NITC
NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

DRAFT FINAL REPORT

Encouraging Active School Travel by Making it "Cool": A quasi-experimental study using Boltage, Phase II

NITC-RR-550 ■ *May 2015*

NITC is the U.S. Department of Transportation's national university transportation center for livable communities.

TREC
Transportation Insight for Vibrant Communities

ENCOURAGING ACTIVE SCHOOL TRAVEL BY MAKING IT "COOL": A QUASI-EXPERIMENTAL STUDY USING BOLTAGE

Draft Final Report

NITC-RR-550

by

Yizhao Yang, University of Oregon
William Harbaugh, University of Oregon
Noreen McDonald, University of North Carolina at Chapel Hill

for

National Institute for Transportation and Communities (NITC)
P.O. Box 751
Portland, OR 97207

May 2015

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NITC-RR-550		

4. Title and Subtitle	5. Report Date
Encouraging Active School Travel by Making it "Cool": A Quasi-Experimental Study Using Boltage	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Yizhao Yang, University of Oregon William Harbaugh, University of Oregon Noreen McDonald, University of North Carolina at Chapel Hill	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
University of Oregon 1209 University of Oregon Eugene, OR 97403	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Institute for Transportation and Communities (NITC) P.O. Box 751 Portland, Oregon 97207	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The research on children's school travel has studied the impacts of the built environment on children walking or biking to school. This three-year research project contributes to current literature by investigating the role played by socio-psychological factors in affecting the environment - travel behavior relationship. By evaluating intervention programs implemented in two elementary and two middle schools involving the use of a novel device called "Boltage," this project conducted a quasi-experimental study to examine how peer influences, incentives and perceived social acceptance have affected the students' active school travel. This project used data collected through Boltage scanners, focus groups and surveys to identify attitudinal and behavioral changes following the implementation of Boltage programs, and compare the changes reported from eight other comparable schools where no such interventions were applied.

Analysis findings provide evidence for the effectiveness of the Boltage programs in improving the rates of children walking or biking to school. In addition to school travel distance, parents' attitudes and their perceived social approval of active school travel played a critical role in determining the likelihood of a student walking or biking to school. Schools that have received Boltage treatment witnessed improvements in parents' attitudes over the study period. The perceived social approval, however, did not appear to have been affected by the implementation of Boltage programs, although parents perceived stronger school support for active school travel in light of the Boltage programs. Younger students tended to respond more positively to the incentives and reported peer influences on their school travel.

Knowledge gained from this project can inform professionals and advocates who hope to develop effective intervention programs for active school travel in three ways: 1. Interventions should target students living within a short distance to schools (less than one mile or so) and parents who exhibit favorable attitudes; 2. Focus on the socializing benefits afforded by children walking or biking to school together when promoting active school travel and create socializing opportunities in the intervention programs; and 3. Incentive-based interventions have greater effects on younger children, and the design of an intervention program should focus on helping children and parents identify suitable approaches to active school travel

17. Key Words	18. Distribution Statement
School travel, Active School Commuting, Boltage Intervention, Safe Routes to School	No restrictions. Copies available from NITC: www.nitc.us

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

ACKNOWLEDGEMENTS

We'd like to thank the NITC for funding this project. This project also received funding from the Oregon Transportation Research and Education Consortium (OTREC). We also would like to thank schools, parents, teachers and students who participated and/or helped in this research project. Special thanks to the coordinators of two Safe Route to Schools Programs, Shane MacRhodes and Nichole Zwink, for their assistance in implementing the Boltage programs in four local schools. We express our appreciation to the principals, staff member and teachers at the four schools that participated in our project: Adam Elementary School, Cal Young Middle School, Clear Lake Elementary School and Cascade Middle School. Their support has been critical for the successful implementation of the Boltage programs. A group of University of Oregon graduate students helped with this research project: Kim Morley, Lauren King, Angela San Filippo, Rebecca Harbage, Paul Hicks, Maddie Phillips, Jeff Kernen, Nestor Guevara and Ross Peizer. Bethany Stein at UO's Community Service Center provided valuable assistance to this project. Their work is greatly appreciated and acknowledged here.

DISCLAIMER

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Research on children's school travel has identified multiple factors affecting the use of active school commuting modes (i.e., walking or biking) among children. These factors can be grouped into several major categories. The environmental ones, such as trip distance, neighborhood walkability and general safety, are the ones that have received the most attention. The second group, the socio-psychological factors, focuses on how behavior is affected by people's own feelings (preferences), thoughts and attitudes, summarized as one's mental state. Research in transportation addressing these factors has been very limited, mainly due to the lack of conceptual frameworks that explicitly consider the role played by these factors in the decision-making process of school travel behavior and also due to the difficulty in operationalizing and measuring these factors.

This three-year research project contributes to current literature by investigating the role played by socio-psychological factors in affecting the environment-travel behavior relationship. By evaluating intervention programs implemented in two elementary and two middle schools involving the use of a novel device called "Boltage," this project conducted a quasi-experimental study to examine how peer influences, incentives and perceived social acceptance have affected the students' active school travel. This project used data collected through Boltage scanners, focus groups and surveys to identify attitudinal and behavioral changes following the implementation of Boltage programs and compare the changes reported from eight other comparable schools where no such interventions were applied.

The research findings provide evidence for the effectiveness of the incentive program in improving the rates of active school commuting ASC. Data collected through the Boltage RFID scanner indicated that participation in Boltage programs was consistent or increasing over the study years, and there were increasing number of trips per student recorded in the Boltage programs. Quantitative analysis, at both school- and individual-levels, showed that the Boltage treatment exhibited statistically significant impacts on the probability of ASC behavior. The Boltage program's independent impacts were significant even after the control of many other factors.

Additional evidence for Boltage treatment's effects can be found in the interviews we conducted with students and school staff. Students, especially at a younger age, expressed excitement for participating in the Boltage programs. Interviews with parents revealed that children's interest in the Boltage program had affected some parents' decisions to let their child walk or bike to school. In some cases, parents made special arrangements to make ASC possible for their child.

The research project examined two aspects of the psychological conditions theorized to affect ASC use – parents' attitudes (beliefs in the ASC's behavioral outcome) and parents' perceived social norm. Analysis of quantitative data suggests that schools that have received Boltage treatment witnessed some improvements in their parents' ASC attitudes over the study period. The perceived social norm, however, did not appear to have been affected by the implementation

of Boltage programs, although parents perceived stronger school support for ASC in light of the Boltage programs.

Knowledge gained from this project can inform professionals and advocates who hope to develop effective intervention programs for active school travel in three ways: 1. Interventions should target students living within a short distance to schools (less than one mile or so) and parents who exhibit favorable attitudes; 2. Focus on the socializing benefits afforded by children walking or biking to school together when promoting active school travel and create socializing opportunities in the intervention programs; and 3. Incentive-based interventions have greater effects on younger children, and the design of an intervention program should focus on helping children and parents identify suitable approaches to active school travel.

1.0 BACKGROUND

Over the past 40 years, the U.S. has witnessed a precipitous decline in the rate of active school transportation (walking and biking) among all student age groups (Booth et al., 2003; McDonald, 2007a). Increased reliance on private automobiles for school travel has led to concerns over the negative impacts of car travel on the environment (EPA, 2003) and possible adverse health impacts on children (O'Brian, 2003; Sallis & Owen, 1999; Strauss & Pollack, 2001).
Active school commuting (ASC) is defined as students using human power to go to school, which includes walking, biking, and skateboarding. Promoting ASC as a part of the daily routine of children and families helps achieve several goals related to health, such as reducing childhood obesity, as well as goals related to environment sustainability, such as reducing greenhouse gas emissions. Recent research also demonstrates other benefits that routine ASC can offer to children in terms of fitness, mental health, intelligence and academic attainment (Garrard, 2011).

Internationally, the campaign to increase rates of ASC among children has encouraged various types of interventions. Most notably in the U.S. is the federal and state funding supporting Safe Routes to School (SRTS) programs, which uses a systematic approach called the five Es – Evaluation, Engineering, Education, Encouragement and Enforcement – to change students' travel behavior. Activities organized through SRTS programs include Walk or Bike to School Day, improvements made to the infrastructure surrounding schools, instructing students in active travel safety skills, and enforcing traffic law in the school vicinity. Congress has appropriated $1.2 billion for the SRTS programs implemented at about 14,000 elementary and middle schools (McDonald, Barth & Steiner, 2013).

Schools and communities working together have also experimented with many other interventions, such as a Walking School Bus that uses coordinated, chaperoned, active travel along a fixed route to school; hiring school travel advisors; implementing cycling programs; and using classroom programs to promote pedestrian safety activities in school. More recently, some schools have started using incentives to encourage students to walk or bike to school. Some of those incentive-based programs involve the use of innovative data capture technology (e.g., the Boltage device) to help track students' active school travel trips.

