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Active Travel for Children and Youth: Lessons from Active Routes to Schools North Carolina

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Active Travel for Children and Youth: Lessons from Active Routes to School North Carolina

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by

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ABSTRACT

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This Integrated Learning Experience (ILE) investigates literature regarding the impact of national Safe Routes to School (SRTS) programs and takes a deeper dive into the lessons that can be learned from North Carolina’s Active Routes to School (NC ARTS) programs through an analysis of data collected from 2007 to 2019. This report is focused on understanding the relationship between and among variables included in the Six Es of SRTS framework: Education, Engineering, Encouragement, Enforcement, Equity, and Evaluation. This investigation provides insight that extends understanding of parental comfort and engagement with these programs. A unique theoretical model was developed as were recommendations for future research in the areas of parental engagement, social norming, and the need for engaging low-wealth communities. Additionally, a community-based social marketing product was developed to improve parental attitudes toward independent active travel for older elementary-, middle school-, and high school-aged children.

DEDICATION

This is dedicated specifically to my son Oliver and daughter Victoria in hopes that I may leave the world a better place than I found it for them and their children.

ACKNOWLEDGEMENTS

Thank you to my readers and champions: P.I. Ferguson, T.S. Walker, C. Dumas, D. Nyarambi, D.D. Lee, D.Washington, K.Baker, R.Pack, K. Beatty, and A.Wahlquist.

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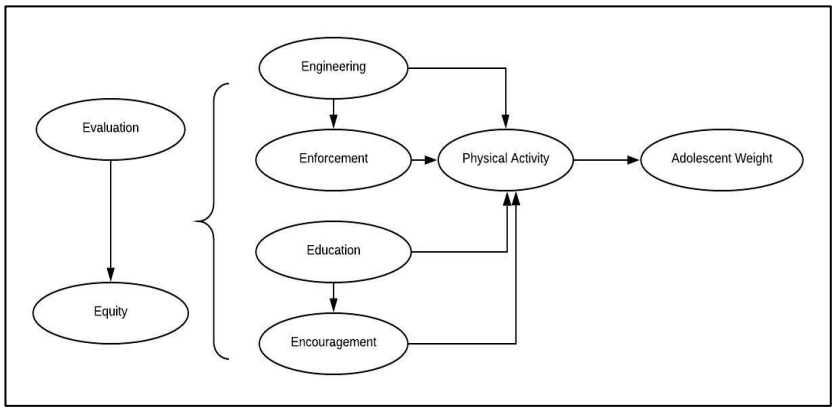
Chapter 1. Introduction

Safe Routes to School

Safe Routes to School (SRTS) is a national program that aims to combine policy, systems, and environmental changes into a comprehensive effort designed, in part, to reduce the incidence and prevalence of childhood obesity. Childhood obesity is a critically important public health challenge, because it is linked to lifelong obesity, a known risk factor for chronic conditions such as Type 2 diabetes, asthma, sleep apnea, joint problems, musculoskeletal discomfort, and fatty liver disease. Additionally, children who are obese report greater anxiety and depression likely due to social isolation and bullying (Centers for Disease Control and Prevention, 2016). National surveillance data show that 18.5% of children in the United States (US) under 20 years old are at or above the 95th percentile of weight for their age group (CDC, 1017). A closer look at data from the 2017 Centers for Disease Control and Prevention (CDC) report, "Prevalence of Obesity among Adults and Youth," shows that childhood obesity prevalence is highest among adolescents (12-19 years), at 20.6%.

Figure 1

Theoretical Model of Predictors



SRTS programs have shown some small success in increasing Active School Travel (AST) by increasing the number of children who bike or walk to school in school districts where the model is implemented. Critical to the ability of SRTS programs to increase daily physical activity is the effective implementation of the "Six Es" framework (Royne et al., 2016). The Six Es of SRTS include Education, Encouragement, Engineering, Enforcement, Evaluation, and Equity. To fulfill the Education component, SRTS programs include safety curricula for students and families. Encouragement is activated through events such as bike trains and walking school buses, which are strategies to encourage walking and biking while providing adult supervision to assuage safety concerns. Partnerships with planning agencies provide Engineered solutions to hazardous route conditions, whereas increases in traffic policing and implementation of crossing guard programs form the foundation for Enforcement. Evaluation components include teacher-facilitated tally counts of students' mode of transportation to school and parent surveys that provide baseline and longitudinal data on mode of travel to and from school, barriers to AST participation, and overall perceptions of school encouragement and AST safety. Equity is a recent addition to the Six Es framework included to account for and address disparities in program access and outcomes based on race, class, rurality, and ethnicity (Zimmerman, 2015). To our knowledge, no programs have systematized equity as an aspect of implementation; rather, it appears to be treated as a subcomponent of program evaluation or AST research.

This study focuses on the interplay among the program components based on the Six Es framework (Figure 1). The model in Figure 1 hypothesizes that Education, Encouragement, Engineering, and Enforcement form the most proximal predictors of increasing physical activity and that Evaluation and Equity are more distal program components used to inform program design and to assess impact. The model forms the foundation for this analysis of data collected

on behalf of the North Carolina Active Routes to School program (NC ARTS). These SRTS program data, collected over eleven school years from 2007 to 2019, were analyzed to betteridentify the most influential components of NC ARTS and to explore which program components may increase AST. Finally, findings were used to develop a white paper and social media campaign video to support effective communications with parents and communities. Additionally, a communications plan was developed to disseminate the findings to support active school and community travel for children and youth.

Rationale for Prioritizing the Issue

Epidemiological Data

This epidemiological exploration focuses on childhood obesity and physical activity rates in the US and NC. One limitation to this exploration is that national surveillance data on childhood obesity are collected and aggregated differently by state, as each state uses a variety of age groupings and, often, inconsistent definitions of risk for childhood obesity. For example, NC, the state of interest in this study, classifies children as underweight, healthy weight, overweight, or obese, whereas other states use only underweight, healthy weight, or obese as categories for aggregated Body Mass Index (BMI) data. In NC, weight data are collected most reliably for children between the ages of 10 and 17. When we use data adjusted for the variation in weight classification across the state, we see that NC ranks 32nd out of 51 states (including the District of Columbia) for childhood obesity, with 13.5% of children between the ages of 10 and 17 in the greater than 95th percentile for their height and weight group. NC's Trend data show that rate has held steady over the last five years (Robert Wood Johnson Foundation, 2004-2019). When the definition of risk is expanded to include children who are overweight and at risk of becoming obese (defined as children between the ages of 2 and 19 with a BMI between the 85th and 95th

percentile for children of the same age and sex), the prevalence rate jumps to 30%. The distinction here is useful because prevention is both more important and more possible for those children who are at risk of becoming obese than it is for children who are already in the obese category (Pandita et al., 2016). A key factor to obesity prevention is daily physical activity. In the next section, physical activity levels are explored to further locate the role that SRTS programs could play in increasing physical activity and, therefore, decreasing the incidence of childhood obesity.

Thirty years ago, the US had substantially fewer children who were classified as obese. In 1970, only 5% of children between the ages of 2 and 19 weighed in at greater than the 95th percentile for their height and age group (Harvard T.H.CHAN School of Public Health, 2020). At that same time, 48% of school-aged children biked or walked to school (Boarnet et al., 2005). By 2009, the AST rate had declined to 13% (National Center for Health Statistics, 2017). The relationship between daily moderate to vigorous physical activity (MVPA) and healthy weight over the life span is profound. Fewer than one-quarter of children (24%) 6 to 17 years old achieve the recommended 60 minutes of physical activity per day (Center for Disease Control and Prevention, 2020). However, SRTS programs have been shown in peer-reviewed research to both increase daily physical activity and decrease bicycle/pedestrian (bike/ped) injury and mortality in areas where these programs are implemented (Chirqui et al., 2012; Heinrich et al., 2008; McDonald et al., 2013; Mendoza et al., 2017; Stewart, 2011). While a direct, causal link between SRTS programs and obesity reduction may not be within our ability to determine using existing data sources, SRTS research does show small gains in physical activity for a majority of programs (Larouche et al., 2018). Larger gains in physical activity are largely linked to comprehensive and competent implementation of the Six Es framework (LaJeunesse et al.,

2019). The complexity of the framework has led to limited published studies that explore all elements of the framework simultaneously (Rahman et al., 2020). LaJeunesse et al.'s thoughtful study of the comprehensive implementation of SRTS through the NC ARTS model provides insight into how coordinated efforts can substantially increase programmatic benefits. For example, their research showed that bike and walk events could increase AST by 34% and that those benefits could be achieved even among schools in low-wealth and/or rural school districts (LaJeunesse et al., 2019).

Potential Return on Investment

The probability that an obese child will become an obese adult increases with age, as children between the ages of 10 and 17 who are obese are 50% more likely to become obese adults (Health Policy Institute, 2019). It is well established that lifelong obesity is a root cause of preventable chronic disease. The economic impact of childhood obesity can be seen in its effect on the chronic disease burden in the health care system. In 2007, the total economic cost of Type 2 diabetes, just one of the conditions associated with lifelong obesity, was over $300 billion in lost productivity and health care costs (National Center for Chronic Diseease Prevention and Health Promotion, 2020). Additional direct costs to the health care system consist of items like "annual prescription drug, emergency room, outpatient, and inpatient costs which total about $14.373 billion annually" (Crawly et al., 2010).

The economic costs of daily home-to-school transport by bus or car could be significantly reduced by increasing active transportation. Right now, nearly half of American students use private vehicles to reach school (McDonald et al., 2014). Depending upon whether or not parents are making a dedicated trip to and from school or if drop-off and pick-up are part of daily

commutes, private transportation costs to and from school in the US range between $1 billion and $2 billion annually. Between 2010 and 2011, taxpayer costs for student transportation to and from school on buses totaled $23 billion. School district busing policy provides transportation to students based on two criteria: 1) that they live more than 1-2 miles (policies vary by state) from their school; or 2) the route between their home and school is considered to be hazardous (McDonald et al., 2014). If hazardous conditions are remediated because bike/ped infrastructure is implemented, many children could walk or bike thereby reducing taxpayer costs for school-based transportation. Since busing within 1 to 2 miles is not available, increasing the number of children within that footprint that walk or bike reduces automobile traffic, traffic pollution, and the individual travel costs to families.

According to the Safe Routes Partnership, the current federal allocation to SRTS programming is contained within the FAST (Fixing America's Surface Transportation) Act passed in December of 2015. This act "Preserves Safe Routes to School, bicycling and walking for five additional years without many changes to the Transportation Alternatives Program (TAP)" (Safe Routes Partnership, 2020). The total allocation scheduled for that five-year span between 2016 and 2020 was $2.5 billion, with funding increasing over time. It should be noted that not all of those funds go towards SRTS programs, and it appears that states have received funding allotments similar to previous years. A state's allotment is calculated based on the number of children attending public elementary and middle schools with a minimum allotment of $1,000,000 per year (Safe Routes Partnership, 2020).

The indirect and direct costs of our inability to effectively address the impact of lifelong obesity on the health care system and US economy is in the hundreds of billions of dollars, while SRTS has been shown to be an effective program costing approximately $1 billion each year

nationally. The relative potential return on this investment is sizable. It does appear that SRTS programs provide a viable option to reduce the economic burden of poor health outcomes related to childhood obesity, while decreasing transportation costs for families and school districts. Yet, the complexity of this issue makes parsing out the direct cost-benefit of SRTS programs difficult, meaning that more research is required in this area.

Extent to Which the Problem is Amenable to Change

Whereas the health problem in this case is childhood obesity, SRTS programs focus on increasing daily physical activity among youth populations in the US. Increasing daily physical activity is an evidence-based prevention and remediation strategy for child and adolescent obesity, and as a population health strategy, it has been shown to improve the health of all children regardless of weight. Therefore, this section focuses on the potential for SRTS programs to adequately increase moderate to vigorous physical activity (MVPA), while decreasing harms related to active transportation.

A critical component of increasing physical activity is a built environment that supports active travel. Evidence shows that when purpose-built infrastructure is combined with appropriate school-based policies, SRTS programming can have a significant impact on the rate of active transportation to schools (Chriqui et al., 2012). Additionally, effective bicycle and pedestrian education are critical to increasing active transportation as a viable option, while decreasing the risk of injury and death. Purpose-built infrastructure is defined as infrastructure that considers foot and bicycle traffic in its design. The intention of purpose-built infrastructure is to increase the number of individuals who walk and ride bicycles either to get to their destination or as part of public transportation access, while simultaneously not increasing traffic fatalities. An ancillary benefit of walkability is that walking is associated with greater social

cohesion in a community, because when people can walk around their communities, they interact more with neighbors and others they see on a frequent basis (Kemper et al., 2018).

Purpose-built infrastructure is often a result of "complete street" programs developed and promoted by community efforts. The success of complete street initiatives relies heavily upon community members' ability to work with planners. The political will to engage the community in planning processes is another critical aspect that impacts successful SRTS implementation. SRTS programs provide resources, a framework, and a community with whom planners can work to retrofit and/or design roadways that accommodate all modes of transportation, while keeping all who use them safe from injury (Lieberman et al., 2018; Omura et al., 2019; Rahman et al., 2020). These components are captured in the Six Es framework. A sustainable outcome of SRTS programs is a reduction in hazardous routes to schools. The NC ARTS program administrated comprehensive and consistent program components that included: 1) regional coordination; 2) coordination at school sites; 3) coordinated activities; and 4) remediation of hazardous road conditions through regional planning organizations. However, it should be noted that the NC legislature passed a law in 2013 (HB817) called the Strategic Transportation Investments Act that "prohibits the use of state funds for stand-alone bicycle and pedestrian infrastructure projects" (North Carolina PTA, 2017). This law significantly shifted the policy environment resulting in a designation of "non-infrastructure" for all SRTS grants. Therefore, there is a lack of adequate data regarding bike/ped infrastructure developments in the years between 2013 and 2019, limiting our ability to explore the potential impact of built environment improvements on NC ARTS outcomes.

In general, however, the combination of the permanence of SRTS infrastructure improvement highlights a rich potential to address childhood obesity and to provide ancillary

benefits to other target populations. For example, sidewalks provide safer travel for the elderly, individuals with alternative modes of transportation (e.g., wheelchairs, motorized scooters, strollers) and people with visual impairments. Therefore, a built environment that supports safe physical activity has vast potential for support in a community, because it addresses a number of priority populations, is a semi-permanent intervention, and is less controversial than many other public health interventions.

