant – Dr. Meizi He Middlesex London Health Unit 2007