Evaluation of the interventions has produced encouraging evidence as well as mixed results. A series of studies shows that the implementation of SRTS programs has increased rates of ASC in general, although the degree of changes varied widely (see reviews by Chillon et al., 2011, and Hosking et al., 2010). The Walking School Bus is another type of intervention that has also been found to be effective. Some authors have pointed out the limitation in the research design of some of the intervention studies.

Much of the evaluation research is aimed at identifying behavioral changes without providing insights into the mechanism via which behavioral changes can be explained. In other words,

while many studies confirmed whether a particular intervention worked, they did not focus on improving our understanding of how and why they had worked. Lack of such understanding limits our ability to enhance the effectiveness of the intervention strategies. Limitation in research design and geographic scope has been identified as a major issue in many of the intervention studies that limit the generalizability of their findings (see McDonald et al., 2014).

While such an issue is oftentimes hard to overcome given the complexity of and often rare opportunity to conduct an intervention study, using an intervention study to identify specific factors that make the intervention work could help us evaluate the transferability of the intervention strategies among different contexts.

This report describes a project studying an intervention program implemented in several schools in a mid-sized community in Oregon. In addition to evaluating the effectiveness of the intervention program, this study also investigates the role played by socio-psychological factors in affecting active school travel behavior. Unlike many other interventions studies where researchers are often not involved in the design and implementation of the interventions, this project involves a strategic integration of the intervention design and its research design so that the intervention implementation process offers an ideal setting for an intellectual inquiry of active school travel behavior.

The intervention at the center of this project is called “Boltage Program,” which takes its name from a device that can be used to track whether a student walks or bikes to school. The Boltage device was invented by a company located in Boulder, CO, in 2005. The Boltage device includes a solar-powered and Internet-enabled Radio Frequency Identification (RFID) reader that can scan tags attached to a student’s helmet, bike or backpack to record the student’s daily active school travel trips. The device uses wireless services to transmit students’ trip information, and can generate reports and data downloads that serve as the basis for implementing various incentive schemes. Currently, about 40 to 45 schools in five states have installed Boltage devices and use the devices to assist with encouragement programs.

Boltage’s success is premised on the notion that the high-tech device and the various incentives can help make biking and walking “cool” and thus gives children a way to belong to something great, helping them to develop a habit of active school travel. But none of the current Boltage programs have been rigorously designed and studied to test this hypothesis. This project is the first that adopts a careful research design to investigate how students and parents may adopt more active school transportation in the context of positive peer and incentive influences beyond the often-studied social and built environments around schools.

2.0 PROJECT OBJECTIVES

The research project reported here involved working with four experimental schools and six control schools to implement Boltage programs. It combined an evaluation study of the Boltage programs and mixed methodology to investigate how changes in the environment (e.g., installation of a Boltage device and presence of a Boltage program) and various incentives could affect active school travel among children in different age groups. The goal of this project was to understand the role played by socio-psychological factors, such as attitudes and perceived social acceptance, together with many other well-studied environmental and individual factors (e.g., travel distance, student age, etc.), in affecting children's active school travel. Specifically, the research involved in this project had three objectives:

- To assess the changes in children's school travel behavior following the implementation of a Boltage system, and to compare changes produced by different types of incentives for children in two age groups (elementary school students vs. middle school students).

- To investigate how parents and students may have changed their perception of the social acceptance of active school commuting and may thus change their own attitude as a result of a Boltage program.

- To identify factors and strategies that can be used to enhance intervention programs' effectiveness.

3.0 LITERATURE REVIEW

Research on children's school travel has identified multiple factors affecting the use of active school commuting (ASC) modes (i.e., walking or biking) among children. These factors can be grouped into several major categories. The environmental ones, such as trip distance, neighborhood walkability and general safety, are the ones that have received the most attention. The second group of factors is the socio-psychological ones, focusing on how behavior is affected by people's own feelings (preferences), thoughts and attitudes, summarized as one's mental state. This group also includes perceptions of other people's attitudes and feelings, which can be characterized as social situations or social influence.

Many of the socio-psychological factors have been considered in public health research on the topic of physical activities (Sirad & Salter, 2008). But research in transportation addressing these factors has been very limited, mainly due to the lack of conceptual frameworks that explicitly consider the role played by these factors in the decision-making process of school travel behavior and also due to the difficulty in operationalizing and measuring these factors.

The literature review is organized into three parts. The first part briefly reviews current school travel research, the second part discusses theories and constructs from the psychology field that can inform school travel research, and the last part presents a conceptual framework that guides the Boltage intervention study.

3.1 ACTIVE SCHOOL TRAVEL RESEARCH AND THE INTERVENTION STUDIES

Studies on the factors that potentially affect parents' use of ASC have informed the development of strategies to increase the rate of ASC. A list of environmental-level and individual-level determinants have been identified, and can be summarized as related to built environment conditions (e.g., distance to school, walkability, land use mix, etc); social context (e.g., safety, sense of community, SES status, etc); parental/family characteristics (e.g., car ownership, family income, employment status, etc); and children's characteristics (e.g., gender and age). An extensive literature review of active school travel can be found in Sirard and Slater (2008), McMillan (2005) and Wilson et al. (2010).

In a recent comprehensive review of existing literature, Sirard and Slater (2008) pointed out that prominent psychological constructs such as attitudes, expectancies, beliefs and social norms have not been explored sufficiently in school travel research. Very few studies have addressed the fact that parents' preferences and attitudes play an important role in predicting their decision to allow their children to walk or bike to school. These studies show that parents' environmental attitudes (Black, Collins & Snell, 2001), their beliefs in the health and environmental benefits associated with active school travel (Yang and Marktowiz, 2012), and their perceived value of their children's socialization with other children (McMillan, 2007) add to their incentives to use active

school travel. Rodriguez and Vogt (2009) explored children's attitudes, measured as semantic differential scales (i.e., fun/boring, safe/not safe), in their decision to walk or bike to school.

School-level characteristics, such as school age, size and location, is another group of factors that have received some attention in recent studies. Most school-level conditions are considered to impose impacts on school travel via their connection with environmental characteristics. Thus when those environmental characteristics, such as home-school distance or walkability, have been taken into consideration, the direct impacts of school-level characteristics appear not to be discernible. For example, the study by Ewing et al. (2004) suggested no direct effects of school size on children walking or biking to school after the school environmental characteristics have been controlled for.

School policies, such as start/end time, parking policies, school choice and policies against/encouraging walking/biking, also play a role in affecting school travel. Some of the policies' impacts are obvious – policies that prohibit or discourage children from walking or biking to school would lead fewer children to do so. The National Center for Safe Routes to School has launched an effort to identify and overcome those "barrier" policies (National Center for Safe Routes to School, n.a.). Other policies, such as the school choice policy, have effects that are most likely mediated through many of the aforementioned environmental conditions or characteristics (Yang et al., 2012).

While most of the studies summarized above reveal associations between various factors and the ASC behavior, they oftentimes could not provide conclusive evidence for a causal relationship between the factors and the behavioral outcome due to the nature of their cross section-based research design. Intervention studies that consider multiple aspects of environment and individual characteristics known to influence children' s modes of travel to school have the potential to address the question of whether modification of certain factors will indeed result in desired behavioral changes. Not all factors identified in the literature can be easily subject to changes via policies or interventions, and modification of some factors often requires substantial investment. Intervention studies, when designed to investigate the complexity of multiple factors influencing ASC, can often provide insight into the possible underlying mechanism via which intervention affects the travel behavior. Such knowledge and insights can be used to improve an intervention's design and implementation and also ensure its long-term sustainability.

Intervention studies targeted at ASC is a new line of research. According to a recent review of intervention studies (Chillon et al., 2012), the first published intervention study appeared in 2004. Most of the intervention studies were intended to document whether the interventions have been effective, hoping to provide scientific evidence for the debate over costs and benefits associated with an intervention. For example, in the U.S., given the large investment in SRTS programs, a series of intervention studies have been carried out to evaluate the SRTS programs. These studies have generally showed the effectiveness of the SRTS programs (Boarnet et al. 2005; Mendoza et al., 2011; Stewart et al., 2014; McDonald et al., 2014), although there seems to be a wide variation in the reported effects (Chillon et al, 2012).

Several limitations of intervention studies have been identified. Studies that have a narrow focus on small geographic areas are limited in the generalizability of their findings (Buckley, Lowry,

Brown & Barton, 2013; McDonald, Yang, Abbott & Bullock, 2013; Mendoza et al., 2011). But overcoming this shortcoming is difficult because most intervention studies involve researchers partnering with organizations whose decision to invest in interventions is constrained by the limit on their service targets and resources. Many researchers conducted intervention studies as a decision after becoming aware of the interventions.