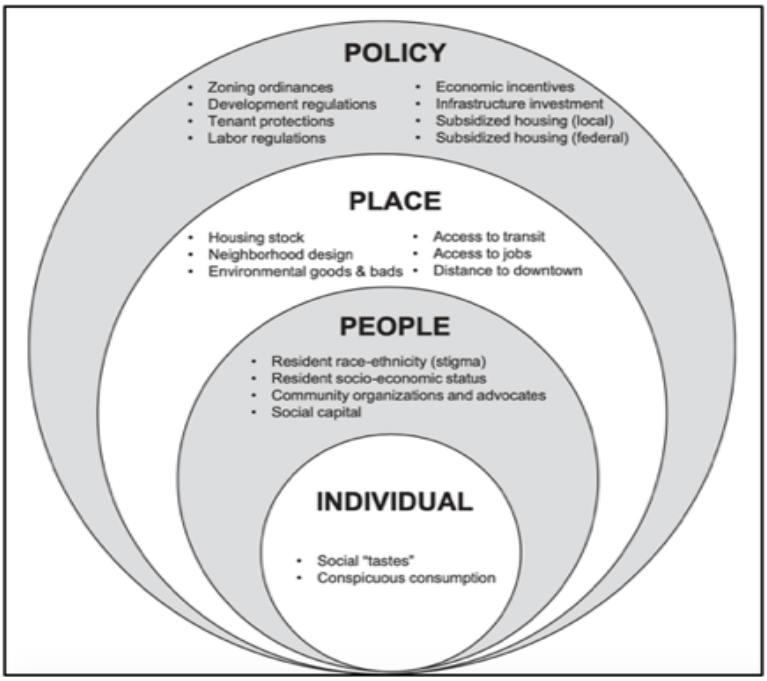
Population-Level Health Impact

To best understand SRTS as a population health strategy, it is important to frame the effort within the context of the strength of evidence as it relates to its impact on people, places, and policies within the broader Six Es framework.

Bronfenbrenner's socioecological model (SEM) has been widely modified in public health practice to describe population health strategies. The SEM was designed to express the spheres of influence on individuals including social networks, organizations, and societal norms (Rigolon & Nemeth, 2019). The SEM has been modified in various contexts to depict the ways in which interventions can be—or are—designed to shift policies and systems or change environments towards a comprehensive culture of health. The Robert Wood Johnson Foundation defines a culture of health by broadly stating that a culture of health is "one in which good health and well-being flourish across geographic, demographic, and social sectors; fostering healthy equitable communities; guides public and private decision making; and everyone has the opportunity to make choices that lead to healthy lifestyles" (Robert Wood Johnson Foundation , 2020).

Figure 2

Rigolon & Nemeth's SEM Model



In 2009, Martin, Moeti, and Pulle-Seufert "urge[d] the field to consider using the SEM for a comprehensive approach and to carefully evaluate their programs to uncover the 'best practices' for SRTS" (Martin et al., 2009). The SEM is mentioned in two of the studies examined in the literature review below. Rigolon and Nemeth (2019) modified the SEM in a way that can be applied in our context (shown in Figure 2). They developed a SEM that is a "model of how people, place, and policy shape neighborhood change". The elegance of Rigolon and Nemeth's model is appropriate for this exploration because, while simple, the People, Places, and Policies framework clearly articulates the nested relationship among policies, neighborhood context, and individual behavior change. The Six Es is an implementation and intervention framework that fits within this people (encouragement & education), place (environment), and policy (enforcement, evaluation, and equity) frame. Throughout the studies of SRTS, the complex

dynamics of individual attitudes and perceptions, neighborhood and school context, and supportive (or prohibitive) policy environments are at play.

Long-term Goals Centered on Addressing the Problem

The overall goals related to the reduction of childhood obesity identified by SRTS programs vary by state. This study focused on the goals of the NC ARTS program. The NC ARTS program was a statewide coordinated and supported effort to implement SRTS with a specific focus on regions considered rural. Ten regional coordinators were hired to systematically recruit and support SRTS coordination in school districts that might lack the time, expertise, or resources to apply for NC ARTS funding and effectively implement programs. The NC ARTS program began in the fall of 2007 and ended in June of 2019. According to the Community & Clinical Connections Active Routes to Schools Summary Report (2019), the activities of NC ARTS were designed to increase:

- One-time awareness events about the importance of Safe Routes to School
- The number of ongoing programs that encourage walking and biking to or at school
- The number of trainings on how to implement SRTS-related activities
- The number of policies that support walking and biking to or at school
- The number of safety features near schools

The end of NC ARTS in 2019 poses an interesting question regarding the sustainability of grant-funded programs over time.

Project Aims

This project is specifically focused on the NC ARTS program from school years 2007/08 to 2018/19. The first aim of this project is to improve the understanding of how the Six Es framework is operationalized through an examination of 11 years of data collected by the NC ARTS program.

Additionally, since the NC ARTS program ended in June of 2019, it will be left to schools and communities to continue the work of the program. By a comprehensive analysis of the data collected to date, we were able to adequately address our second aim which is to explore associations between parental characteristics, perceptions of school encouragement and AST uptake.

Finally, our third aim is to develop meaningful products that can be used by active routes programs to increase active travel for children and youth to school and elsewhere in the community.

Identification of DrPH Competencies

Data & Analysis. Design a qualitative, quantitative, mixed methods, policy analysis or evaluation project to address a public health issue.

Policies and Programs. Integrate scientific information, legal, and regulatory approaches, ethical frameworks and varied stakeholder interest in policy development and analysis.

Education & Workforce Development. Deliver training or educational experiences that promote learning in academic, organizational and community settings.

- **Leadership, Management, & Governance.**

  This project:

  - Proposed strategies to promote inclusion and equity within public health programs, policies, and systems.
  - Communicated public health science to diverse stakeholders, including individuals at all levels of health literacy, for purposes of influencing behavior and policies.

- **Concentration Area: Community and Behavioral Health Competency.**

  This project:

  - Translated community and behavioral research into population-based programs and policies;
  - Translated health behavior theoretical models into public health interventions; and
  - Translated theories, conceptual paradigms, and evidence to inform planning, implementation, evaluation, and dissemination of innovative, tailored public health interventions.

Chapter 2: Background and Significance

Comprehensive Review of the Literature

This literature review examines available evidence to broaden our understanding of successful SRTS implementation. This review informed this study's analysis of NC ARTS data. A systematic and comprehensive review of AST and SRTS program literature was conducted to identify research studies that: 1) evaluated SRTS through a comprehensive analysis of each component of the Six Es framework; or 2) focused on one or some combination of framework components.

Research Question and Objective

The primary research questions asked through this literature review were: What is the impact of SRTS on increasing AST? and Which components of the Six Es framework are most efficacious in achieving this increase? The objective was to systematically review the literature over the last 10 years seeking well-designed and executed, peer-reviewed studies that provide insights into SRTS or any program element of SRTS.

Article Selection

Articles were selected based on their alignment with the research question and objective of this study. This section details the process of article selection including the MeSH terms, databases searched, and reasons for elimination.To identify relevant articles, several combinations of MeSH terms were searched. They were: "Safe Routes to School", "Active Routes to School", "Bike OR Walk AND School", "Active School Travel AND SRTS", "Active School Travel AND Encouragement", "Active AND Transportation AND Crossing guards",

"Active AND Transportation AND Engineering"; "Active school travel AND engineering", "Built Environment AND Walk AND Bike AND School".

The databases searched were the Transportation Research Board (TRB), PubMed, and Google Scholar. Initial results yielded 6,136 articles [TRB (n=85); PubMed (n=44); Google Scholar (n=6,007)]. Duplications across and within databases were removed to produce a group of 5,890 results. From these results, studies were further grouped by each "E" in the framework most addressed in the research. When needed, additional search terms were used until saturation was reached. All studies focused beyond the geographic regions of the US and Canada were removed. To ensure that the evidence was informed by up-to-date public health practice and because the implementation of SRTS programming in the US is relatively new, only articles published in or after 2010 were included in this review.

The elimination of articles older than 2010 (N=3,737) resulted in N=2,153 studies published during or after 2010. Of those 2,153 studies, those focused on geographic regions beyond North America were eliminated (N=829). The remaining N=1,324 citations were reviewed for relevancy to the aims of this study. An additional 1,255 citations were removed for the following reasons:

- Not peer-reviewed (N=879)
- Published in journals listed in the predatory journal list (n=18)
- Not related to AST (N=358)

Sixty-nine full text sources were reviewed, and 47 were eliminated for the following reasons:

- Study was focused on built environment and its effects on pollution (N=1)

- Walking in general or adult populations (N=5)
- Increasing walking for children but no link to SRTS (N=2)
- Study on the CLASP program which promoted physical activity, policy change, but had no direct relationship to SRTS Framework (N=1)
- Meta-analysis on the link between traffic-related factors and childhood obesity, but no SRTS direct link (N=1)
- Increasing Active Travel for children with no AST or SRTS connection (N=1)
- Focused on adult populations (N=2)
- Focused on parental perceptions of road safety unrelated to AST (N=1)
- Primarily focused on increases in active travel in youth populations not directly related to schools (N=1)
- Focused on clinical outcomes rather than behavior (N=32)

Figure 3

Prisma Flow Chart

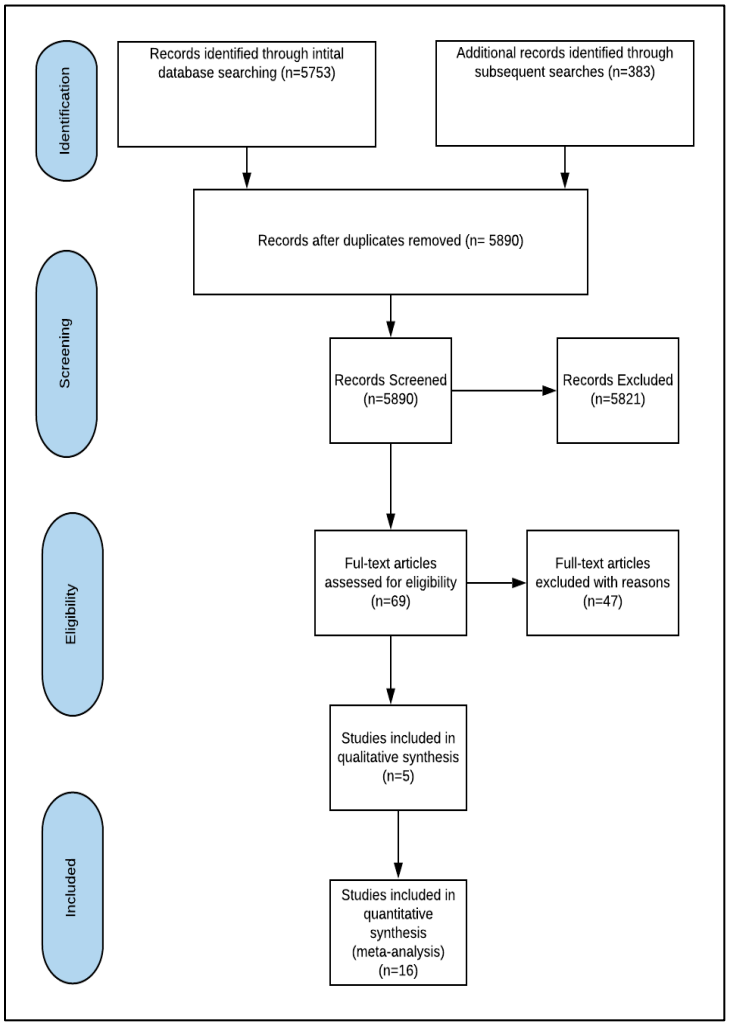


Figure 3 is a Flow Chart illustration of the literature review selection process based on the PRISMA method. Twenty-one studies met the complete criteria for inclusion. The Evidence Matrix (Table 1) details the authors, year of publication, most relevant "Six Es" framework component, study design, population from which a sample population was derived, the sample size, and a summary of results.

Table 1

Evidence Matrix Organized by "E"

Citation	Year	Framework	Design & Population	Sample Size	Results Summary
Comprehensive (Includes all E's)					
Buttazzoni, N., Kesteren, E.S.V, Shah,T.I., Gilliland, J.A., "Active School Travel Intervention Methodologies in North America: A Systematic Review," *American Journal of Preventive Medicine,* pp.115-124	2018	Qualitative	Systematic Literature Review Active Routes to Schools Programs from 2011-2016/ US Journal Articles evaluating aspects of SRTS Programming.	N=22	This study found two important lessons from the evidence 1) urgency of the concerns facing a community and 2) capacity of the community. Both matter in terms of the strength of the intervention effects.
Buttazzoni, N., Coen, S.E., Gilliland, J.A., "Supporting active school travel: A qualitative analysis of implementing a regional safe routes to school program", *Social Science & Medicine*, pp.181-190	2018	Qualitative	Qualitative thematic analysis of interviews and focus groups. Safe Routes to Schools facilitators and committees	N=18 facilitators N=4 focus groups of committee members.	Six themes identified: 1) accounting for school context; 2) establishing committee capacity and leadership; 3) supporting STP action; 4) responsiveness to external and internal barriers; 5) engaging schools at the grassroots level; 6) building future champions.
Larouche, R., Chaput, Leduc, J.G., Boyer, C., Belanger, P., LeBlanc, A.G., Borghese, M.M.,Tremblay, M.S., "A cross-sectional examination of socio-demographic and school-level correlates of	2014	Quantitative	Cross-sectional Study	Stratified sample of children N=567	Individual factors associated with higher odds of AST were males and travel time. Children were more likely to engage in AST when crossing guards were employed. In schools that identified safe routes to school and where there was traffic

children's school travel mode in Ottawa, Canada, BMC Public Health, 14(1):497, DOI: 10.1186/1471-2458-14-497					calming, children were much more likely to engage in AST compared to schools without these features. if only one of these features was present, this was not associated with an increased likelihood of AST. These findings suggest that crossing guards may be a necessary condition but are not sufficient alone to facilitate AST.
Larouche, R., Mammen,G.,Rowe, D.A., Faulkner, G., "Effectiveness of active school transport interventions: a systematic review and update" *BMC Public Health*, 18:206, DOI 10.1186/s12889-017-5005-1	2018	Quantitative	Replication of systematic literature review analyzing quantitative impact of SRTS programs. 6318 potentially relevant articles	27 articles reporting 30 interventions.	13 interventions reported a small increase of active school travel. 8 found not changes.4 reported inconsistent results and 5 did not report inferential statistics.
McDonald, N.C., Yang, Y., Abbott, S.M., Bullock, A.N., "Impact of the Safe Routes to School program on walking and biking: Eugene, Oregon study", *Transport Policy*, 29, pp. 243-248	2013	Quantitative	Quasi-experimental research design Eugene, Oregon	14 Schools	SRTS is associated with increases in biking and walking. Education and Encouragement programs were associated with a 5%-point increase in biking. Engineering strategies including sidewalks, crosswalks, covered bike parking, and signage were associated with 5-20 percentage point increases.