The fact that many intervention studies were carried out as an afterthought had impacts on the overall research design and data collection quality. One important issue with most of the intervention studies is that they generally did not have a theoretic framework to guide the intervention study design, data collection, and the analyses of co-founders and mediators (Chillon et al., 2011). As Chillon et al. pointed out in their review of more than a dozen intervention studies, the existing studies were inadequate in addressing the complexity of multiple factors influencing active transportation to and from school. Limitation in current intervention studies could undermine the research results and fail to offer practical insights to ensure the sustainability of those ASC interventions.

3.2 SOCIO-PSYCHOLOGICAL THEORIES APPLICABLE TO ACTIVE SCHOOL TRAVEL RESEARCH

Most of the existing literature on ASC adopts conceptual models developed from an ecological perspective. Thus they guide us in the research to identify the associations between a factor and the behavioral outcome, but they do not provide an explanation of the manner or mechanism of how the factor of interest works. This literature review aims to highlight the empirical evidences, point out the limitations in the conceptual models guiding the research, and discuss theories from the socio-psychological field that can help expand current conceptual thinking.

Several theories in the socio-psychology field have been identified as useful in conceiving the complex relationship among factors affecting ASC. These theories utilize new constructs such as attitude, social norms, habits, etc., as possible determinants for the ASC behavior. Table 3.1 summarizes these theories, their main supposition, and the primary constructs connected with each theory.

Table 3.1: Summary of Useful Psychology Theories for Active School Travel Research

Theory & Citations	Theory Content	Primary Constructs
Theory of Planned Behavior (Ajzen, 1991)	Human behavior is guided by three kinds of considerations: beliefs about the likely outcomes of the behavior and the evaluations of these outcomes (Attitude); beliefs about the normative expectations of others and motivation to comply with these expectations (Subjective norms); and beliefs about the presence of factors that may facilitate or impede performance of the behavior and the perceived power of these factors (Perceived behavioral control). Attitude toward the behavior, subjective norm and perceived behavioral control lead to the formation of a behavioral intention which is likely to be carried out given a sufficient degree of actual control over the behavior and availability of opportunity.	Attitude toward behavior Subjective norms Perceived behavioral control Intention
Social Learning Theory (Bandura, 1977)	People can learn new information and behaviors by watching other people. Known as observational learning (or modeling), this type of learning can be used to explain a wide variety of behaviors. Three core concepts are at the heart of social learning theory. First is the idea that people can learn through observation. Next is the notion that internal mental states are an essential part of this process. Finally, this theory recognizes that just because something has been learned, it does not mean that it will result in a change in behavior.	Attention Retention Reproduction Motivation
Theory of Interpersonal Behavior (Triandis, 1980)	This theory suggests that behavior is a function of an intention, habitual responses, situational constraints and conditions. The intention is influenced by social and affective factors and by rational deliberations. Habit is explained as situation-behavior sequences that are so automatic, they occur without self-instruction.	Attitude Social factors (norms, roles, etc.) Affect (emotions) Habits Intention
The Attitude-Behavior-Context (ABC) Model (Stern, 2000)	An integrated model of environmentally significant behavior, suggesting that behavior is a function of the organism and its environment. It is summarized in the language of ABC, behavior (B) is an interactive product of personal sphere attitudinal variables (A) and contextual factors (C). Attitudinal variables considered in such theories might include a variety of specific personal beliefs, norms and values as well as general 'pre-dispositions' to act in certain ways. Contextual factors can potentially include a wide variety of influences such as: monetary incentives and costs, physical capabilities and constraints, institutional and legal factors, public policy support, social norms and broader dimensions of the social context (e.g., allegiance to or influence by environmental groups).	Attitude Contextual factor

Existing literature on walking or biking has either focused on the environmental influences (especially the built environment) or included the socio-psychological consideration without attention paid to the built environment. Very limited research has addressed both and even less considered their interactions (see reviews by Van Acker et al., 2010; Panter and Jones, 2010). A recent review by Dill et al. (2014) of transportation research that has explicitly used the theory of planned behavior reveals that attitudes are consistently found as an important and significant predicting factor for walking or biking. Again, Dill et al. noticed that, while they address the socio-psychological influences, these studies hardly used any objective measures of the physical environment.

Many studies also recognize the need to expand a particular psychology theory or integrate theories together in order to better explain the walking or biking behavior (Bamberg, Ajzen & Schmidt, 2003; Bamberg, Hunecke & Blobaum, 2007).

Very little research on ASC has explicitly adopted the aforementioned psychology theories to guide research design, data collection and analysis. There is little consistency among the researchers on how to measure the constructs at the center of those theories. ASC studies that have included psychological measures such as attitudes find a significant relationship between those measures and the use of ASC, although these studies did not explicitly adopt a theoretical framework developed in the psychology field. Table 3.2 summarizes some of the empirical studies on children's walking or biking to school.

Table 3.2: Summary of ASC Studies that have Considered Socio-psychological Measures

Constructs Considered	Influences or measures associated with the constructs	Theories applicable	Empirical studies (related to school travel directly)	Findings
Attitudes Parental Involvement School Intervention	Health benefits Socialization benefits Environmental benefits Community benefits (neighborhood awareness, community involvement)	Theory of planned behavior	Eyler et al. (2008a) Black et al. (2001) Groesz (2007) McMillan (2007) Yang and Markowitz (2012) Zuniga (2012)	Parental support and participation. Bicycle safety and perceived environment. Stronger attitudes encourage the willingness to negotiate the environment.
Affect	Fun Socializing Environmental benefits		Rodrigues and Vogt (2009)	Students with stronger affects were more likely to use ASC
Subjective Norms	Social support or pressure	Theory of planned behavior	Buliung et al., 2011	School encouragement program increase perceived social support
Perceived Environment Control	Distance, access to facilities (e.g., sidewalk) walkability	Theory of planned behavior	Price et al. (2011) Eyler et al. (2008b) Fulton et al. (2005) Yang et al. (2011)	Distance, traffic speed and volume negative effect on ASC. Lack of sidewalks negative to ASC. ASC more frequent with boys than girls.
	Weather		Schlossberg et al. (2006)	Perceived weather as an impeding factor for ASC.
	Safety		Addington (2011) Pooley et al (2005) Yang and Markowitz (2012)	Gangs and bullies decreases walking. Walking with parents has increased.
Intention Preference Habit Personal norms Values Self-worth Responsibility	Individual preference (car travel, lifestyle, etc)	Theory of planned behavior Theory of interpersonal behavior	Yang et al. (2011) Panter et al. (2010)	Parents with positive ASC attitudes were likely to have stronger intention and greater likelihood to use ASC.
Attention, Retention, Reproduction Motivation		Social learning theory	Cole et al. (2006)	Summary of effective school-based ,childhood overweight interventions

3.3 AN EXPANDED CONCEPTUAL FRAMEWORK FOR ACTIVE SCHOOL TRAVEL RESEARCH AND INTERVENTION

This study builds upon the aforementioned theories developed in the psychology field and existing research to develop a conceptual framework outlining factors affecting ASC and the relationships among them. The framework is depicted in Figure 3.1.

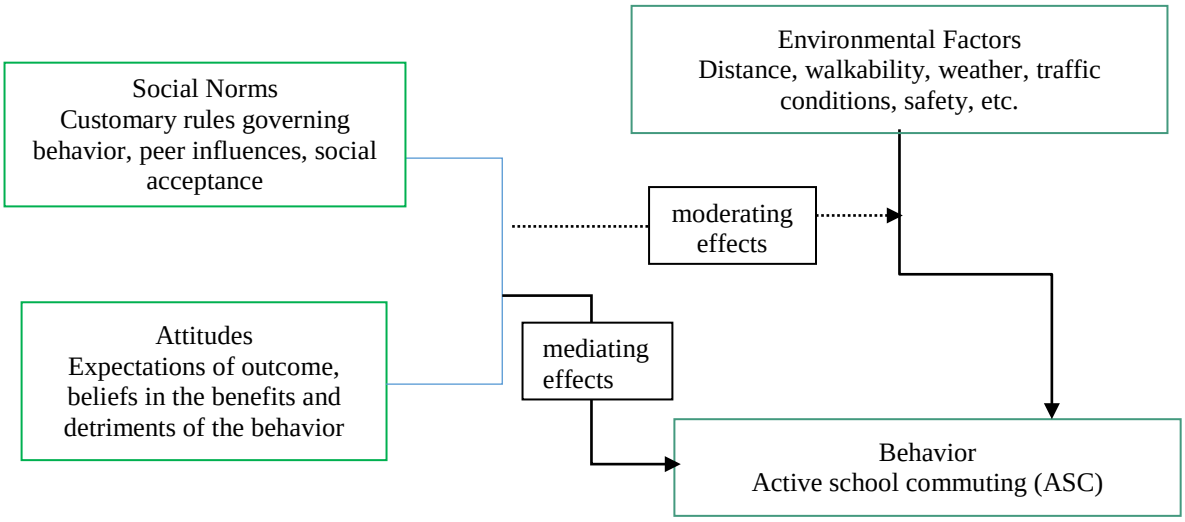


Figure 3.1: The Conceptual Framework

The framework suggests that two major socio-psychological factors, social norm and attitude, work with the environmental factors, such as distance, walkability, weather, etc., to affect the ASC behavior. These socio-psychological factors have mediating effects, meaning that they can exert influence independent of the environmental factors, on the behavioral outcome. They are also expected to have moderating effects, meaning they can modify the environment-behavior relationship and affect the behavioral outcome. The conceptual framework guides the design of the Boltage intervention programs implemented and studied in this project. Figure 3.2 depicts conceptually how the Boltage program plays a role to encourage more walking or biking to school. Essentially, the hypotheses are:

1. The socio-psychological factors will have mediating and moderating effects on ASC.
2. The Boltage program will have impacts on the socio-psychological factors.
3. The Boltage program will also have independent impacts on ASC.