Education					
Greer, A.E., Martinez-Carrasco, A., Goldsman, D., Knausenberger, A., "Walking Toward a Brighter Future: A Participatory Research Process to Advocate for Improved Walk-to School Corridors", *Health Promotion Practice*, 1-9 DOI:10.1177/1524839919890872	2019	Qualitative	Qualitative study using participatory research methods including participatory mapping and questionnaires, Bridgeport High Schools	15 youth leaders, 21 classrooms, three high schools, 187 questionnaires	Chi-square was used to examine associations between students' travel model and negative travel-related experiences. A greater number of students using active transportation reported feeling unsafe (p=.001), missing first period (p=.006), and lower grades (p=.001) due to travel-related challenges.
Mendoza, J.A., Haaland,W., Jacobs, M. Abbey-Lambertz, Miller, J.,Salls,D., Todd,W., Madding,R., Ellis, K., Kerr, J., "Bicycle Trains, Cycling, and Physical Activity: A Pilot Cluster RCT", *American Journal of Preventive Medicine*, 53 (4) 481-489	2017	Quantitative	Pilot Cluster RCT Fourth and Fifth grade public school children in Seattle, WA in 2014	N=4 schools N=54 students	Sort term increase of 44% in AST and mean increase of 21.6 minutes/day of MVPA. A pilot bicycle train intervention increased cycling to school and daily MVPA in the short term among diverse, inner-city elementary school students. The bicycle train intervention appears promising and warrants further experimental trials among large, diverse samples with longer follow-up.

Encouragement					
Royne, M., Ivey, S., Levy, A. K. Fox and S. L. Roakes, "Marketing active transportation to school to improve children's health: Utilizing parental perspectives from an inner-city environment," *Health Marketing Quarterly,* pp. 353-368	2016	Qualitative	Cross-sectional study. Short questionnaire administered through school-based communications. 1 US School with large African American population	No specific number given. <500	POC (Parents of Color) perceive different barriers to allowing their children to walk to school
LaJeunesse, S., Thompson, S., Pullen-Seufert, N.,Kolbe, M.B., Heiny,S.Thomas C., Johnson, E.R., "Diverse school community engagement with the North Carolina active routes to school project: a diffusion study," *International Journal of Behavioral Nutrition and Physical Activity* , pp. 1-11 https://doi.org/10.1186/s12966-019-0889-z	2019	Quantitative	Observational, Case-Control Study using repeated measures survey data. Public and private K-8 schools in NC Cases = participating schools Control = nonparticipating schools North Carolina	N=2602	Successful SRTS programs increased bike or walk to school day event participation by six times that of baseline participation. Event effects diffused beyond participating schools

Engineering					
Rothman, L., To,T.Buliung, R., Macarthur, C., Howard, A., "Influence of social and built environmental features on children walking to school: An observational study", *Preventive Medicine*, pp. 10-15	2014	Qualitative	Observational study Children living within walking distance who walk to school in Toronto, Canada	Observations were completed at N=118 elementary schools	Strong associations were found for child population density and traffic lights. Crossing guards have a strong positive association with AST and also act as an effect modifier.
Omura, J.D., Hyde, E.T., Watson, K.B., Sliwa, S.A., Fulton, J.E., Carlson, S.A., "Prevalence of children walking to school and related barriers—United States, 2017," *Preventative Medicine,* pp. 191-195	2019	Quantitative	Prospective, randomized, cross-sectional study Parents of school aged children across the US	Randomized survey provided to 5586 adults. 4107 completed the survey. 1137 respondents after exclusion criteria	Behavior patterns and perceptions in US adults with school aged children impact implementation success.
Coughenour, C., Clark, S., Singh, A., Huebner, J., "Are single entry communities and cul-de-sacs a barrier to active transport to school in 11 elementary schools in Las Vegas, NV metropolitan area?" *Preventive Medicine Reports*, pp. 144-148	2017	Quantitative	Cross-sectional study Normed 50 item questionnaire 11 school districts in Las Vegas	N=1217	Neighborhood design and trip distance are significant barriers to active transportation.
Hoelscher, D., Ory, M., Dowdy, D., Miao, J., Atteberry, H., Nichols, D.,	2016	Quantitative	Quasi-experimental, Cross-sectional, evaluation study	Schools Awarded infrastructure	This study found little active transportation differences between schools that received infrastructure

Evans, A., Menendez, T., Lee, C.,Wang, S., "Effects of Funding for Safe Routes to Schools Programs on Active Commuting to School and Related Behavioral, Knowledge, and Psychosocial Outcomes: Results from the Texas Childhood Obesity Prevention Policy Evaluation (T-COPPE) Study"*Environment and Behavior*, pp. 210-229			Serial cross-sectional surveys, mixed linear regression and growth curve models. 78 Schools in Texas. 4th grade student groups of approximately 50 with equal gender, majority Latinx, and 7% African American.	projects (N=23), Schools awarded non-infrastructure projects (N=21) and matched comparison schools (N=34)	projects and schools that did not. Overall, the study did find a short-term increase in active travel to school for all SRTS funded schools.
Enforcement					
Chriqui, J.F.,Taber, D.R., Slater, S.J.,Turner, L., Lowrey, K.M., Chaloupka, F.J., "The impact of state safe routes to school-related laws on active travel to school policies and practices in U.S. elementary schools.", *Health & Place*, 18, pp. 8-15	2012	Quantitative	Pooled, cross-sectional analysis. Nationally representative samples of U.S public elementary schools between 2007-2009	Sample size ranged from 1770 to 1894 over three years of data	State laws are critical in removing barriers and, therefore facilitating, active school travel for elementary school students. Crossing guards are a particularly effective strategy. This study looked at minimum bussing distances, hazardous route exemptions, sidewalks, crossing guards, speed zones, and traffic control measures around schools. Sidewalks were the only law that did not show a relationship to Active School Travel in the multivariate analysis.
Rothman, L., Perry, D., Buliung, R., Macarthur, C., To, T., Macpherson, A., Larsen, K., Howard, A., "Do	2015	Quantitative	Quasi-experimental study pre-and-post test of all age collision counts near newly implemented crossing guards	27,827 PMVCs occurred during the	Implementation of Crossing Guards had no effect on the incidence of child related PMVC.

school crossing guards make crossing roads safer? A quasi-experimental study of pedestrian-motor vehicle collisions in Toronto, Canada", *BMC Public Health*, DOI10.1186/s12889-015-2065-y			& retrospective cohort study of all child-related pedestrian motor vehicle collisions (PMVCs).	study period with 260 at guard locations	
DiMaggio, C., Frangos, S., Li, G., "National Safe Routes to School program and risk of school-age pedestrian and bicyclist injury," *Annals of Epidemiology* , pp. 412-417	2016	Quantitative	Case Control study of the impact of SRTS. Pooled and unpooled analysis of national injury data. All children experiencing traffic related injury or death in 18 US states representing 62 million children.	Undefined	SRTS implementation is conclusively linked to a reduction in traffic-related injury risk for children during school hours.
Evaluation					
Pelletier, J.E., Laska, M.N., Nanne, M.S., Pratt, R.,"Cross-Sector collaboration on Safe Routes to School policy advocacy and implementation: A mixed methods evaluation from Minnesota," *Journal of Transport & Health,* pp. 132-140	2018	Mixed Methods	Retrospective, observational Cohort Study using a mixed-methods approach: Network survey and one-on-one interviews/ High-capacity leaders and organizations that have a more central relationship to SRTS implementation.	80 Organizations	This study contributes to the understanding of the role of partnership and collaboration in SRTS success.
Stewart, O., Moudon, C. Claybrooke, C., "Multistate Evaluation of Safe Routes to School Programs" *American*	2014	Quantitative	One group pre-post-test. Florida, Mississippi, Washington, and Wisconsin	48 completed SRTS projects	Statistically significant increases in active school travel were observed across projects in all four states. Increases in all active travel modes

***Journal of Health Promotion*, 28, DOI:10.4278/ajhp.130430-QUAN-210**				53 schools affected by a completed SRTS project	from 12.9% to 17.6% with the greatest increase in walking from 9.8% to 14.2%.
Heinrich, K.M., Dierenfield, L., Alexander, D.A, Prose, M., Peterson, A.C., "Hawai'i's Opporunity for Active Living Advancement (HO'ALA): Addressing Childhood Obesity through Safe Routes to School, *Hawai'i Medical Journal,*70, pp. 21-26	2011	Quantitative	Quasi-Experimental. Hawai'i	13 Schools	Baseline evaluation of SRTS programs including active transportation rates to and from school and to track changes related to statewide policy, safety, and comfort efforts.
Equity					
Macridis, S., Bengoechea, E.G., McComber, A.M., Jacobs, J., Macaulay, A.C., Members of the Kahnawake Schools Diabetes Prevention Project-School Travel Planning Committee, *Evaluation and Program Planning*, 56, pp. 99-108	2016	Qualitative	Community-Based Participatory research Indigenous community in Canada	3 elementary schools serving Kahnawake children	School travel data including traffic-pedestrian observations, walkability and parent surveys identified key pedestrian-traffic locations. This information informed routes and traffic calming strategies.
Kontou, E., McDonald, N.C., Brookshire, K., Pullen-Seufert, N.C., LaJeunesse, S., "U.S. active school travel in 2017: Prevalance and correltes", *Preventive Medicine Reports*, 17	2020	Quantitative	Descriptive Analysis of all the NHTS data set which contains demographic and travel information on children and adolescents between the ages of 5 and 17 (N=58,576,741)	35,197	<10% of children usually walked to school and 1.1% usually biked to school. Income disparities impact ATS. This study found that race, gender, and ethnicity were not associated with ATS.

Analysis of Evidence

Using the Six Es framework as an anchor, this analysis explored the evidence for each aspect of the Six Es, as each are addressed in the literature with an eye towards how these findings might inform this study's recommendations.

Theoretical Frameworks

A wide variety of theoretical frameworks was used by researchers perhaps, in part, because of the diversity of aspects within the Six Es model. To explore cross-sector collaboration, Buttazzoni, Coen, et al. (2018) used Kurt Lewin's Field Theory (Lewin, 1951). Greer et al. (2019) and Macridis et al. (2016) used community-centered, asset-based approaches through community-based and participatory research and Coalition Action Research. LaJeunesse et al. (2019) used Rogers' Theory of Diffusion of Innovation to track how intervention uptake occurs across large systems (Rogers, 1962). The socioecological model (Bronfenbrenner, 1989) was used to illustrate the spheres of impact and influence, while the Theory of Planned Behavior (Ajzen, 1991) addresses the impact of knowledge and attitudes on AST uptake (Bronfenbrenner, 1989) (Ajzen, 1991). Ecological models and cognitive behavioral theory (Bandura, 1977) were consistently acknowledged as underlying frameworks of the SRTS program in general.

Measurement Tools

Sixteen studies employed primary data collection through the use of surveys. Stakeholder surveys and questionnaires were the most common data collection instruments used. However, other methods were also used. Three research studies collected data through community-based and participatory methods; Buttazzoni, Coen, et al., (2018) used thematic analysis to assess

stakeholder interviews and focus groups to better understand effective implementation practices, whereas Greer et al. (2019) worked with high school age youth populations to assess active travel routes. Macridis, et al. (2016) used participatory action research to evaluate the effectiveness of SRTS programming in one large indigenous community in Canada.

Of the studies (N=3) that used mixed methods, all used key informant interviews to better understand findings originating from stakeholder surveys. Mendoza et al. (2017) focused on increases of AST within a small, diverse, inner-city elementary school. LaJeunesse et al. (2019) looked at the impact of bike and walk events among a broad section of elementary schools in North Carolina to explore how successful SRTS practices diffused among different school sites and regions. Finally, Coughenour et al. (2017) explored barriers to AST within a community in Las Vegas, Nevada.

Published secondary data analyses included national and state-level grant reporting data and national- and state-level school reporting data. Secondary datasets were used in two studies which focused on traffic-related injuries and death. Secondary datasets that were used included SpringStyles Survey and National Highway Traffic Safety (NHTS) data (DiMaggio et al., 2016; Omura et al., 2018), SRTS survey data, and active travel reporting (Larouche et al., 2014). The Effective Public Health Practice Project (EPHPP) Quality Assessment tool for studies was used in N=2 systematic literature reviews (Buttazzoni, Kesteren, et al., 2018; Larouche et al., 2018).

Analysis of Evidence Gaps

For which specific populations are SRTS programs more likely to result in the desired behavior change? It is clear from the literature that SRTS programs have better outcomes in white urban, exurban, and suburban environments. Rural schools showed some uptake in North

Carolina when the program was implemented at a statewide level with regional coordination and state-level partnership between the transportation department and the state office of public health (LaJeunesse et al., 2019). It also appears that schools with active parent teams or Parent Teacher Associations (PTA) have a ready-made internal infrastructure with which to implement core program components, such as the walking school bus or bike trains (LaJeunesse et al., 2019; Pelletier et al., 2018; Royne et al., 2016).

More analysis is needed on rural assets that can be capitalized upon to support SRTS implementation successfully. Low wealth communities were more likely to participate in AST programs if they lived in more densely populated areas with built environment infrastructure that facilitated AST. Low wealth communities of color were less likely to participate if they perceived their community to be unsafe (Graham et al., 2020).

How are harms or unintended consequences resulting from active transportation to schools mitigated? The data show that SRTS programs reduce the overall incidence of traffic injuries and fatalities in school-aged populations. The focus on identifying and remediating hazardous roadways between school sites and communities is a critical aspect of this positive outcome (DiMaggio et al., 2016; Omura et al., 2019). It is possible that in many communities even if youth do not walk or bike to school during the weekdays, they do walk or bike to playgrounds and/or nearby recreation areas during after-school hours and weekends. Studies are needed to investigate the usage of SRTS infrastructure beyond the home-to-school commute.

Under what community circumstances do SRTS work? It is still unclear what community circumstances have the most significant effect on program outcomes. The research focuses heavily on parental attitudes, participating schools' capacity, and infrastructure

improvements (DiMaggio et al., 2016; LaJeunesse et al., 2019; Pelletier et al., 2018). This project sought to unearth the influence of a facilitative environment as well as investigate what assets contribute to success in communities not typically associated with SRTS program success. However, the available data limited our ability to determine the answer to this question. We were, however, able to find areas for more exploration.