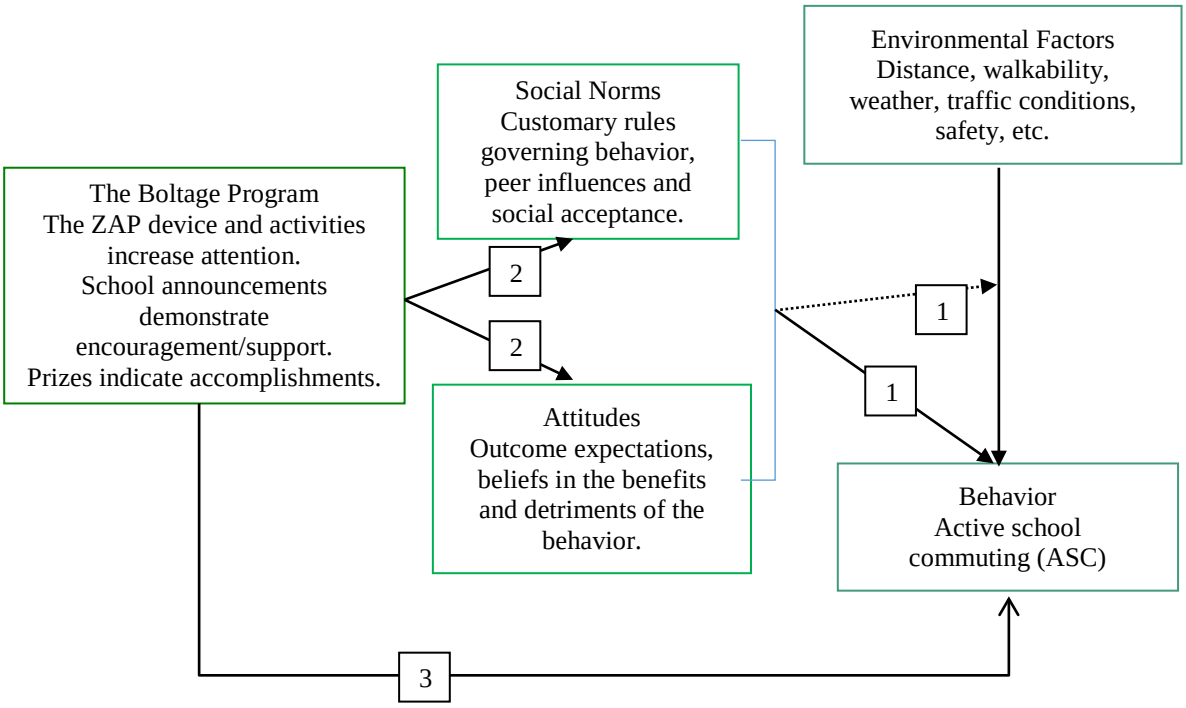


Figure 3.2: A Conceptual Framework Outlining Boltage Intervention's Effects

4.0 METHODOLOGY

This project aims to evaluate the impacts of the Boltage program on school travel behavior change and, at the same time, test the conceptual framework outlined in the previous section. To achieve these two goals, this project adopted a quasi-experimental research design and employed mixed methodology.

4.1 RESEARCH DESIGN

4.1.1 Study Area

The study area includes two school districts, the 4J School District and the Bethel School District, in Lane County, OR, serving primarily the city of Eugene and the surrounding community. The target population in this study includes students from elementary and middle school age (K to 8th grade) and their parents or guardians. Such a wide age range allows us to

investigate the possible differential, age-related impacts of the Boltage intervention on school travel behavior.

While it may be unique and thus limit the ability to generalize the research outcome, this study area does possess some characteristics that are important for revealing the effects of attitudinal factors on school travel behavior. Eugene is a place known for its support of outdoor activities and well-equipped infrastructure for biking and walking. The extent to which physical activity is normative within a community may influence walking or biking to school. The use of the alternative travel mode (automobile) is likely to be less habitual in Eugene than in many other places in this country. All these characteristics could allow for identification of a more distinctive relationship between the socio-psychological factors and the school travel behavior.

4.1.2 Quasi-experimental design

The research adopts a quasi-experimental design. Two groups of schools, experimental and control, were selected through coordination with the Bethel and 4J School Districts' SRTS program coordinators. The SRTS coordinators were able to identify schools that were willing to participate and had strong internal support to be able to sustain the Boltage program.

The Experimental Schools

The experimental group includes schools where a Boltage program has been implemented for one to three years. From 2011 to 2013, four schools - two elementary and two middle schools - worked with us to run a Boltage program. In all four schools, a Boltage device was installed at the entrance to a main school building; students registered to participate in the Boltage program on a voluntary basis; and incentives were given to students based on several criteria. For the experimental schools, we compared active school travel behavior pre- and post-Boltage implementation, and used the Boltage data to compare/track active school travel behavior in relation to different types of prizes.

The Control Schools

These control schools were selected based on their comparability with the study schools. Control schools were paired with study schools based on similar enrollment, grade levels, and parent and student demographics. With the help from the SRTS coordinators, we strategically chose control schools from participating SRTS schools so that we could take advantage of the data that have been collected for the SRTS programs. In total, six control schools are selected. Using multiple control schools to compare with a study (experimental) school makes the comparative analyses more robust. The control schools did not have the intervention program implemented, but data collection was carried out at those schools following a similar schedule as in the experimental schools.

Table 4.1: Summary of Schools Selected in the Study

Group	School name	School type	School enrollment (average)	School grades	% of free and reduced lunch	Whether a SRTS participant
1	Adams	Experimental	380	k-5	32.3	Yes
	Edison	Control	342	k-5	26.9	Yes
	Camas Ridge	Control	430	k-5	33.2	Yes
2	Cal Young	Experimental	558	6-8	27.1	No
	Roosevelt	Control	598	6-8	28.2	Yes
	Monroe	Control	550	6-8	37.7	Yes
3	Clear Lake	Experimental	343	k-5	69.4	No
	Malabon	Control	364	k-5	70.9	Yes
4	Cascade	Experimental	350	6-8	82.8	No
	Meadow View	Control	750	k-8	41.3	Yes

Note: Information obtained from National Center for Education Statistics. School enrollment is averaged through the four years of study period from 2011-2013.