What are the primary barriers within communities to proper SRTS implementation? The research lists a number of community barriers to implementation. Primarily they list rurality, urban crime, and a lack of facilitative coordination among schools, school district leadership, counties, regions, and states. More research needs to be done to better understand the nature of these barriers. While Pelletier et al.'s (2018) Minnesota study highlights the benefits of collaborative governance practices across a collaborative SRTS network, this element of the intervention landscape continues to be under-researched and not well understood.

What is the impact of each "E" in the "Six Es Framework" individually and/or in concert? State-level studies of active travel barriers and impact form the bulk of the analysis including a focus on neighborhood design (Nevada), collaborative network leadership (Minnesota), infrastructure funding (Texas), and bike- or walk-to-school events (North Carolina). Larger multi-state evaluation studies were focused on parent perceptions of safety (N=1) and potential for traffic-related injury reduction through SRTS programming (N=1).

- **Education.** Education was the area of least focus with only one study focusing specifically on the impact of educational programming within the SRTS programmatic frame. Furthermore, in the studies captured in this literature review, Education does not appear as a discrete aspect of the Six Es framework for study.

- **Encouragement.** The primary encouragement component included in the outcome evaluations examined in this literature review focused on bike trains and walking school buses. Surveys of overall parent intentions and perceptions, while researched to better inform the encouragement component of the program framework, appear to be more closely aligned with Equity as the researchers focused on parents of color to better understand their barriers and facilitators for participation.
- **Engineering.** The most prominent aspect of the framework examined in the literature is Engineering (N=10). Studies explored associations between the built environment and bike/walk uptake in and around SRTS implementation sites. One speculation for this focus, to the exclusion of other framework components, is that the impact of intervention elements such as bike lanes and sidewalks, is less difficult to evaluate, because use of them can be easily observed by trained volunteers.
- **Enforcement.** Engineering and Enforcement appear to be overlapping aspects of the intervention framework connected through traffic calming measures. Several studies (N=3) explored the impact of crossing guards specifically and found contradicting results regarding the role of crossing guards in increasing AST signifying a need for more research in this area. Additionally, there is a gap in understanding the impact of traffic enforcement in school zones of participating schools and school district-law enforcement partnerships to support SRTS implementation.
- **Evaluation.** Studies taking a comprehensive approach to the framework (N=4) and evaluation studies (N=4) provide baseline data, explore outcomes of SRTS programs, or examine the distribution of impact across demographics and regions. Intervention

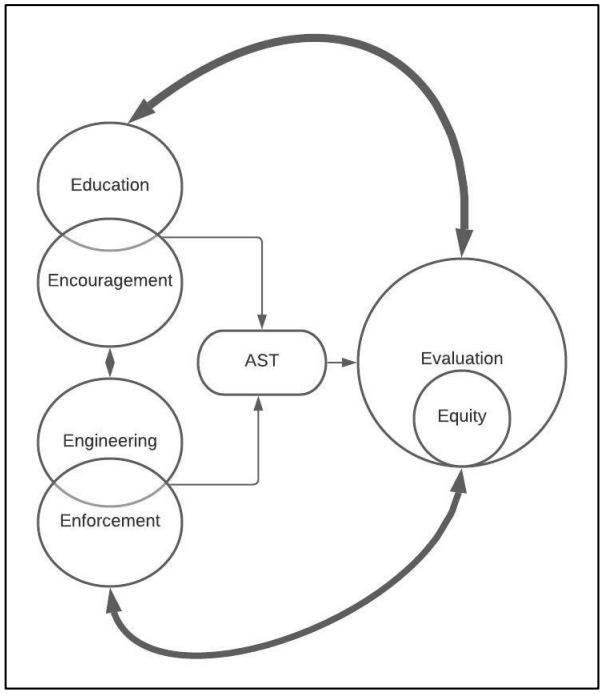
methods were more comprehensively studied; these included two studies focused on the cross-sector collaboration needed for successful implementation of SRTS.

- **Equity.** Equity shows up in this research primarily as an evaluation metric of which populations are most impacted by program success. Attitudes and perceptions of parents of color living in urban environments were also studied. Overall, to my knowledge, the distribution of impact among populations still has not been thoroughly examined. Therefore, more research is needed to understand how SRTS programs further or remediate inequities in access to safe AST routes and support.

Analysis of the Model

Figure 4

New Model of AST Predictors



The model that emerged based on the comprehensive review of the literature in each area of the framework shows the overlapping nature of the framework aspects. This new model,

illustrated in Figure 4, revises the previous model to more accurately approximate what the literature presents about the way in which the model is implemented. The Six Es are not independent components; rather they are overlapping based on the agencies most responsible for carrying them out (Buttazzoni, Kesteren, et al., 2018; Coughenour et al., 2017; Hoelscher et al., 2016; Kontou et. al., 2020; Larouche et al., 2014; Rothman et al., 2014; Rothman et al., 2015

In this model we see that Education is closely linked with the broader framework of Encouragement in that education provided is focused on bicycle and pedestrian safety to mitigate aspects of safety concerns. Additionally, Encouragement activities like bike trains and walking school buses also provide an opportunity for applied learning about best routes and ways to address hazards. The benefit of Engineering, which encompasses built environment interventions to address hazardous routes, is extended through Enforcement efforts such as crossing guards and police presence. Evaluation of the frameworks, both through systematic literature reviews and national and regional program evaluations, yields the aspects of the framework that are necessary, if not entirely sufficient, to promote AST. Finally, Equity appears only as a deeply embedded aspect of Evaluation. This may be due to the nascent nature of Equity's inclusion into the framework and that more research is needed in this area.

Chapter 3. Methodology

How will the aims be addressed?

To meet the overall aims of this study, NC ARTS survey and tally data were analyzed to identify the key predictors influencing AST. Initially, this analysis was intended to inform school-based recommendations for continued program implementation at the school and community level. The original intent was to develop a "toolkit" on program implementation. Unfortunately, the global COVID-19 pandemic led to complete closure of all school districts in NC in March of 2020 that is currently ongoing. Therefore, the third aim of this study, which was to provide meaningful products informed by this research, was addressed by working with a bicycle and pedestrian advocacy organization based in Asheville, North Carolina: Asheville On Bikes (AOB). AOB has broad-based programming aimed at improving bicycle and pedestrian infrastructure as well as increasing the number of individuals who commute by bike. Most relevant to the aim of this study is the AOB program that provides school-based applied bicycle and pedestrian skills training for youth.

To act on relevant findings, an online promotion and information campaign and a white paper were created to increase parent awareness of bicycle skills training programs and opportunities. While AOB is local and serves only one of the districts in which NC ARTS was implemented, they are part of a state and national network of similar organizations and are nationally recognized for their work. Therefore, one could reasonably assume that successful implementation of the campaign proposed in Chapter 6 could result in program replication among similar bicycle and pedestrian organizations across NC.

Data Sources and Methodological Approach

The analyses contained in this report used two datasets. The first dataset captured tally counts of students' mode of transportation to school in schools participating in the NC ARTS programs. The second dataset included survey data collected from parents who had children attending a school participating in a NC ARTS grant-funded program. Survey items included current active travel behavior and perceptions about active travel. Both datasets were obtained from the NC Department of Transportation through a request for information. These data represent successive samples taken from K-12 students and their families in NC public schools over an 11-year timespan (academic years: 2007-08 through 2018-19). These data were collected as part of state grant reporting requirements.

Tally Data Collection Methods and Survey Tool

The tally dataset included data from 212 of the 261 schools that participated in NC ARTS programming (81% participation rate), representing about 8% of the 2,500 traditional public schools in NC. The tally dataset included demographic and categorical data as well as numerical counts or tallies of students at the classroom level. Tally sheets collected teacher's name and the month, year, time of day, and weather on the day of the report. The tallies indicated the number of students who used various travel modes to get to school. Travel modes collected were: bike, walk, family vehicle, carpool, school bus, transit, and an "other" category that included: scooter, inline skates, and skateboard. A more complete description of this dataset is provided below, and a copy of the tally report sheet is located in the appendix.

Tally Report Sheet Categories:

- A unique school identification number provided for each participating school site

- Total number of students enrolled at the school
- Classroom Teacher's Name
- Year tallies were taken
- Month tallies were taken
- Monday date of the week the tallies were taken
- Whether the tallies were taken in the morning or afternoon
- Weather on the day the tallies were taken
- Tally count of the # of students using each travel mode that day (Bike, Walk, School Bus, Family Vehicle, Carpool, Transit, Other [Skate Board, Scooter, Inline Skates])

Parent Survey Data Collection Methods and Survey Tool

Parent surveys were collected from parents in 168 of the 261 schools that participated in NC ARTS programming (64% participation rate). Information was not available from the NC Department of Transportation on target participation rates, the validity of the survey questions, or participant sampling. There was no information provided on the purpose of the survey, and the survey itself was not provided. Therefore, it is unclear how parents understood the purpose of the survey. From our estimation the intent was to understand parent perceptions of, barriers to, and experiences with the NC ARTS program. The survey data contained categorical, continuous, and binary survey items. Additionally, these general demographics were also collected:

- School Identification Number
- Survey Set Identification
- Student gender (binary)
- Student grade (ordinal)
- Street address of bus stop

- Parent's education level (ordinal)
- Number of school-aged children living in home (continuous)

The survey also included categorical data extracted from 5-level Likert-type items that assessed:

- Student health level (Not at all healthy/Unhealthy/Neutral/ Healthy/Very healthy),
- Perceived school encouragement for active transportation (Strongly Discourages/Discourages/Neither/Encourages/Strongly Encourages)
- How much fun is walking or biking to school for your child? (Very fun/Fun/Neutral/Boring/Very boring)

Ordinal Scale Variables:

Distance to school and Distance from school were separate variables with the same choices:

- Less than ¼ mile
- ¼ mile up to ½ mile
- ½ mile up to 1 mile
- 1 mile up to 2 miles
- More than 2 miles

Likewise, time traveled to school and time traveled home were separate variables with the same choices:

- Less than 5 minutes
- 6 and 10 minutes
- 11 and 20 minutes
- More than 20 minutes

Mode of arrival and dismissal were two separate variables with the same choices:

- School bus
- Walk
- Carpool
- Family Vehicle
- Transit
- Bike
- Other

Binary variables related to AST:

Did your child ask permission to bike or walk to school?

- Yes/No

Not comfortable with my child(ren) walking at any age

- Yes/No

Ordinal variable:

Grade that parents would allow their child to walk or bike to school.

Methods

The Student Tally Data and Parent Survey Data were analyzed separately using SPSS Version 27. Descriptive statistics were analyzed for each data set. Then using the parent survey data, binary logistic regression models were performed for each predictor variable. Finally, two full model logistic regressions were performed against two dependent variables: AST and Not

Comfortable. A Chi-Square test was conducted to determine the relationship between AST and Not Comfortable.

Tally data were examined to quantify the total reported AST uptake by year and grade. The parent survey data were analyzed to understand the relationship between the proxy variable for AST, which tracked the arrival mode of students reported by parents, and three variables: 1) student grade, 2) distance from home to school, and 3) parent perception of school encouragement for AST. More detail is captured below organized by dataset.

Tally Data

All non-motorized forms of travel were coded as "1", and all motorized forms of travel were coded as "0". Over the timespan of data collected, there were n= 90,269 total observations. Descriptive tables of these data developed to provide information on the variation of AST by grade and year are presented below.

Parent Data

To better understand the predictors of AST through the parent survey, the variable that captured the mode of travel students used to get to school labeled "Arrival" was used as a proxy variable for AST. To accomplish this, a new variable was created in that dataset and named "AST". AST contained all active travel modes of bike, walk, and other coded as "1" and non-active travel modes of family vehicle, school bus, carpool, and transit coded as "0". Categorical variables were coded numerically. Categorical variables that included "don't know" or "prefer not to answer" were treated as missing in the analysis. The next section provides detail on each set of predictors and reference variables for each.

School encouragement values of strongly encouraged and encouraged were combined as were strongly discouraged and discouraged to create a new variable "combined SE" with three levels. The value "neither" was used as a reference category.

Due to small observations (<55 per grade) of AST in grades 9-12, those grade levels were excluded in the bivariate and multivariable regression analysis. Pre-Kindergarten and Kindergarten were combined together, and 8th grade was used as the reference category for the regression analysis.

To adjust for the very small sample size of parents who lacked a high school education the categories of some high school and elementary education only were combined. The response "prefer not to answer" were treated as missing. The category of 1-3 years of college was the reference variable for this estimation.

Observations of parents who reported that they "did not know" the distance from their home to the school site were treated as missing. Between 1 and 2 miles was used as the reference category in the bivariate and multivariable logistic regressions. The distance of 1-2 miles was chosen, rather than the variable with the largest or smallest set of observations, because AST was more likely to occur in distances less than 2 miles, and families that lived more than 2 miles are over represented in the sample.

A binary logistic regression model for each variable of interest was conducted to better understand the impact of child's grade, parent education level, distance to school, and perception of school encouragement on AST. Then, a multivariable logistic regression model was conducted to see how the full model performed when including all predictors of interest.

A second binary regression analysis was conducted to explore the role of parent comfort in relationship to the variables of interest. The variable "not comfortable", that identified parents who reported that they were not comfortable with their child using AST at any age, was used as the dependent variable to assess which factor among the predictors of child's grade, distance to school site from the child's home, perceptions of school encouragement, or parent's education level most influenced parent comfort with AST as a mode of travel to school. "Not comfortable" was coded as "1" and a blank response, indicating that the parent had chosen a grade that they would be comfortable with AST, was coded as "0". The same analysis process used for modeling AST was used for this dependent variable.

Institutional Review Board

The Institutional Review Board of East Tennessee State University determined that this project did not constitute human subjects research because it examined de-identified, secondary data. The determination letter is located in the appendix of this document.

Challenges and Mitigation Strategies

One critical challenge to this analysis was the lack of childhood obesity data at the school and county levels. An attempt was made by the North Carolina Pediatric Nutrition and Epidemiology Surveillance System (NC PNESS) to collect the prevalence of obesity, overweight, and underweight children 5-11 years old by age and county. This data collection process was only maintained for two years (2014-15). The lack of knowledge regarding the schools, only indicated by a school ID, did not facilitate attempts to connect these data to obesity rates. Based on the most proximal outcome of NC ARTS, biking, walking, or other non-

motorized transportation to school, noted as AST, was used as a proxy outcome variable, as moderate to vigorous physical activity is a known predictor for healthy weight (CDC, 2020)

These data were collected as part of grant reporting and not as part of a scientific research study or formal evaluation. There were challenges with missing data, survey inconsistencies and errors, and no reference information, except what can be inferred from the data alone, about data collection methods. These limitations are explored further in the Limitations and Discussion sections. To address this challenge, no assertations are made regarding these analyses; rather, they are used to provide recommendations for future research.

School closures due to the COVID-19 pandemic made outreach to school site personnel untenable as people moved on from positions or were unwilling to participate. To remedy this challenge, a community-based organization (Asheville On Bikes) was contacted to explore whether or not the findings in this study would be of relevance to community-based bike/ped organizations.

Competencies and Integration

- **Data & Analysis.** The data and analysis competency this study intended to address was the design of a qualitative, quantitative, mixed methods, policy analysis or evaluation project to address a public health issue. This study demonstrated this competency by designing a quantitative analysis through a statistical analysis of NC ARTS' program data.
- **Policies and Programs.** This study sought to integrate scientific information, legal and regulatory approaches, ethical frameworks and varied stakeholder interest in policy development and analysis through a comprehensive review of the literature regarding

SRTS program success and a partnership with a local bicycle pedestrian organization to share findings and implement health communications that can increase program participation and general awareness.

- **Education & Workforce Development.** Deliver training or educational experiences that promote learning in academic, organizational and community settings. To demonstrate this competency, this project developed a social marketing campaign based on the research findings. A webinar of findings was presented to the board and key volunteers of Asheville On Bikes.

- **Leadership, Management, & Governance.**

  This project:

  - Proposed strategies to promote inclusion and equity within public health programs, policies, and systems.
  - Communicated public health science to diverse stakeholders, including individuals at all levels of health literacy, for purposes of influencing behavior and policies.
  - Recommendations in the white paper focused on the findings regarding parent perceptions of active youth travel. To ensure ease of use, the white paper communicates critical information in plain language easily understood by people at various levels of literacy.

- **Concentration Area: Community and Behavioral Health Competencies.**

  - Through the social marketing campaign this project:

- Translated community and behavioral research into population-based programs and policies;
- Translated health behavior theoretical models into public health interventions; and
- Translated theories, conceptual paradigms, and evidence to inform planning, implementation, evaluation, and dissemination of innovative, tailored public health interventions.

This project was designed to be highly translative by focusing on the praxis of SRTS research and community-based implementation and practice. It successfully incorporates the competencies of analyzing data and policy to develop tools for addressing a population health issue. The intent of this work is to translate data collected by state grantors into an actionable tool that ensures that the benefits of NC ARTS programming can continue even after directed funding is no longer available.

The models developed provide a foundation for a novel understanding of the theory of change for SRTS programming. Additionally, this project provided insights into the role of grant reporting data in informing public health practice as well as a role for public health practitioners in shaping what and how grant reported data could be collected to better inform program, policies, and practice.

Chapter 4. Results

Results: Tally Data

It is unclear whether tally data were collected randomly or systematically over the 11-year data collection period. Data were collected on all weekdays and could have been collected in the morning or the afternoon. Classrooms that participated in tally counts spanned pre-kindergarten through 12th grade. The following tables provide descriptions of the data by grade of the student, mode used by the student to travel to school on the day that the tally count was taken, and the number of students using each travel mode.

All tallies were collected by school personnel. Table 2 shows participation across grade level. Grades kindergarten through 5th grade made up the largest proportion (60%) of the tally data. The most frequently used forms of travel overall were family vehicles (34.6%) and school bus (34%). Walking was the preferred form of AST, representing 12.6% of all travel reported. All forms of AST accounted for 17.5% of travel reported over the timespan that the data were collected. Travel varied by year, as did the number of observations. Table 3 shows the variation of travel by year.

Table 2

Tally Data Distribution of Travel Mode by Grade and Percent Within Travel Group

	BIKE		WALK		OTHER AST		CARPOOL		FAMILY VEHICLE		SCHOOL BUS		TRANSIT		GRADE TOTAL	
PRE-K	11	(0.5%)	46	(0.4%)	20	(0.8%)	51	(0.5%)	333	(1.1%)	234	(0.8%)	27	(2.2%)	722	(0.8%)
KINDERGARTEN	208	(10.2%)	1310	(11.5%)	352	(14.7%)	744	(6.8%)	3705	(11.9%)	3637	(11.8%)	146	(11.8%)	10132	(11.2%)
1ST	292	(14.3%)	1297	(11.4%)	391	(16.4%)	1070	(9.5)	3761	(12.1%)	3702	(12.1%)	200	(16.2%)	10713	(11.9%)
2ND	294	(14.4%)	1360	(12.0%)	445	(18.6%)	1133	(10.0%)	3851	(12.3%)	3795	(12.4%)	258	(20.9%)	11136	(12.3%)
3RD	236	(11.6%)	1350	(11.9%)	300	(12.6%)	1207	(10.7%)	3786	(12.1%)	3757	(12.2%)	183	(14.8%)	10819	(12.0%)
4TH	236	(12.9%)	1235	(10.9%)	294	(12.3%)	1131	(10.0%)	3296	(10.6%)	3257	(10.6%)	140	(11.3%)	9616	(10.7%)
5TH	258	(12.6%)	1297	(11.4%)	221	(9.3%)	1175	(10.4%)	3171	(10.2%)	3114	(10.1%)	128	(10.4%)	9364	(10.4%)
6TH	169	(8.3%)	1051	(9.2%)	63	(2.6%)	1238	(10.9%)	2585	(8.3%)	2569	(8.4%)	51	(4.1%)	7726	(8.6%)
7TH	153	(7.5%)	905	(8.0%)	66	(2.8%)	1036	(9.2%)	2150	(6.9%)	2167	(7.1%)	14	(1.1%)	6491	(7.2%)
8TH	110	(5.4%)	905	(8.0%)	64	(2.7%)	1105	(9.8%)	2132	(6.8%)	2181	(7.1%)	21	(1.7%)	6518	(7.2%)
9TH	16	(0.8%)	185	(1.6%)	31	(1.3%)	366	(3.2%)	659	(2.1%)	662	(2.2%)	12	(1.0%)	1931	(2.1%)
10TH	10	(0.5%)	126	(1.1%)	32	(1.3%)	349	(3.1%)	559	(1.8%)	561	(1.8%)	22	(1.8%)	1659	(1.8%)
11TH	6	(0.3%)	102	(0.9%)	49	(2.1%)	309	(2.7%)	426	(1.4%)	385	(1.3%)	9	(0.7%)	1286	(1.4%)
12TH	1	(0%)	73	(0.6%)	23	(1.0%)	268	(2.4%)	478	(1.5%)	410	(1.3%)	6	(0.5%)	1259	(1.4%)
UNKNOWN	13	(0.6%)	123	(1.1%)	38	(1.6)	94	(0.8%)	307	(1.0%)	276	(0.9%)	19	(1.5%)	870	(1.0%)
TRAVEL TOTAL	2040	100%	11365	100%	2389	100%	11306	100%	31199	100%	30707	100%	1236	100%	90,242	(100%)
MODE % OVERALL	2.3%		12.6%		2.6%		12.5%		34.6%		34.0%		1.4%			

Table 3

Tally Data Distribution of AST by Year and Percent Within Travel Mode

	AST	NOTAST	TOTAL
YEAR			
2007	140 (0.9%)	593 (0.8%)	733 (0.8%)
2008	643 (4.1 %)	3600 (4.8%)	4243 (4.7%)
2009	984 (6.2%)	3332 (4.5%)	4316 (4.8%)
2010	3307 (20.9%)	11585 (15.6%)	14892 (16.5%)
2011	953 (6.0%)	3906 (5.2%)	4859 (5.4%)
2012	460 (2.9%)	932 (1.3%)	1392 (2.2%)
2013	642 (4.1%)	1349 (1.8%)	1991 (2.2%)
2014	1344 (8.5%)	9657 (13%)	11001 (12.2%)
2015	2557 (16.2%)	14717 (19.8%)	17274 (19.1%)
2016	2936 (18.6%)	15958 (21.4%)	18894 (20.9%)
2017	1073 (6.8%)	5313 (7.1%)	6386 (7.1%)
2018	691 (4.4%)	3101 (4.2%)	3792 (4.2%)
2019	64 (0.4%)	405 (0.5%)	469 (0.5%)
TOTAL	15,794	74,448	90,242 [1]

[1] 27 observations did not include a year

Results: Parent Survey

A total of 26,351[2] parent surveys were analyzed from 168 schools during the study period. There is no response rate calculated because no information was provided on how many possible families were surveyed during this time period among these schools. A majority of the respondents reported that their child was female (52.2%). The tables below provide descriptions of the parent survey data. Table 4 shows the distribution of surveys by year. Some data were collected by season (fall, winter, spring). Seasonal data were collected between fall of 2007 and 2010.

Participation by grade in the parent survey mirrors participation by grade in the tally dataset, with a majority of respondents reporting a child in kindergarten through 5th grade. More parents of 6th through 8th graders participated in the parent survey than 6th through 8th grade classrooms participated in the tally data. A little more than half of parents (51.0%) reported living within two miles of their school, while 44.7% of respondents reported living more than two miles from the school. Almost two-thirds of parents (65.3%) reported that they were not comfortable with their child using AST at any age.

More than two thirds of respondents (68.0%) reported that their school was neutral, neither encouraging nor discouraging AST. One quarter (24.4%) reported that the school either strongly encouraged (6.1%) or encouraged (18.3%) AST. Only 7% reported that AST was either strongly discouraged (3.2%) or discouraged (3.8%) by their child's school. The majority of parents (71.5%) reported attending at least one year of college, with 41.9% reporting that they completed at least 4 years or more of college. Of parents who reported less than a college

[2] As the descriptive statistics indicate, 27 surveys were considered "missing" and were not included in the analysis.

education, 15.9% were high school graduates and 9.5% reported not graduating from high school. Finally, 86.4% of respondents reported that their child's mode of travel was either the school bus or a family vehicle, and 6.6% did not report the travel mode they used to get their child to school. Therefore, AST accounted for 7% of all respondents' travel. Tables 4-10 show distributions of survey year, distance from school, parent comfort with AST, parent perceptions of school encouragement, and travel mode for the parent survey.

Table 4

Parent Survey Distribution by Year

Year	Count	Percent of Total
Unreported	4908	18.4%
2008	488	2.3%
2009	344	1.6%
2010	4968	23.1%
2011	2443	11.4%
2012	628	2.9%
2013	1146	5.3%
2014	3922	18.2%
2015	3851	17.9%
2016	1806	8.4%
2017	1026	4.8%
2018	729	3.7%
2019	92	.4%
Missing	27	.01%
Total	26378	100%

Table 5

Grade Distribution of Parent Survey Responses

Grade	Count	Percent of Total
Pre-K	254	1.0%
Kindergarten	3301	12.6%
1st	3188	12.2%
2nd	3293	12.6%
3rd	3188	12.2%
4th	3187	12.1%
5th	3155	12.0%
6th	2660	10.1%
7th	2225	8.5%
8th	1711	6.5%
9th	47	.2%
10th	10	0%
11th	5	0%
12th	11	10%
Unknown	116	.4%
Missing	27	.01%
Total	26378	100%

Table 6

Distribution of Distance as Reported by Parent Survey

Distance	Count	Percent of Total
Less than ¼ mile	2482	9.4%
¼ mile up to ½ mile	2110	8.0%
½ mile up to 1 mile	3526	13.4%
1 mile up to 2 miles	5324	20.2%
More than 2 miles	11794	44.7%
Don't know	1115	4.2%
System Missing	27	.01%
Total	26378	100%

Table 7

Perception of School Encouragement as Reported by Parent Survey

Perceived School Encouragement [3]	Count	Percent of Total
Strongly Encourages	1612	6.1%
Encourages	4886	18.5%
Neither	18001	68.3%
Discourages	1006	3.8%
Strongly Discourages	846	3.2%
System Missing	27	.01%
Total	26378	100%

[3] For the analysis strongly encouraged and encouraged were combined as just encouraged as were strongly discouraged and discouraged combined and labeled discouraged.

Table 8

Distribution of Parent Education as Reported by Parent Survey

Parent Education [4]	Count	Percent of Total
Elementary (Grades 1-8)	1214	4.6%
Some High School (Grades 9-11)	1288	4.9%
High School (Grades 9-12 or GED)	4207	16.0%
Some College (College 1-3 Years)	7819	29.7%
College 4 years or More	11041	41.9%
Prefer Not to Answer	782	3.0%
Missing	27	0.1%
Total	26378	100%

Table 9

Count and Percent of Parents Either Reporting a Grade or Age They Feel Comfortable with AST or Not Comfortable with AST at Any Age

Not Comfortable[5]	Count	Percent of Total
Reported a Grade or Age Comfortable*	9154	34.7%
Not Comfortable at Any Age	17224	65.3%
Total	26378	100%

[4] For the analysis Elementary and Some High School were combined to create Less than High School.

[5] *The variable that captured the grade that parents felt comfortable included at least 10 incidences a value outside grade range was reported (assumed to be age).*

Table 10

Distribution of Travel Mode as Reported by Mode Child Arrived at School

Travel Mode	Count	Percent of Total
Bike[6]	275	1.0%
Walk	1505	5.7%
Other AST[7]	69	0.3%
School Bus	9961	37.8%
Family Vehicle	12816	48.6%
Carpool	1213	4.6%
Transit	41	0.2%
No Data	471	1.8
System Missing	27	.01%
	26378	100%

Results of the Statistical Analysis

The primary analyses were focused on two models: 1) the effects of grade level, distance lived from school, school encouragement, and parent education level on AST travel (the travel mode students used to get to school); and 2) the effects of those same variables on parent comfort with AST at any age or grade level. The chi-square analysis in Table 11 shows that 96.6% of people who reported that they were not comfortable with AST did not allow their child to travel to school using AST modes of travel. The Pearson Chi-Square test reported a highly

[6] *Bike, Walk & Other AST were combined to create the AST Variable. All others were combined to create the non-AST variable*

[7] *AST Other Includes Skateboard, inline skates, and nonmotorized scooter*

significant association (Pearson Chi-Square 1046.98, p= <.001) between AST and parent comfort with using AST.