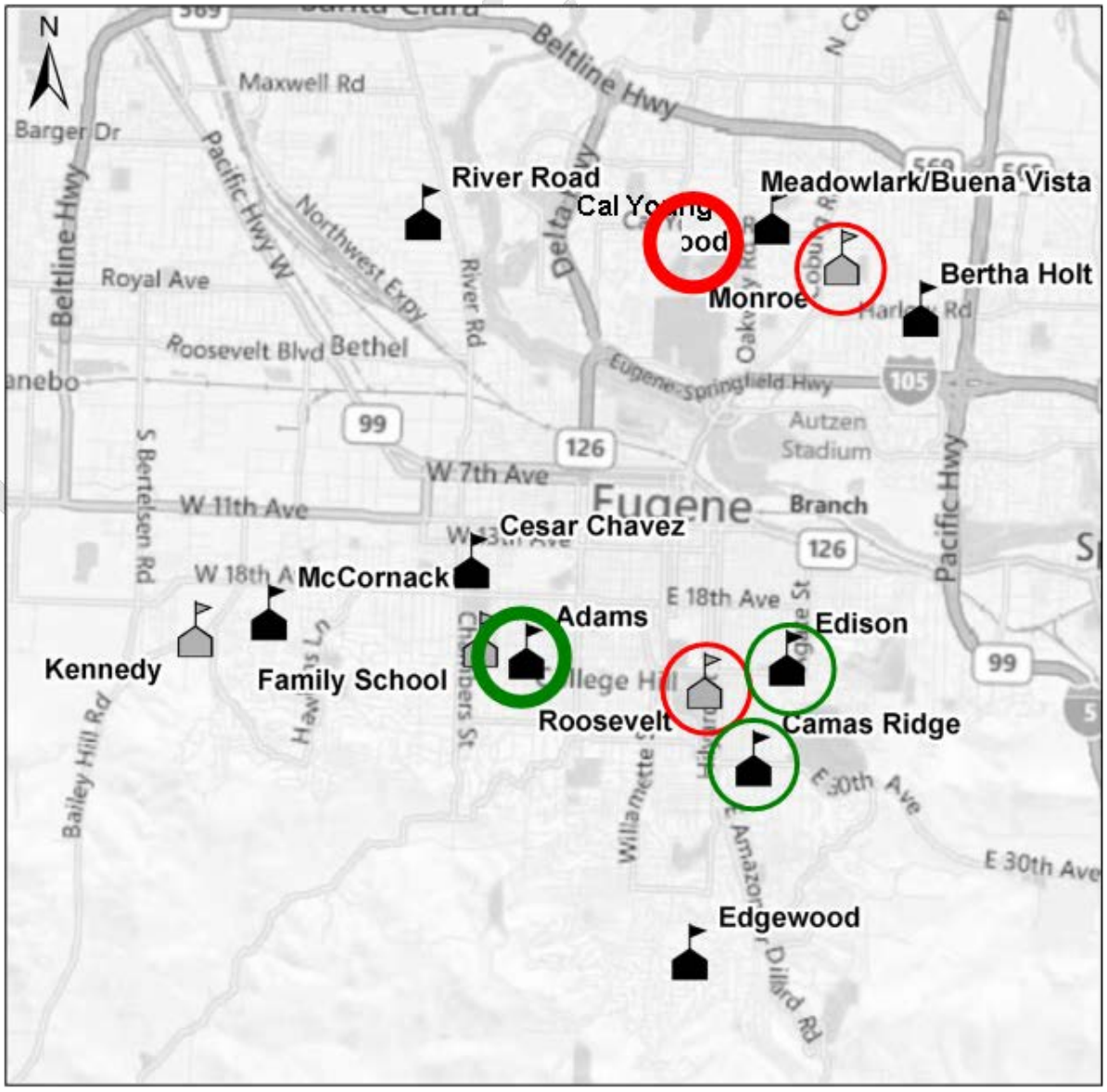


Figure 4.1: Location Map of Schools

4.1.3 Mixed Methodology

Both quantitative and qualitative methods were employed in this project. The aspect of quantitative research aims to statistically determine any changes in the rates of students walking or biking to school following the implementation of a Boltage program in an experimental school. It also identifies the impacts of socio-psychological factors on school travel behavior. The quantitative research of this project involves data from the following sources:

1. Several waves of parental surveys collected from all 10 schools.
2. Trip count data collected by Boltage device for the four experimental schools.

The qualitative research of this project mainly serves as a follow-up of the quantitative component. It aims to provide knowledge about the program implementation and insights into students' and parents' perceptions of and attitudes toward ASC. The qualitative information comes from the following sources:

1. Focus group with parents from the experimental schools.
2. Focus group with students from the experimental schools.
3. Interviews with SRTS coordinators, school principals and teachers.

4.2 THE INTERVENTION – THE BOLTAGE PROGRAM

Setting up a Boltage program at an experimental school requires close collaboration among researchers from the University of Oregon, the SRTS coordinator, the school principal, and school teachers and staff members. Implementing a Boltage program in an experimental school involves several steps: Installing a Boltage device, recruiting and registering students, and distributing the incentives or prizes based on pre-designed criteria.

Installing a Boltage Device

A Boltage device consists of a RFID scanner powered by a solar panel and mounted on top of a pole. In all experimental schools, the location of a Boltage device was sited to allow the mounted RFID scanner to easily capture a tag worn by a student who actively travels to school (see Figure 4.2). Successful scanning of a tag triggers a beep sound from the scanner.

Figure 4.2: A Boltage Device Installed at One of the Experimental Schools

Recruiting and Registering Students

All experimental schools promoted their programs by sending home flyers, making in-class announcements, and displaying large posters in school buildings (see Figure 4.3).

Figure 4.3: A Boltage Poster

Students were given two ways of registering: online and paper registration forms. A Boltage registration form is provided in Appendix A. Online registration requires the student's parent to create a Boltage account and input the student's information, including distance to school, teacher, grade level and home address. The paper registration form has the same information but is filled out and signed by the student's parent and registered by members on the research team at the University of Oregon. Having two methods of registration ensures that all students have

access to the program and are not hindered by lack of access to online and computer services. Students who registered with the program received a tag that could be attached to their backpack (see Figure 4.4). A tag number is connected to a student's registration information.

Figure 4.4: A Tag Attached to a Student's Backpack

Administering the Program – Winners and Prizes

Boltage program implementation involves using various incentives to reward students who walk or bike to school, which was implemented on an honor system. Students who'd like to walk or bike to school were instructed to walk under the mounted Boltage RFID scanner so that a tag attached to their backpack can be scanned. Information associated with a scanned tag is then recorded at a Boltage server via WIFI data service and can be accessed at the Boltage website. This information was used to identify weekly winners to receive prizes.

Typically, three winners were chosen each week for the Boltage program. The criteria for identifying winners have been adjusted during the entire study period based on schools' feedback. We began with randomly choosing students on a weekly basis to award prizes. Later criteria also included awarding students who actively traveled to school most days of the week, and awarding students who actively traveled to school for the longest distance in a week. That was estimated based on self-reported, home-school distance information.

4.3 DATA COLLECTION

4.3.1 Parent Surveys

The surveys collected information from parents about their children's school travel patterns and their attitudes toward school travel. Surveys were distributed to students in their take-home folders/packets, and were returned to classroom teachers or to the front office. Various incentives (toys and popular drinks) were given out to students to encourage survey return.

Between Fall 2011 and Spring 2014, the project conducted 24 parent surveys in four experimental schools and six control schools. Table 4.2 displays the survey timeline. There were at least two surveys done at any of the schools. In the experimental schools, baseline surveys were collected before a Boltage program was implemented. Post-program surveys were conducted continuously every year in the same season. We tried our best to conduct surveys in the control schools in a similar season when surveys were conducted in their corresponding experimental schools. But surveys in two of the control schools (Roosevelt and Monroe Middle schools) were delayed, and were collected at the beginning of the following term.

The survey instruments include the standard SRTS parent questionnaire and a revised version of the SRTS questionnaire where additional questions were included to measure the socio-psychological factors of interest in this study (see Appendix B). All but one experimental school used the longer, revised SRTS questionnaire starting in 2011, and the control schools used the standardized one in the beginning and switched to the longer, revised version starting in 2012 or 2013 (see Table 4.2).

Table 4.2: Summary of Parent Survey Schedule

			2011	2012	2012	2013	2013	2014	2014
School name	**school type**	**school grade**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Winter**
Adams	Study	elementary	**x**		**X**		**X**		
Edison	Control	elementary	**x**		**x**		**X**		
Camas Ridge	Control	elementary	**x**				**X**		
Cal Young	Study	middle	**X**		**X**		**X**		
Roosevelt	Control	middle	**x**		**X**				**X**
Monroe	Control	middle	**x**						**X**
Clear Lake	Study	elementary		**X**		**X**			
Malabon	Control	elementary		**x**		**X**			
Cascade	Study	middle		**X**		**X**			
Meadow view	Control	k-8		**x**		**X**			

Note: X indicates the revised, long SRTS questionnaire, and x indicates the standardized SRTS questionnaire.

4.3.2 Interviews and Focus Groups

Focus groups with parents from the experimental schools in the 4J School District were conducted in Spring 2012, and focus groups with parents from the Bethel School district in Spring 2013. We relied on parent-teacher organizations to recruit parents to participate. Four focus groups were conducted and a total of about 40 parents participated. Each focus group lasted about 20 to 25 minutes long. The focus group question guide is provided in Appendix C.

Focus groups with students in the 4J experimental schools were conducted in Spring 2012, and focus groups with students in the Bethel experimental schools were conducted in Spring 2013. Each experimental school made two classes available to our research team to talk with the students. The students who participated in the focus groups were of a wide age range, from 1st grade to 8th grade. School principals and interested teachers helped identify classes to participate in the focus group. A parent consent letter for the student focus group activity was sent to parents of students from each identified class; the letter asked parents who did not want their child to participate in the focus group to notify the school. At the beginning of each focus group, an assent letter was read to students to let them know that they did not have to participate if they didn't want to. See Appendix D for the parent consent letter and the student assent letter.

About 200 students participated in a total of 25 focus group sessions. Each focus group session lasted 20 minutes and involved one researcher interacting with about six to eight students. Information collected from the students included their attitude toward active school travel, their reaction to the Boltage programs, and their ideas about what types of incentives worked for them.

Interviews were also conducted with school contacts at the experimental schools. In total, four interviews were conducted with principals and teachers who were champions for the Boltage program and assisted with the program's implementation.

4.3.3 Boltage Data

The Boltage data contains trip counts and total-miles-traveled (based on self-reported, home-school distance) for each participating student. The Boltage website allows us to aggregate trip counts and distance traveled by periods and by schools. The aggregate data help reveal Boltage program participation characteristics and ASC patterns.

4.4 MEASURES AND VARIABLES

Table 4.3 summarizes measures/variables considered in subsequent analysis and the data sources. The dependent variable, whether a student uses ASC for his or her trip, is measured with information directly from the survey. The independent variables are organized into two factors, perceived social acceptance/norm and attitude toward ASC. Controlling variables include environmental factors (e.g., travel distance, walkscore around one's residence, etc.) and family/student characteristics (e.g., education levels, child's grade, etc.)

Literature in the socio-psychological field has informed the development of a series of survey questions to measure the two critical socio-psychological factors at the center of this study.

Specifically, parents' attitude toward ASC is assessed with a number of belief statements pertaining to various positive or negative behavioral outcomes associated with walking/biking and driving. All the attitudinal questions follow a 1-5 Likert scale. The higher value of their answer, the stronger the level of agreement they have with a particular belief statement. Parents' perceived social acceptance is assessed with five questions that ask parents to estimate the travel behavior of their peers and the level of approval exhibited by their family and friends (see Table 4.3).

Table 4.3: Summary of Measures and Variables and Source of Data

Variable / measures	Explanation (variable name)	Type	Source
Active school travel	On most days a student walks or bikes, either arriving at school or leaving from school (active)	dichotomy	Parent surveys
	w/b trip to school	continuous integral	Boltage website
Boltage program	Schools implemented Boltage (boltage)		
Environmental factor			
travel distance	Self-estimated home-school distance (distance)	continuous	Parent surveys
walkscore	Walkability measures of neighborhood (walkscore)	continuous	Walkscore website
season	Season when travel information is collected (indicative of weather effects) (fall, spring)		Parent survey
Family and child characteristics	Parent self-reported education levels(parent_ed), child grade(child_grade), child gender (male=1), and number of children in household (num_kids), child being healthy(healthy)		Parent surveys
Socio-psychological factors			
Perceived social norm	Include several Likert-scale items to measure the concept: • School encourages walking/biking (encourage); • My child walks or bikes to school as often as her friends do(n_often); • Perceived proportion of families that allow their children to w/b to school (n_proportion); • My family and friends think it is a good idea for me to let my child walk or bike to school(n_gidea); • Compared with other families we know, our family drives less/about the same/more(n_often).	Scale (1-3 or 1-5); Likert scale (1-5)	Parent surveys
Attitude toward w/b to school	Include several Likert-scale items to measure the concept: • Walking is fun for your child(fun); • Walking/biking to school is a good way for my child to get to know the neighborhood and interact with friends(n_social); • Allowing my child to w/b to school is risky because bad things can happen along the way(n_risky); • Walking/biking to school is a good way to increase my child's physical activity(n_physical); • On balance, children walking or biking to school is desirable(n_desirable).	Likert scale (1-5)	Parent surveys

5.0 FINDINGS

Data collected from multiple sources allowed us to conduct cross verification and to ensure the validity and reliability in the interpretation of analytical outcome. Findings reported in this section are organized into two main parts. The first part reports Boltage program implementation and outcomes for the experimental schools, using information from interviews, focus groups and Boltage data. The second part mainly reports analysis of parent survey data.

5.1 BOLTAGE PROGRAM IMPLEMENTAION

5.1.1 Adams Elementary School

School context and Boltage program description

Adams Elementary School is located at 950 West 22nd Ave. in Eugene. The neighborhood is exclusively residential. The surrounding streets are residential streets with a low speed limit. The school is well connected by sidewalks. There are a number of intersections with two-way stop signs surrounding the school. It is a safe neighborhood both in terms of criminal activity and safety from motor vehicles. There is a low volume of traffic and traffic travels at a low speed. The only major barriers are several hills surrounding the school that may be difficult for younger children to bike.

Adams Elementary has a strong commitment to protecting the environment through teaching and maintaining sustainable practices. It installed solar panels and a solar hot-water heater and achieved the "premier level status" under the Oregon Green Schools program. Consistent with the school's commitment to sustainability, it is very supportive of walking and biking. The principal served as one of our main advocates of the program. Additionally, several teachers and parent-volunteers appeared to be strong advocates of walking and biking.

Table 5.1 summarizes the characteristics of Adams' Boltage program and participants over the three years. Over a third of the students in the school registered with the program, and the registration rate was around 35% every year. But not all registered students participated in the program (i.e., logged walking or biking trips via the Boltage device). Since the Boltage program started in 2011, about 80 to 100 students participated in the program by logging at least one trip annually. The prizes given out to students included medals, gift cards to various local recreational facilities, and $2 bills.

Among the students who had participated in the program, more than a third lived farther than one mile from the school. The average travel distance of Boltage participants was farther than or close to one mile. More students who live within a short distance participated. Figure 5.1 shows locations of students who participated in the program.

Table 5.1: Adams Elementary School Boltage Program Summary (2011-2013)

Duration (Spt. 1 - Jun. 15)	Number of students who had trips >=1	% of participants with h-s distance > 1mile	% of participants with h-s distance <0.5 mile	Avg. trips per person	Participant avg. h-s distance	School enrollment	Boltage registration rate
2011-12	86	36%	19%	38	1.126	400	38%
2012-13	102	40%	17%	38	1.325	438	34%
2013-14	88	33%	19%	49	0.992	421	36%

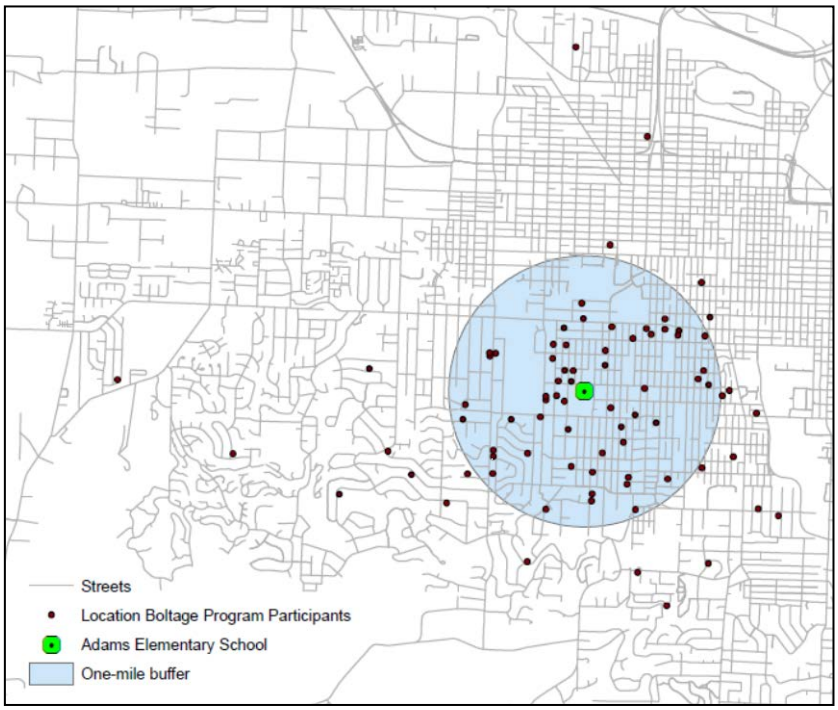


Figure 5.1: Spatial Distribution of Boltage Program Students at Adams Elementary School

Boltage Program Impacts – Findings from Interviews with Students and Parents

In spring (May) and winter (October) 2012 and again in spring (May) 2013, we conducted a series of focus group interviews with more than 80 students at Adams Elementary school. These children were from all grades and were of balanced gender makeup. The children who participated in the focus groups used all types of transportation modes in their travel to school.

The interviews revealed very positive attitudes that children at this age group had toward walking and biking to school. Almost all children considered walking to school as "fun" to do, and "like" being allowed to walk or bike to school. They were particularly excited about walking or biking to school with friends or family members. Language such as walking or biking to school is "fun if you get to see or play with friends" is often heard from the children. Other reasons children offered that made them like walking or biking to school included walking with pets (dogs), "good for their body," "can play along the way," "like to spend more time outside," "save time (because riding a bike is faster than being driven to school)," "help save environment," etc.

The interviews also revealed children's desire to walk or bike and the influence of peers on them. All children, regardless of their current travel mode to school, reported that they knew someone who walked or biked to school and said they would like to do the same. Many of them said their parents wouldn't let them do so because of concerns about safety and distance.

The children expressed their excitement about having the Boltage program in their school. Quite a few students considered walking or biking to school more fun because of the Boltage program. Children thought many aspects of the Boltage program were cool, such as the high-tech solar panel, the beeping sound of the RFID scanner, and badges hanging on their backpacks.