Table 11

2X2 of AST and Not Comfortable with AST at Any Age

		Some age comfortable	Not comfortable at any age
Not AST	**Count**	7657	16374
	% within Not Comfortable	85.7%	96.6%
AST	**Count**	1276	573
	% within Not Comfortable	14.3%	3.4%
Total	**Count**	8933	16947[8]

[8] Missing cases of Not Comfortable were 498 (1.9%)

Table 12

Bivariate and Multivariable Logistic Regression Results of AST and Predictors

	Bivariate Results			Multivariable Results		
	OR	95% CI	p-value	OR	95% CI	p-value
Distance						
Overall			<.001			<001
Less than ¼ mile	30.424	24.683-37.502	<.001	9.705	7.300-12.902	<.001
¼ mile up to ½ mile	11.333	9.080-14.144	<.001	3.339	2.484-4.491	<.001
½ mile up to 1 mile	4.429	3.775-5.924	<.001	1.365	1.012-1.842	.042
More than 2 miles	.192	.136-.272	<.001	.059	.287-.205	<.001
1 mile up to 2 miles	Ref	---------	------	----	----------	-----
School Encouragement						
Overall			<.001			<.001
Encourages	3.280	2.975-3.617	<.001	2.371	2.109-2.666	<.001
Discourages	.727	.562-.940	.0156	.696	.525-.922	.012
Neither	Ref	---------	------	------	----------	------
Parent Education Level						
Overall			<.001			<.001
Less than High School	3.744	1.609-2.087	<.001	2.964	2.459-3.574	<.001
High School	1.444	1.222-1.707	<.001	1.323	1.096-1.597	.004
4 years College	1.833	1.609-2.087	<.001	2.259	1.945-2.623	<.001
Some College	Ref	--------	-----	------	--------	-------
Student Grade						
Overall			<.001			.080
Kindergarten	2.494	1.886-3.298	<.001	1.269	.913-1.765	.156
1st	2.223	1.675-2.951	<.001	1.122	.804-1.565	.499
2nd	2.430	1.837-3.216	<.001	1.351	.971-1.882	.075
3rd	1.902	1.427-2.535	<.001	1.080	.771-1.514	.655
4th	2.443	1.845-3.236	<.001	1.463	1.050-2.040	.025
5th	2.366	1.785-3.135	<.001	1.271	.910-1.776	.159
6th	1.000	.724-1.381	1.000	1.174	.805-1.714	.405
7th	.934	.665-1.311	.693	1.102	.742-1.639	.630
8th	Ref	---------	------	Ref	----------	------

Table 13

Bivariate and Multivariable Logistic Results of Parents Not Comfortable with AST and Predictors

	OR	95% CI	P-Value	OR	95% CI	P-Value
Distance						
Overall			<.001			<.001
Less than ¼ mile	.453	.411-.500	<.001	0.385	.347-.427	<.001
¼ mile up to ½ mile	.499	.450-.553	<.001	0.460	.413-512	<.001
½ mile up to 1 mile	.640	.587-.699	<.001	0.604	.552-.662	<.001
More than 2 miles	1.699	1.583-1.823	<.001	1.775	1.648-1.912	<.001
1 mile up to 2 miles	Ref	----------	------	--------	---------	-------
School Encouragement						
Overall			<.001			<.001
Encourages	.491	.493-.521	<.001	.558	.523-.596	<.001
Discourages	1.095	.985-1.219	.094	.995	.886-1.117	.995
Neither	Ref	----------	------	--------	----------	-------
Parent Education Level						
Overall			<.001			<.001
Less than High School	.931	.844-1.029	.164	1.117	.999-1.249	.053
High School Graduate	1.219	1.119-1.328	<.001	1.263	1.152-1.384	<.001
College 4 years or More	.554	.521-.590	<.001	.535	.500-.571	<.001
Some College	Ref	-------	----	-------	--------	-----
Student Grade						
Overall			<.001			<.001
Kindergarten	1.398	1.238-1.579	<.001	2.296	2.004-2.629	<.001
1st	1.397	1.236-1.579	<.001	2.216	1.934-2.540	<.001
2nd	1.312	1.162-1.482	<.001	2.009	1.755-2.300	<.001
3rd	1.187	1.052-1.341	0.006	1.725	1.508-1.973	<.001
4th	1.190	1.052-1.344	0.005	1.740	1.521-1.991	<.001
5th	1.009	.894-1.138	0.884	1.411	1.234-1.614	<.001
6th	1.239	1.090-1.402	<.001	1.222	1.065-1.402	.004
7th	1.112	.977-1.267	0.108	1.091	.947-1.258	.227
8th	Ref	------	------	------	--------	------

The regression tested the null hypothesis that distance, parent education level, and grade had no impact on AST uptake. There were 24,701 cases included in the model (95.3%) as 1,207 (4.7%) were missing.

Distance to school was a significant predictor of AST travel *(p* < .001). The bivariate results showed a graduated relationship between the distance to school and AST uptake, suggesting that the further a child lives from the school, the less likely they are to engage in AST. When controlling for the predictors of education level, grade, and variance in school encouragement, these analyses show that parents of a child who lives less than ¼ of a mile from school are 9.7 times more likely to report participating in AST than parents of a child who lives between 1 and 2 miles away (OR = 9.750, 95% CI = 7.300-12.902, *p* = <.001). If that child lives between ½ and ½ a mile, they are 3.3 times more likely to use AST (OR = 3.339, 95%CI = 2.484-4.49, *p* = <.001), and they are 1.4 times more likely to use AST at ½ to 1 mile (OR = 1.365, 95% CI 1.012-1.842, *p* <.042). A child living more than 2 miles from the school site is less likely to use AST (OR = .059, 94% CI = .287-.205, *p* = <.001) when compared with those children who live between 1 and 2 miles.

The impact of the child's grade level is not a statistically significant predictor of parent report of AST when controlling for all other predictors in the model (*p*=0.08).

In the multivariable model parent perceptions of encouragement or discouragement are significant overall (*p* < .001). Parents who perceived an encouraging school environment were 2.3 times more likely to report participating in AST than did those parents who perceived that the school was neutral in its orientation towards AST (OR = 2.371, 95% CI = 2.109-2.666, *p* < .001). Discouraging environments resulted in a reduction of reported AST (OR = .696, 95% CI = .525-.922, *p* =.012)

Parents who reported not completing high school were almost 3 times more likely than parents who completed at least some college (between 1 and 3 years) to report that their child traveled to school using AST modes (OR = 2.964, 95% CI = 2.459-3.574, p<.001). Parents who reported 4 or more years of college reported that their child used AST 2 times more (OR = 2.259, 95% CI = 1.945-2.623, p <.001) than those who had some college. Parents with a high school education reported just a slight increased association with AST (OR= 1.323, 95% CI = 1.096-1.597, p = .004).

The second model tested the null hypothesis that child's grade level, distance from school, parent perceptions of school encouragement, and parent education level have no effect on parent comfort with AST travel. The analysis included 25,880 observations, which was 98.1% of the surveys completed (n=498 surveys [1.9%] were missing data for these variables).

In these results, we again see the graduated impact of distance on parent comfort with AST (p <.001) for all distances. The analysis shows that the further a child lives from the school site the less comfortable a parent is with AST as mode of school travel. It is important to note that the variable is parent report that they were not comfortable at any age so an odds ratio of less than one indicates that the parent selected an age or grade that they were comfortable with their child walking or biking to school (i.e., less likely to be never comfortable). At less than ¼ mile from the school site, parents were significantly more likely to report comfort with AST (OR =0.385, 95% CI = .347-.427, p < .001) than parents who lived between 1 and 2 miles. Parents who reported living more than 2 miles from the school site were 1.7 times more likely to report that they were not comfortable with their child walking or biking at any age (OR = 1.775, 95% CI = 1.648-1.912, p < .001).

Grade was a significant predictor of discomfort with AST at any age with parents of children in Pre-K through 5th grade reporting that they were approximately 2 times more likely to report discomfort with AST at any age than parents of 8th graders (see table 13).

Encouraging school environments were a significant predictor of parents' report of discomfort with AST at any age (OR = .558, 95% CI =.523-.596, p = <.001) compared to those parents who reported a neutral school environment. School discouragement was not different as compared to school neutrality on parent report of discomfort (p = .995).

Parents who reported completing high school showed a statistically significant increase in discomfort with AST (OR= 1.263, 95% CI = 1.152-1.384, p <.001) as compared to parents with some college, and parents with more than 4 years of college reported a decrease in discomfort compared to those who had 1-3 years of college (OR = .535, 95% CI = .500-.571, p <.001).

Limitations of the Data

Limitations in the Sample, Survey Tool, and Data Collection Methods

Arrival Mode

These data sets could not be reliably combined for a pooled analysis of these data. Therefore, as stated in the methods section, the mode of arrival was used as a proxy variable for AST. This proxy is problematic in several ways: 1) it is unclear how the question was understood by survey participants (e.g., they may have answered based on the usual mode of travel or based on how the child traveled to school on the day the survey was completed; and 2) this proxy cannot be used to determine the effectiveness of the NC ARTS program in improving AST. This is our estimation poses a serious challenge for understanding the actual program impact through analyses of these data. Further limitations of each data set are explored below.

Tally Data Set

There are at least two critical limitations worth noting with the tally data: 1) these data were self-reported by the students to their teachers and could be subject to participant bias; and 2) we do not know that a protocol was followed each time with fidelity. For example, we are not sure if a script was followed to ensure that the same question was asked in the same way at each count, in each classroom, at each school. Therefore, we have to assume that data were collected differently by different teachers even within the same schools and that student counts can include the same student counted more than once.

Walk and bike day events represented another limitation. Regional NC ARTS coordinators were charged with supporting the coordination of active routes days. These days included bicycle trains and walking school buses that were supervised group walks or rides. These days are not indicated in the data and varied by region, district, and school; therefore, the tally data could include bike and walk events coordinated by a regional NC ARTS program coordinator which would inflate AST outcomes and influence parent perceptions during those event periods.

Neither the tally nor the parent survey datasets included information on whether or not the child walking or biking was accompanied or supervised by an adult who was either from the NC ARTS programming staff, the school or a parent, or a community-based volunteer. The absence of this information impedes the ability to fully understand the nature of the response variable.

Parent Survey Data

The parent survey represented a convenience sample that was heavily skewed towards parents with four or more years of college and parents who lived further than two miles from the

school. The effect of distance on parent comfort and the disproportionate number of surveys collected from families that lived beyond 2 miles from the school site has resulted in an analysis of parent characteristics that does not represent the population of families who are more frequently using AST based on the difference in AST uptake between the classroom tallies and the parent survey (17.5% verses 7%). For example, parents reporting four or more years of college represented only 8.0% of respondents living less than 1/4 mile from the school site as compared to 30.7% of parents reporting less than a high school education. Therefore, the disparate representation of the parents surveyed verses the students tallied, who may represent the population most likely to participate in AST, may limit the applicability of these findings.

These data suggest that the survey tool design facilitated overlapping categories. The grade that parents felt comfortable allowing their child to walk to school was removed from this analysis because responses ranged from 0 to 15, suggesting that the survey field was a text field that allowed respondents to enter a value rather than make a selection, allowing some parents to potentially interpret the question to mean the child's age that they were comfortable rather than at what grade level they were comfortable. Therefore, this Grade/Age category could not be reliably analyzed and was removed from the analysis which presents some challenge to the complete understanding of parent comfort regarding the start grade at which parents would be comfortable with AST.

This analysis was an examination of the parent perceptions of AST through a convenience sample administered by the schools themselves. It is common knowledge that convenience samples much less generalizable to the broader population than are probability samples. Therefore, these data were limited in their applicability. Very little was known about data collection methods and the sample is not representative of the public-school population in

NC. There were no baseline data provided with which to compare the results to assess a difference or change over time. Additionally, the evidence-base examined in the literature review strongly supports the impact of external factors such as policies, school environment, and school route quality. This analysis does not include those factors.

Chapter 5. Discussion by Aim and Conclusion

Discussion of the Statistical Analysis

This analysis revealed a number of significant findings. Yet it should be noted that these data are highly skewed and nonrepresentative as parents with some college and college graduates represent 71.6% of respondents and families living more than 2 miles from school represented more than 44% of the sample. These facts alone indicate that this sample does not represent the North Carolina traditional, non-charter school, population. Additionally, the difference between grade and year participation rates between the tally data and the parent survey further challenge the applicability of these data. Additionally, the survey itself could have been perceived, and perhaps even marketed, as an opportunity to share parent feelings with school district leadership or state legislators on school transportation. This perception, if held, could highly bias responses. The two policies below are other possible confounders.

School Choice Policy

North Carolina has both Charter and Magnet schools within its public school system. In 1996 House Bill 955 introduced Charter Schools to NC. In addition to Charter Schools, themed schools, also known as Magnets, are available to families who seek a specific type of education such as Montessori or STEM. School choice policies as well as the way those policies are implemented could have a dramatic impact on AST. As parents are less likely to allow children to walk to bike to schools that are more than 2 miles from home and Charter and Magnets are accessible to students regardless of where they live within a school district.

Busing Policy

Another example of a possible confounding factor external to the data is NC's busing policy to only bus children who live beyond 1 mile of their school. This policy incentivizes school bus use for families who live more than one mile from their school while leaving children who live within a mile only the choice of AST, carpool, public transit, or family vehicle.

A further confounder may be that if parents believed that these surveys were a tool for communicating with district or state level policy makers, the more than 1-mile policy might confound the results of the survey as some responses might reflect parent dissatisfaction with lack of bus access rather than with overall perceptions or comfort with AST. For instance, the NC ARTS program might be seen as a covert attempt to reduce busing service even further. School busing policies are also likely to contribute to disparate AST travel as many low-wealth parents may not have easy access to a car to drive their child, who is within 1 mile of the school site, while parents with more resources who live within the same radius are able to drive their child to school.

Children Walking or Biking

Parent education level was a predictor of AST as three times more children who had parents without a high school education walked or biked to school than parents with between 1 and 3 years of college. This is a finding worth exploring as it has implication for programs that could ensure that children with parents without a high school education are at a higher risk of traffic related injury or death due to increased rates of walking and biking to school as the primary mode of travel. This finding has at least two implications for active travel programming, either through community-based organizations or schools, the routes closest to schools from low-wealth neighborhoods should be prioritized for remediation and that applied skills training is

critical for children who are more likely to walk or bike to school, whether or not an AST program is in place, to protect against disproportionate harm in that population.

Data Collection

Grant reported data can be a rich source of information to inform our understanding of program impacts and improvements. However, survey design, administration, and data triangulation all are critical components of developing a true understanding of program impact. The challenges with analyzing these data suggests another research question: What is the value of these types of data sources when collected by public institutions? The intent of this type of reporting is to inform funding allocations towards health and safety improvement. Yet, this data set and many others connected to important projects languish because the analysis is tedious and fraught. There are transaction costs of utilizing classroom and school resources to collect data as well as is the unintended harm inflicted on over researched populations (Chicago Beyond, 2018). Therefore, it is important to reflect on what kind of role public health researchers and practitioners should have in these types of data collection. One recommendation is more partnership between state level agencies and schools of public health so that these data both are collected systematically and data collection is supported so that partners like schools and school districts can focus on program implementation to ensure program success.

Overall, this discussion highlights the complex role that schools, as governmental agencies, play and perhaps suggest that partnering organizations like Asheville On Bikes have an important role to play in promoting and supporting AST in partnership with schools. More research should be conducted to better understand how community-based organizations, that parents trust, could better support effective program implementation and serve to provide

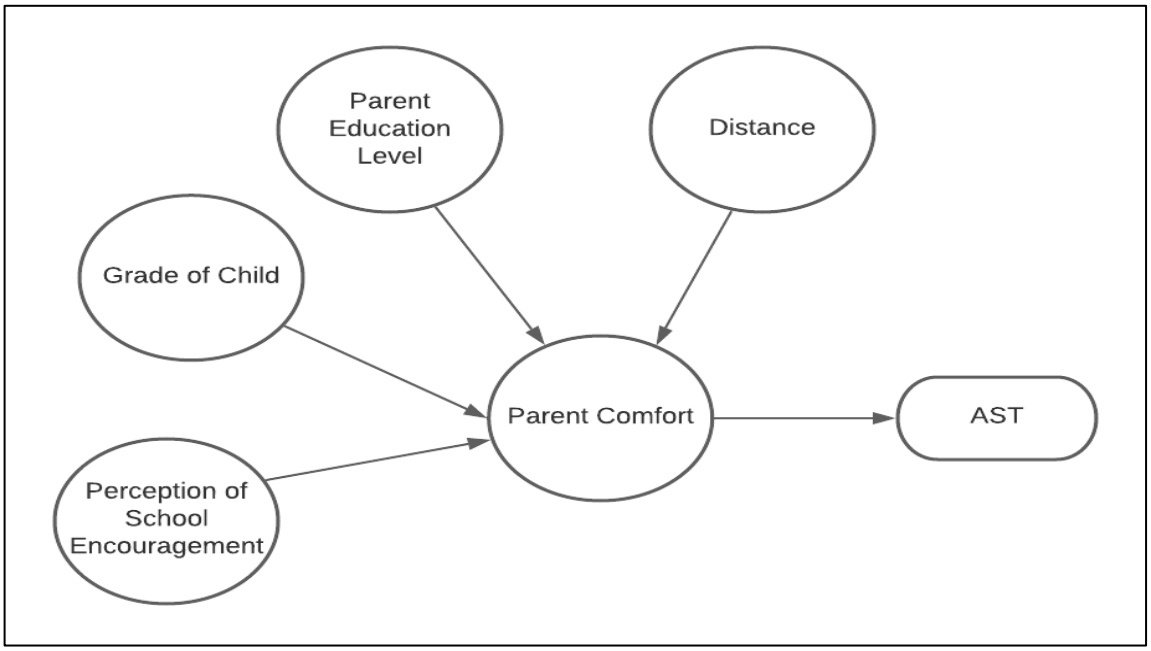
programs that enhance safety such as applied skills training and group walks or bike rides for children within 1 mile of schools.

However, the lack of additional data sources with which to compare these data results in difficulty in making meaning of these data without a more robust analysis. The most appropriate analysis would likely be to identify schools that showed significant success in implementing the NC ARTS program and conducting a school-by-school analysis on their survey data alone so that a better estimate of the impact NC ARTS could be assessed against the surveyed perceptions of parents. The analyses presented here can only estimate the outcome of the school reported NC ARTS program and the characteristics of surveyed parents who were not representative of the schools in which this program was implemented.

This analysis provided insight into a possible new theoretical model pictured here (Figure 4) that can be validated in future studies. This model suggests that parent comfort is a critical proximal predictor in whether or not a parent will allow their child to participate in active travel to school or to other locations within 2 miles of their home. The other predictors: distance, parent education level, and the current grade of the child are not changeable. Yet, they provide valuable insight into effective criteria for program design. Finally, the perception of school encouragement can be seen to be akin to perceived social norms in Theory of Planned Behavior research. Therefore, the perceived social norming of AST seems to be a critical leverage point for shifting parent comfort and potentially mitigating the effects of the other, more static, variables.

Figure 5

Possible Model for Future Study



While these results do suggest opportunities for deeper research into the relationships among the distal variables, especially how perception of school encouragement is mediated by the grade of the child, parent education level, and distance to school site, the data available to this study were limited in their capacity to illuminate the relationships among these predictors.

Translation into Practice

The Integrated Learning Experience's (ILE) focus is on translating research into practice. The aims of this study were to improve the understanding of how the Six Es framework is operationalized; understand the strength of association between parent characteristics and AST uptake; and develop meaningful products that can be used by active routes programs to increase active travel for children and youth to school and elsewhere in the community. This section includes the findings from the analysis, presents the strength of association among the

framework components, and shares the products developed for the partner agency (Asheville On Bikes).

It is important to note that initially, this project was conceived out of the necessity to think through SRTS program continuation at the local school level because state-level funding for the NC ARTS program was eliminated in June of 2019. The elimination of the primary funding stream means that schools and communities could deprioritize NC ARTS programming.

Unfortunately, the Integrated Learning Experience (ILE) was interrupted by the pandemic. School closures forced a pivot to community-based agencies and Asheville On Bikes identified that this project possessed insights that could also be applied to youth programming beyond the school day. This stakeholder communicated that, during the pandemic, public facilities including school and park closures revealed the necessity for community-based programming and infrastructure for physical activity to replace both structured and unstructured play that children were experiencing during the school day. The products in this section seek to support Asheville On Bikes in outreach to families so that they can provide applied skills training, education, and other safety support to children and youth as they move about our community through active travel.

ILE Field-Based Product 2

This field-based product is based on a rationale that supposes that an increase of community awareness and parental confidence in youth competencies will increase parent comfort with all forms of independent active travel for children older than 12 years. Furthermore, best practices in public health marketing and social media influencing were considered in this design and dissemination plan.

Field-Based Product 2 consists of two stand-alone elements that were disseminated to improve parent perceptions of encouragement for AST and increase their confidence in their child's ability to safely use a bike or walk within two miles of their neighborhood. The first element is a social media campaign called the "Every Street Campaign". The second element is a digital toolkit that includes:

- A 30-second promotional video intended to raise awareness, disseminate core messages, and drive traffic to the dedicated information on the Asheville On Bikes website; and
- A white paper that shares findings regarding parent perspectives.

Social media marketing has been shown to increase physical activity. A study of ten years of the CDC's VERB campaign showed that these types of campaigns are effective (Huhman, Kelly, & Edgar, 2017). The potential of social media marketing to impact perceptions through increasing social norms is well documented. Social marketing has also been shown to be an effective tool for supporting the development of "culturally innovative" interventions (Thackery & Neiger, 2003). The primary function of the social media posts is to drive traffic to the web content located on the Asheville On Bikes website.

Chapter 6. Communication & Dissemination Plan

Field-Based Product #3: Communication & Dissemination Plan

This communication and dissemination plan maps the planning, implementation, and evaluation of the social media campaign "Every Street" designed for Asheville On Bikes. The RE-AIM Framework provides an overarching methodology for the three phases of planning, implementation, and evaluation while the Social Marketing Wheel suggests specific processes for planning and implementing social marketing campaigns. The RE-AIM framework is one of the most commonly used planning and evaluation frameworks because of its particular functionality in the realm of translation of theory to practice (Glasgow et al., 2019).

The Social Marketing Wheel was developed by the National Cancer Institute to outline processes to effectively plan, implement, and assess social marketing campaigns in public health contexts. The processes suggested by the Social Marketing Wheel are: 1) develop a plan and strategy, 2) select channels and materials, 3) develop materials and pretest them, 4) implement, 5) assess the effectiveness of materials and channels, and 6) use information to refine program and/or process (National Cancer Institute, 2009). Each phase of the Social Marketing Wheel can be nested inside of the RE-AIM Framework while RE-AIM will be used specifically to flesh out the evaluation process.

Overview

The practice of translating evidence into a community context is well established in public health (Layde et al., 2012). This product took lessons learned from the literature review and the analysis in this report and translate them into the community context through a social marketing campaign.

It is important to note that the context in which these products are being created is unique as the US is still struggling to overcome the Covid-19 pandemic. The pandemic's disruption to schooling is far-reaching and is predicted to have a number of serious consequences. One potential consequence is an increase in childhood obesity due to sedentary conditions. Asheville On Bikes, an advocacy organization has been working with community members and organizers to increase access to pop-up bicycle playgrounds and skills training. The "Every Street" social media promo provided parents context for participating in bicycle skills training, hosting a pop-up bicycle playground, and information about how to support advocacy for built-environment infrastructure.

The final model developed to illustrate the findings of the research conducted provides context for the plan and strategy. The underlying assumption is that a direct marketing campaign is intended to make active travel for children and youth a more socially acceptable mode of travel for college-educated parents and that by engaging them in supporting Asheville On Bikes, more children, regardless of parent income, can develop the essential skills and knowledge needed to be safe during active travel. The next sections detail the objective, target audiences, key messages, and assessment strategies.

The Plan and Strategy

Dissemination Objective

Engage various groups of stakeholders in a better understanding of the role that parent comfort and community encouragement play in increasing active travel for youth.

Target Audiences

Parents. According to the research, parents perceive active travel as dangerous. The top two perceived dangers are traffic and community violence. Parents prefer to receive information from trusted sources (e.g., schools and community-based agencies). Asheville on Bikes needs to be seen as a trusted source of information on this topic.

Youth serving agencies. Youth serving agencies perceive that developing bike and pedestrian skills training programs is complicated and expensive. They prefer to receive information that is supported by evidence and to see local examples of success. Asheville on Bikes has trusted partnerships with other youth serving agencies.

School districts. School districts perceive that Active School Travel is valuable, yet they do not realize the potential impact they have on increasing parent comfort and student safety. They prefer information to come from trusted sources within the education system. Asheville on Bikes is a known school district partner.

Key Messages

Message #1: Bicycle and pedestrian skill training results in fewer injuries and deaths in all populations including children.

Message #2: Every street is a playground. Safe access to physical activity is essential to healthy children and social cohesion.

Message #3: Call to Action- Connect with community resources to improve built environment, host a bicycle playground pop-up, support bike-ped advocacy.

Selecting Channels and Materials

The "Every Street promo" is primarily an online resource in video format designed to be smart-phone friendly. A white paper accompanies the video to provide web copy and be available for distribution. Additionally, the products were reviewed by Asheville On Bikes' board and key stakeholders who provided feedback on the final products.

Assessing Effectiveness and Refining the Program

The following section maps out the process and outcome evaluation metrics for the "Every Street Campaign" through the RE-AIM framework components. This evaluation plan was provided to Asheville On Bikes for their use in evaluating the social media campaign.

Reach. The intent of this program is to reach as many parents of school aged children within the service area of Asheville On Bikes as possible. The video was be posted on all social media outlets by AOB staff and volunteers. The reach of the web-based materials will be assessed using Google analytics that provide information on:

- Click-throughs: The number of individuals who click through from the post to supporting materials.
- Unique hits: The number of unique URLs who view the video.
- Time on page: The length of time spent on the content page of the website.
- Page returns through IP address tracking (Google Analytics)
- Location of page visitors (Google Analytics)

In addition, attempts will be made to assess the reach of the social media posts on Facebook, Instagram, and Twitter through the number of likes, shares, and retweets.

Effectiveness. The effectiveness of key messages will be assessed through web-based surveys of parents associated with the schools where Asheville on Bikes implements programming.

Adoption. Key message adoption will be assessed through assessing the integration of the "Every Street" campaign with Asheville On Bikes' broader messaging content.

Implementation. These materials will be accessed through the website so implementation will be limited to the execution of the project.

Maintenance. These materials are intended to be short-lived in nature as they are specific to a short-term program and program goals.

As part of maximizing the value of this ILE to the community partners, these frameworks will be presented to organization leaders so that they can use these methods in other program evaluation contexts.

Table 14

Work Plan

Activities	Source/Channel	Timeframe	Responsibilities	Budget
Develop core messages	AOB Board and Key Volunteers	December-January	▪ Develop proposed messages. ▪ Host zoom focus group. ▪ Modify messages.	
Develop promo outline		December- February	▪ Length ▪ Mode ▪ Visual arc	
Shoot promo footage		February 15, 2021	▪ Schedule day ▪ Recruit kids to ride the course ▪ Work with community partner to find location and to set up. ▪ Contract with filmmaker	$150 for filming support.
Edit promo		March	▪ Work with filmmaker to edit promo accordingly.	$100 for editing support.
Deliver messaging package to community partner		March 14, 2021	▪ Schedule presentation meeting with AOB key volunteers and board.	

References

Ajzen, I. (1991). The Theory of Planned Behavior . *Organizational Behavior and Human Decision Processes*, 179-211.

Boarnet, M. G., Anderson, C. L., Day, K., McMillan, T., & Alfonzo, M. (2005). Evaluation of the California Safe Routes to School Legislation: Urban Form Changes and Children's Active Transportation to School. *American Journal Medical*, 134-140.

Bronfenbrenner, U. (1989). Ecological systems theory. *Annals of Child Development* , 187-249.

Brussoni, M., Olsen, L. L., Pike, I., & Sleet, D. A. (2012). Risky Play and Children's Safety: Balancing Priorities for Optimal Child Development. *International Journal of Environmental Research and Public Health*, 3134-3148.

Buttazzoni, A. N., Coen, S. E., & Gilliland, J. A. (2018). Supporting active school travel: A qualitative analysis of implementing a regional safe routes to school program. *Social Science & Medicine*, 181-190.

Buttazzoni, N., Kesteren, E., Shah, T., & Gilliland, J. (2018). Active School Travel Intervention Methodologies in North America. *American Journal of Preventive Medicine*, 115-124.

Center for Disease Control and Prevention. (2020). *CDC Healthy Schools: Physical Activity Facts.* Atlanta.

Centers for Disease Control and Prevention. (2016, December 15). *Overweigtht and Obesity*. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/obesity/childhood/causes.html

Chriqui, J. F., Taber, D. R., Slater, S. J., Turner, L., Lowrey, K. M., & Chaloupka, F. j. (2012). The impact of state safe routes to school-related laws on active travel to school policies and practices in U.S. elementary schools. *Health & Place*, 8-15.

Coughenour, C., Clark, S., Singh, A., & Huebner, J. (2017). Are single entry communities and cul-de-sacs a barrier to active transport to school in 11 elementary schools in Las Vegas, NV metropolitan area? *Preventive Medicine Reports*, 144-148.

DiMaggio, C., Frangos, S., & Li, G. (2016). National Safe Routes to School program and risk of school-age pedestrian and bicyclist injury. *Annals of Epidemiology*, 412-417.