Children were generally thrilled to get prizes, regardless of what kinds. Many students (about 40 to 50 percent) who had participated in the focus groups told us they had asked their parents for permission to walk or bike to school after the Boltage program started, although fewer students said they eventually were allowed to do so. But quite a few of the children reported that they knew someone who started walking or biking to school after the Boltage program had started. Most of the children also thought their parents liked the Boltage program.

Interviews with the principal and several parents suggested that students were very excited about having the Boltage device installed on the school site, and were fascinated at hearing the beeping sounds triggered by a tag under the Boltage scanner. Students and parents also enjoy prizes.

5.1.2 Cal Young Middle School

School context and Boltage program description

Cal Young Middle School is located at 2555 Gilham Road in Eugene. The surrounding properties are largely low-density residential. Gilham Road is a collector street that connects the neighborhoods to Cal Young Road. There is a sidewalk on both sides of the street surrounding the school. The sidewalk is wide, but there is no buffer between the sidewalk and the street. Additionally, the school is well connected by bike lanes. The sidewalks and bike lanes appear well maintained. The only major safety issue appears to be the speed of traffic.

Cal Young Middle School faculty and staff are enthusiastic about promoting walking and biking to school. Prior to starting the Boltage program, the school already engaged the students in promoting healthy habits. In the fall of 2011, the school conducted a walk-a-thon during the

school day. All students were encouraged to walk, and the students were awarded based on the distance they completed. The school has approximately 40 bike racks and 10 skateboard racks.

However, it took some time for the students in the middle school to get interested in the program. The faculty indicated that there was clear distinction between 6th and 8th graders. Younger students were more enthusiastic about the program. Still, all students often did not collect their prize when their name was announced. Additionally, many students did not get a tag or register. It was particularly surprising that students who already walked or biked to school did not demonstrate interest in the program.

Table 5.2 summarizes the characteristics of Cal Young's Boltage program and participants over the three years. During that period the registration rates remained consistent at 18 percent, but more students registered and participated as the school's overall enrollment increased. From 2011-2012, the prizes given to students included medals, gift cards to local recreation facilities, and $2 bills. Feedback from the students helped us to make changes to the program. In 2013, the program implemented a competition scheme where students were divided into two groups to compete for the most total number of trips. After switching the individual-based prizes to a competition-based team prize, we saw an increase in the participants, particularly those living close to school (i.e., home-school distance is shorter than half a mile). Also, the average active travel trips made by students increased over the years.

Table 5.2: Cal Young Middle School Boltage Program Summary (2011-2013)

Duration (Sep. 1 - Jun. 15)	Number of students who had trips >=1	% of participants with h-s distance > 1mile	% of participants with h-s distance <0.5 mile	Avg. trips per person	Participant avg. h-s distance	School enrollment	Boltage registration rate
2011-12	62	36%	7%	20	1.631	557	18%
2012-13	67	37%	18%	39	1.228	560	18%
2013-14	73	32%	22%	51	0.966	564	18%

Boltage Program Impacts – Findings from Interviews with Students and Parents

We conducted focus groups with students at Cal Young Middle School on a schedule similar to that for Adams Elementary School. In total, we conducted focus group interviews with about 60 students from 6th and 8th grades. The participating students were of balanced gender makeup and used all types of transportation modes to travel to school.

The focus groups showed that students in the older age group did not appear to have a strong interest in walking or biking compared with the younger children from Adams. While some students said walking or biking to school helped them "wake up," or "feel independent," other answers such as "I have to walk or bike," "parents don't have time to drive me to school," and "there is no bus" were often offered as reasons for those who walked or biked to school. When asked to rate on a scale from 1-10 how fun it is to walk or bike to school, the students tended to give a score lower than 6. Students who didn't walk or bike to school cited reasons such as

"living too far," "carrying too much," "bad weather," "safety," etc. Students were primarily concerned with predators and "getting kidnapped."

The socialization opportunity that could come with walking or biking to school seems to be the best benefit seen by most students. Among the students we spoke with, a high percentage indicated that "get to hang out with friends" will make them more likely to consider walking or biking to school. Many students expressed interest in walking *home from* school because it allowed them more time to be with their friends. Students also suggested that they'd be interested in walking to school if more students started to do so or if walking to school is an organized, group activity. For example, many students became highly motivated by the idea that active school travel behavior is connected to competition among student groups or even different schools.

In general, the middle school students expressed welcoming sentiments toward the Boltage programs in their school; they commented that having the solar panel and beeping sound of the RFID scanner is "cool." It seems that the students liked the idea of receiving prizes for walking to school, but were not impressed with the prizes that were offered in the Boltage program. When asked about what prizes would work for them, the students suggested an iPad, iTunes cards, a MP3 player, higher cash prizes (e.g., $20), etc. While some students admitted that the Boltage program increased their interest in walking or biking to school, none of them was willing to admit that the Boltage program made them change their travel behavior. An interesting dynamic we observed is some students felt it was not "cool" to acknowledge that they were influenced by the Boltage program.

5.1.3 Clear Lake Elementary School and Cascade Middle School

Clear Lake Elementary School and Cascade Middle School are two schools in the Bethal School District. Despite using similar methods to promote the Boltage programs and receiving support from the schools' principals, the Boltage programs had very low participation rates in both schools. Compared with those in the 4J School District, participants in the two schools lived closer to schools. The geography of this area is also relatively flatter than the 4J district. But the number of trips recorded for the two Bethel schools was much lower than that for the two 4J schools (see Tables 5.3 and 5.4). The socioeconomic status of students' families for the Bethel schools is lower than that for the 4J schools, reflected in their much higher percentage of students eligible for free or reduced lunch (see Table 4.1).

We conducted focus groups with students at both Bethel schools in Spring 2013. In total, we conducted focus group interviews with about 40 students at Clear Lake Elementary School and 50 students at Cascade Middle School. The participating students were of balanced gender makeup and used all types of transportation modes to travel to school. We also conducted one parent focus group in each school.

The interviews with students revealed a general fear of the neighborhood safety and traffic conditions in the school vicinity. Students frequently mentioned "crazy people in the neighborhood" and "scary traffic" as reasons for not walking or biking to school. Parents from both schools were almost unanimous about the unacceptable traffic conditions along a major

thoroughfare close to both schools. The amount of traffic, the drivers' aggressive driving behavior and the lack of crossings along the road were frequently mentioned by parents as reasons for not letting their child walk or bike to school.

Table 5.3: Clear Lake Elementary School Boltage Program Summary (2012-2013)

Duration	Number of students who had trips >=1	% of travel distance > 1mile	% of travel distance <0.5 mile	Avg. trips per person	Avg. travel distance	School enrollment	Boltage registration rate
2012 (Apr. 1 - Jun. 15)	25	22%	50%	10	0.7	343	7%
2012-13	23	20%	56%	12	0.65	340	7%

Table 5.4: Cascade Middle School Boltage Program Summary (2012-2013)

Duration	Number of students who had trips >=1	% of travel distance > 1mile	% of travel distance <0.5 mile	Avg. trips per person	Avg. travel distance	School enrollment	Boltage registration rate
2012 (Apr. 1 - Jun. 15)	21	43%	20%	11	1.6	350	6%
2012-13	21	40%	20%	12	1.6	350	6%

5.2 SURVEY DATA ANALYSIS

5.2.1 Survey Return and Descriptive Analysis

During the three-year study period, an estimated 11,000 parent surveys were sent out with the help of teachers in those schools. These included about 3,500 standard SRTS questionnaires and about 7,500 revised SRTS questionnaires. Thanks to the schools' support and the assistance from local SRTS coordinators, the survey response rates were relatively higher than typical mail surveys (see Yang et al., 2010). In total, we received about 4,555 survey, for an average return rate of 40 percent, although the return rates varied considerably across the schools and over the years. Table 5.5 summarizes each school's survey return numbers. Table 5.6 provides a summary of the variables considered in subsequent analysis. Please refer to Table 4.3 for an explanation of these variables.