Glasgow, R. E., Harden, S. M., Gaglio, B., Rabin, B., Smith, M. L., Porter, G. C., Ory, M.G., Estabrooks, P. A. (2019). RE-AIM Planning and Evaluation Framework: Adapting to New Science and Practice with a 20- Year Review. *Frontiers in Public Health*, https://doi.org/10.3389/fpubh.2019.00064.

Graham, A., Haner, M., Sloan, M., Cullen, F. T., Kulig, T. C., & Jonson, C. L. (2020). Race and Worrying about Police Brutality: The Hidden Injuries of Minority Status in America. *Victims & Offenders*, DOI: 10.1080/15564886.2020.1767252.

Greer, A. E., Martinez-Carrasco, A., Goldsman, D., & Knausenberger, A.-U. (2019). Walking Toward a Brighter Future: A participatory research process to advocate for improved walk-to-school corridors. *Health Promotion Practice* , DOI:https://doi.org/10.1177/1524839919890872.

Harvard T.H.CHAN School of Public Health. (2020, May 20). *Child Obesity: Too Many Kids Are Too Heavy, Too Young*. Retrieved from Obesity Prevention Source: https://www.hsph.harvard.edu/obesity-prevention-source/obesity-trends/global-obesity-trends-in-children/

Health Policy Institute. (2019). *Childhood Obesity: A lifelong threat to health.* Washington, D.C.: Georgetown University.

Heinrich, K. M., Dierenfield, L., Alexander, D. A., Prose, M., & Peterson, A. C. (2008). Hawai'i's Opportunity for Active Living Advancement (HO'ALA): Addressing Childhood Obesity through Safe Routes to School.

Hoelscher, D., Ory, M., Dowdy, D., Miao, J., Atteberry, H., Nichols, D., Evans, A., Menendez, T., Lee, C., Wang, S. (2016). Effects of funding for Safe Routes to Schools Programs on Active Commuting to School and Related Behavioral, Knowledge, and Psychosocial Outcomes: Results form the Texas Childhood Obesity Prevention Policy Evaluation (T-COPPE) Study. *Environment and Behavior* , 210-229.

Huhman, M., Kelly, R. P., & Edgar, T. (2017). Social Marketing as a Framework for Youth Physical Activity Initiatives: 10-Year Retrospective on the Legacy of CDC's VERB Campaign . *Current Obesity Reports*, 101-107.

Kemper, K. A., Pate, S. P., Powers, A. R., & Fair, M. (2018). Promoting Healthy Environments in Afterschool Settings: The LiveWell Greenville Afterschool Initiative . *Preventing Chronic Disease* , doi: 10.5888/pcd15.180164.

Kontou, E., McDonald, N., Brookshire, K., Pullen-Seufert, N., & LaJeunesse, S. (2020). U.S. active school travel in 2017: Prevalence and correlates. *Preventive Medicine Reports*.

LaJeunesse, S., Thompson, S., Pullen-Seufert, N., Kolbe, M. B., Heiny, S., Thomas, C., & Johnson, E. R. (2019). Diverse school community engagement with the North Carolina active routes to school project: a diffusion study. *International Journal of Behavioral Nutrition and Physical Activity* , 1-11 https://doi.org/10.1186/s12966-019-0889-z.

Larouche, R., Chaput, J., Leduc, G., Boyer, C., Belanger, P., LeBlanc, A., Borghese, M.M., Tremblay, M. (2014). A cross-sectional examination of socio-demographic and school-level correlates of children's school travel mode in Ottawa, Canada. *BMC Public Health*, DOI: 10.1186/1471-2458-14-497.

Larouche, R., Mammen, G., Rowe, D. A., & Faulkner, G. (2018). Effectiveness of active school transport interventions: a systematic review and update. *BMC Public Health*, DOI 10.1186/s12889-017-5005-1.

Lewin, K. (1951). *Field Theory in Social Science.* New York : Harper.

Lieberman, M. (2018). *Complete Streets Policies + Bicycle + Pedestrian Plans.* Safe Routes to School National Partnership. Kaiser Permanete National Community Benefit.

Macridis, S., Bengoechea, E. G., McComber, A. M., Jacobs, J., Macaulay, A. C., & Committee, M. o.-S. (2016). Active transportation to support diabetes prevention: Expanding school health promotion programming in an Indigenous community. *Evaluation and Program Planning*, 99-108.

Martin, S. L., Moeti, R., & Pullen-Seufert, N. (2009, October). Implementing Safe Routes to School: Application for the Socioecological Model and Issues to Consider. *Health Promotion Practice, 10*(4), 606-614 DOI: 10.1177/1524839907309378.

McDonald, N. C., Steiner, R. L., Palmer, W. M., Bullock, A. N., Sisiopiku, V. P., & Lytle, B. F. (2014). Costs of school transportation: quantifying the fiscal impacts of encouraging walking and bicycling for school travel. *Transportation*, DOI 10.1007/s11116-014-9569-7.

McDonald, N. C., Yang, Y., Abbott, S. M., & Bullock, A. N. (2013). Impact of the Safe Routes to School program on walking and biking: Eugene, Oregon study. *Transport Policy*, 243-248.

Mendoza, J. A., Haaland, W., Jacobs, M., Abbey-Lambertz, M., Miller, J., Salls, D., Winfred, T., Madding, R., Ellis, K., Kerr, J. (2017). Bicycle Trains, Cycling, and Physical Activity: A Pilot Cluster RCT. *American Journal of Preventive Medicine*, 481-489.

National Cancer Institute. (2009). *The Social Marketing Wheel, Issue Brief.* March: National Institute for Health Care Management Foundation.

National Center for Chronic Disease Prevention and Health Promotion. (2020, March 23). *Health and Economic Costs of Chronic Diseases*. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/chronicdisease/about/costs/index.htm

National Center for Health Statistics. (2017). *Prevalence of Obesity Among Adults and Youth: United States, 2015-2016.* Atlanta : Center for Disease Control and Prevention.

NHTSA. (2018). *Traffic Safety Facts.* Washington, D.C.: NHTSA.

North Carolina PTA. (2017). *Safe Rotues to School.* Raleigh: NCPTA.

O'Brian, R. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality and Quantity*, 673-690 doi:10.1007/s11135-006-9018-6.

Omura, J. D., Hyde, E. T., Watson, K. B., Sliwa, S. A., Fulton, J. E., & Carlson, S. A. (2019). Prevalence of children walking to school and related barriers--United States, 2017. *Preventative Medicine* , 191-195.

Pandita, A., Sharma, D., Pandita, D., Pawar, S., Tariq, M., & Kaul, A. (2016). Childhood obesity: Prevention is better than cure. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 9* (March 15), 83-89.

Pelletier, J. E., Laska, M. N., Nanney, M. S., & Pratt, R. (2018). Cross-Sector collaboration on Safe Routes to School policy advocacy and implementation: A mixed methods evaluation from Minnesota. *Journal of Transport & Health*, 132-140.

Pollok, A., & Berge, E. (2018). How to do a systematic review. *International Journal of Stroke, 13*(2), 138-156.

Rahman, M. L., Antoni, M., Smith, M., Lieswyn, J., & Mandic, S. (2020). A Conceptual Framework for Modelling Safe Walking and Cycling Routes to High Schools. *International Journal of Environmental Research and Public Health*, doi:10.3390/ijerph17093318.

Rigolon, A., & Nemeth, J. (2019). Toward a socioecological model of gentrification: How people, place, and policy shape neighborhood change. *Journal of Urban Affairs*, 887-909 https://doi.org/10.1080/07352166.2018.1562846.

Robert Wood Johnson Foundation . (2020). *Evidence For Action.* Princeton, NJ.

Robert Wood Johnson Foundation. (2004-2019). *State of Childhood Obesity: Helping All Children Grow Up Health*. Retrieved from State of Childhood Obesity: https://stateofchildhoodobesity.org/

Rogers, E. M. (1962). *Diffusion of innovations.* New York: Free Press of Glencoe.

Rothman, L., Perry, D., Buliung, R., Macartgur, C., To, T., Macpherson, A., Larsen, K.,Howard, A. (2015). Do school crossing guards make crossing roads safer? A quasi-experimental study of pedestrian-motor vehicle collisions in Toronto, Canada. *BMC Public Health*, DOI 10.1186/s12889-015-2065-y.

Rothman, L., To, T. B., Macarthur, C., & Howard, A. (2014). Influence of social and built environmental features on children walking to school: An Observational Study. *Preventive Medicine*.

Royne, M. B., Ivey, S., Levy, M., Fox, A. K., & Roakes, S. L. (2016). Marketing active transportation to school to improve children's health: Utilizing parental perspectives from an inner-city environment. *Health Marketing Quarterly*, 353-368.

Safe Routes Partnership. (2020, June 4). *History of Safe Routes to School*. (Safe Routes to Schools) Retrieved June 2020, from https://www.saferoutespartnership.org/safe-routes-school/101/history

Stewart, O. (2011). Findings from research on active transportation to school and implication for safe routes to schools program. *Journal of Planning Literature, 26*(2), 127-150.

Thackery, R., & Neiger, B. L. (2003). Use of Social Marketing to Develop Culturally Innovative Diabetes Interventions. *Diabetes Spectrum, 15*(1), 15-20.

Wong, G. Y., & Mason, W. M. (1985). The Hierarchical Logistic Regression Model for Multilevel Analysis. *American Statistical Association*, 513-524.

Zimmerman, S. (2015, November 4). The 6 E's of Safe Routes to School: Embracing Equity. *Safe Routes Partnership Blog*. Fort Washington, Maryland, USA.

APPENDICES

APPENDIX A: Acronyms

AST- Active School Travel

BMI – Body Max Index

CDC – Center for Disease Control and Prevention

EPHPP -Effective Public Health Practice Project

FAST Act - Fixing America's Surface Transportation Act

ILE – Integrated Learning Experience

IRB – Institutional Review Board

MVPA – Moderate to Vigorous Physical Activity

NC- North Carolina

Pre-K – Pre-Kindergarten

SEM – Socio-ecological Model

SRTS- Safe Routes to Schools

TAP - Transportation Alternatives Program

APPENDIX B: Code Book

Distance

Code	Value	Count	Percent
1	1/4 mile	2482	9.40%
2	1/4-1/2 mile	2110	8.00%
3	1/2 -1 mile	3526	13.40%
4	1-2 mile	5324	20.20%
5	2 miles +	11794	44.80%
6	Don't know	1115	4.25%

AST

Code	Value	Count	Percent
0	Not AST	24031	91.20%
1	AST	1849	7.00%
	Missing	471	1.80%

Not Comfortable

Code	Value	Count	Percent
0	No Answer	9127	34.60%
1	Not Comfortable with AST at Any Age	17224	65.40%

School Encouragement

Code	Value	Count	Percent
	Discourage	1006	3.80%
	Encourage	4886	18.50%
	Neither	18001	68.30%
	Strongly Discourages	846	3.20%
	Strongly Encourages	1612	6.10%

Education Level

Code	Value	Count	Percent
1	4 Years or More of College	11041	41.90%
2	Some College	7819	29.70%
3	High School Graduate	4207	16.00%
4	Some High School	1288	4.90%
5	Elementary School	1214	4.60%
6	Prefer not to Answer	782	3.00%

Safe Routes to School Students Arrival and Departure Tally Sheet

CAPITAL LETTERS ONLY – BLUE OR BLACK INK ONLY

School Name: **Teacher's First Name:** **Teacher's Last Name:**

Grade: (PK,K,1,2,3...) 0 2 **Monday's Date** (Week count was conducted) M M D D Y Y Y Y **Number of Students Enrolled in Class:** 1 5

- Please conduct these counts **on two of the following three days Tuesday, Wednesday, or Thursday. (Three days would provide better data if counted)**
- **Please do not conduct these counts on Mondays or Fridays.**
- Before asking your students to raise their hands, please read through all possible answer choices so they will know their choices. Each Student may only answer once.
- Ask your students as a group the question "**How did you arrive at school today?**"
- Then, reread each answer choice and record the number of students that raised their hands for each. **Place just one character or number in each box.**
- Follow the same procedure for the question **"How do you plan to leave for home after school?"**
- You can conduct the counts once per day but during the count please ask students both the school arrival and departure questions.
- Please conduct this count regardless of weather conditions (i.e., ask these questions on rainy days, too).

Step 1. Fill in the weather conditions and number of students in each class

Step 2. **AM** – "**How did you arrive at school today?**" Record the number of hands for each answer. **PM** – "**How do you plan to leave for home after school?**" Record the number of hands for each answer.

Key	Weather	Student Tally	Walk	Bike	School Bus	Family Vehicle	Carpool	Transit	Other
	S= sunny R= rainy O=overcast SN=snow	Number in class when count made	-	-	-	Only with Children from your family	Riding with children from other families	City bus, subway, etc.	Skate-board, scooter, etc.
Sample AM	S N	2 0	2	3	8	3		3	1
Sample PM	R	1 9	3	3	8	1	2	2	
Tues. AM									
Tues. PM									
Wed. AM									
Wed. PM									
Thurs. AM									
Thurs. PM									

Please list any disruptions to these counts or any unusual travel conditions to/from the school on the days of the tally.

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NC Chronic Disease Action Institute Panel Presentations, 2014. Bethal, M., Ferguson L., Kostelec, D. (2014, May) The Geography of Intervention: Using maps to communicate and made decisions to reduce health disparities.

Gates, H., Ferguson, L. (2014, May) Building a Foundation for Clinical Community Connections.

Ferguson, L., Fromewick, J., Simmerman, J., Thompson, C. (2014, May). *Communication Evaluation: Evaluating the*

CTG Madison @ Heart Campaign. Paper presented at the 2014 North Carolina CTG (Community Transformation Grant) Action Institute.

Ferguson, L., Fromewick, J., Simmerman, J. (2014, April). *Going Local: Policy Change through Effective Communication Campaigns.*

Paper presented at the North Carolina Society for Public Health Education Midyear Meeting, Brown Summit, NC. Ferguson, L., Fromewick, J., (2014, March). *Naming Health Assets: A Strength Based Approach to Policy, Systems, and Environmental Change in Rural Appalachia.*

Paper presented at the Society for Public Health Education 65th Annual Meeting, Washington, DC. Ferguson, L., Fromewick, J., (2014, March). *Naming Health Assets: A Strength Based Approach to Policy, Systems, and Environmental Change in Rural Appalachia.*

Honors and Awards:

Outstanding Student Award, Community & Behavioral Health Department, College of Public Health ETSU 2021

Appointed to the Asheville City Schools Board of Education (2012-2016)

Community Leadership Award, Asheville City Schools Foundation (2013)

People Who Tell the Truth Award, YMI Cultural Center (2014)

Thomas K. Hearn Nonprofit Leadership Fellow (2011)