Table 5.5: Parent Survey Return Summary (2011-2013)

	Parnet Surveys Collected During the Study Period											
	2011			**2012**			**2013**			**2014**		
	returned	response rate	season	returned	response rate	season	returned	response rate	season	returned	response rate	season
Adams Elementary	233	58%	Fall	108	25%	Fall	184	44%	Fall			
Edison ES	161	47%	Fall	83	24%	Fall	82	24%	Fall			
Camas Ridge ES	168	39%	Fall	-		Fall	138	32%	Fall			
Cal Young Middle School	353	63%	Fall	401	72%	Fall	271	48%	Fall			
Roosevelt MS	196	33%	Fall	149	25%	Fall	-		-	199	33%	winter
Monroe MS	133	24%	Fall	-		Fall	-		-	197	36%	winter
Clear Lake Elementary	-		-	154	45%	Spring	90	26%	Spring			
Malabon ES	123	34%	Spring	60	16%	Spring	73	20%	Spring			
Cascade Middle School	-		-	199	57%	Spring	188	54%	Spring			
Meadow View ES	318	42%	Spring	71	9%	Spring	223	30%	Spring			
Total	1685			1225			1249			396		

Table 5.6: Descriptive Summary of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
active	4555	.3216246	.4671511	0	1
boltage	4555	.2726674	.4453801	0	1
parent_ed	4174	14.81025	2.058207	8	16
distance	4259	1.319823	1.055771	.125	3
walkscore	3852	39.99688	19.44161	0	97
child_grade	4487	4.903499	2.571198	0	8
num_kids	4442	1.717019	.8299849	0	8
male	4555	.4884742	.499922	0	1
year1	4555	2011.991	.855072	2011	2013
encourage	4350	4.037011	.7886644	1	5
fun	4179	3.619048	.9521239	1	5
healthy	4278	4.3705	.7213886	1	5
Variables from long form survey only					
n_physical	2892	4.115837	.818794	1	5
n_social	2895	3.593782	.9990127	1	5
n_risky	2903	3.534964	1.05438	1	5
n_desirable	2802	2.422912	.6998365	1	3
n_gidea	2872	3.03273	1.120861	1	5
n_proportion	2837	2.911526	1.112627	1	5
n_often	2844	2.808368	1.173419	1	5

5.2.2 Boltage Program's Effects – School-level Analysis

The survey data collected over the three (academic) years from 2011 to 2013 allow us to study if there are any significant changes in the psychological (perceived social norm and attitudes) and behavioral (rates of ASC) conditions.

Changes in Perceived Social Norm

We used four questions to assess whether parents' perceived social acceptance toward ASC exhibited any changes during the study period. The level of social acceptance is gauged by using parents' perception of school encouragement and family/friends' approval of ASC, as well as perceived frequency of ASC uses by their peers. Table 5.7 summarizes the changes in the answers to the four perception questions over the three years from 2011-2013. We compared the changes in the Boltage experimental schools with those in the control schools.

Table 5.7: Frequency Analysis of Answers to Various Questions Gauging Perceived Social Norm

My family and friends consider ASC a good idea

-> boltage_d = Control Schools

Year	Family and Friends Accept ASC Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2012	7.80	7.80	34.75	28.37	21.28	100.00
2013	9.81	12.62	38.20	25.93	13.43	100.00
Total	9.53	11.94	37.71	26.28	14.54	100.00

Pearson chi2(4) = 8.6398 Pr = 0.071

-> boltage_d = Boltage Schools

Year	Family and Friends Accept ASC Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2011	10.78	17.96	42.22	24.25	4.79	100.00
2012	13.15	18.82	42.22	16.65	9.17	100.00
2013	13.76	16.71	39.19	22.89	7.44	100.00
Total	12.96	17.87	41.07	20.37	7.73	100.00

Pearson chi2(8) = 19.9046 Pr = 0.011

Perceived proportion of families allowing children to use ASC

-> boltage_d = Control Schools

Year	Perceived peer using ASC None	Almost No	Less than	More than	Almost al	Total
2012	2.14	13.57	40.71	29.29	14.29	100.00
2013	11.50	17.96	35.21	23.47	11.85	100.00
Total	10.18	17.34	35.99	24.29	12.20	100.00

Pearson chi2(4) = 14.9458 Pr = 0.005

-> boltage_d = Boltage Schools

Year	Perceived peer using ASC None	Almost No	Less than	More than	Almost al	Total
2011	13.02	24.85	35.50	19.82	6.80	100.00
2012	13.62	23.56	36.44	20.25	6.13	100.00
2013	12.43	25.43	40.75	14.45	6.94	100.00
Total	13.06	24.50	37.89	17.99	6.56	100.00

Pearson chi2(8) = 11.5773 Pr = 0.171

Perceiving child w/b to school as often as peers

-> boltage_d = Control Schools

Year	Child w/b to school as often as peers Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2012	9.15	29.58	27.46	21.83	11.97	100.00
2013	13.68	25.35	26.89	23.23	10.85	100.00
Total	13.03	25.96	26.97	23.03	11.01	100.00

Pearson chi2(4) = 3.0045 Pr = 0.557

-> boltage_d = Boltage Schools

Year	Child w/b to school as often as peers Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2011	12.31	28.23	27.63	27.03	4.80	100.00
2012	17.32	29.36	26.78	18.55	7.99	100.00
2013	14.99	28.85	29.70	19.80	6.65	100.00
Total	15.53	28.96	28.05	20.55	6.90	100.00

Pearson chi2(8) = 17.4652 Pr = 0.026

For the control schools, while parents' perceived school encouragement and family/approval of ASC have remain mostly unchanged from 2012 to 2013, parents believed that fewer families allowed their children to walk or bike to school. In the 2012 survey, about 15 percent of the parents believed none or almost none of the families they know allowed their children to walk or bike to school; that percentage increased to almost 30 percent in 2013. For the Boltage experiment schools, a higher level of perceptions of ASC approval was reported in the baseline year for the Boltage schools (2011); but the level dropped in year 2 (2012) and then increased in year 3 (2013). The percentage of parents who believed none or almost none of the families they knew were using ASC remained at 37 percent from 2012 to 2013.

Changes in ASC-Attitudes – Beliefs in the Outcome of the ASC Behavior

We used five questions to assess parents' attitudes toward ASC. Four questions asked parents about their beliefs in specific positive or negative outcomes (fun for children, social interaction, physical activity, and risk) associated with the ASC behavior. The fifth question asked parents to provide an overall assessment of the ASC's desirability. Table 5.8 summarizes the changes in the answers to attitude questions over the study period.

Table 5.8: Frequency Analysis of Answers to Various Questions Gauging ASC Attitudes

ASC is fun for child

-> boltage_d = Control Schools

Year	ASC is fun for child: Very bori	Boring	Neutral	Fun	Very fun	Total
2011	1.28	2.76	31.20	40.85	23.92	100.00
2012	1.81	3.92	34.94	37.65	21.69	100.00
2013	2.79	6.06	37.58	34.18	19.39	100.00
Total	1.93	4.19	34.19	37.83	21.86	100.00

Pearson chi2(8) = 32.4260 Pr = 0.000

-> boltage_d = Boltage Schools

Year	ASC is fun for child: Very bori	Boring	Neutral	Fun	Very fun	Total
2011	2.62	9.36	37.64	32.40	17.98	100.00
2012	3.89	8.04	43.34	31.28	13.44	100.00
2013	4.44	6.66	37.28	33.58	18.05	100.00
Total	3.74	7.93	39.78	32.35	16.20	100.00

Pearson chi2(8) = 16.5121 Pr = 0.036

ASC is a good way to increase child social interactions

-> boltage_d = Control Schools

Year	ASC increase social interaction: Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2012	0.69	13.19	22.22	35.42	28.47	100.00
2013	2.20	9.27	26.42	38.47	23.64	100.00
Total	1.99	9.83	25.82	38.03	24.33	100.00

Pearson chi2(4) = 5.6745 Pr = 0.225

-> boltage_d = Boltage Schools

Year	ASC increase social interaction: Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2011	4.09	12.28	28.65	44.44	10.53	100.00
2012	3.24	12.12	33.49	36.97	14.17	100.00
2013	3.23	9.12	29.31	39.13	19.21	100.00
Total	3.39	11.02	31.04	39.14	15.41	100.00

Pearson chi2(8) = 23.5806 Pr = 0.003

ASC is a good way to increase child physical activities

-> boltage_d = Control Schools

Year	ASC increases physical activities: Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2012	0.00	2.07	8.97	41.38	47.59	100.00
2013	0.93	2.90	14.50	46.17	35.50	100.00
Total	0.79	2.78	13.70	45.48	37.24	100.00

Pearson chi2(4) = 9.9261 Pr = 0.042

-> boltage_d = Boltage Schools

Year	ASC increases physical activities: Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2011	2.36	2.65	11.50	65.19	18.29	100.00
2012	1.55	2.39	14.34	48.15	33.57	100.00
2013	0.71	2.40	13.82	46.12	36.95	100.00
Total	1.38	2.44	13.63	50.45	32.10	100.00

Pearson chi2(8) = 50.4400 Pr = 0.000

ASC is risky because bad things may happen on the way

-> boltage_d = Control Schools

Year	ACS is risky: Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2012	4.14	22.07	33.79	30.34	9.66	100.00
2013	4.73	17.78	31.41	29.68	16.40	100.00
Total	4.65	18.40	31.75	29.77	15.43	100.00

Pearson chi2(4) = 5.2351 Pr = 0.264

-> boltage_d = Boltage Schools

Year	ACS is risky: Str. Disa	Disag	Neutral	Agree	Str.Agre	Total
2011	2.92	13.74	26.61	47.95	8.77	100.00
2012	2.51	11.95	22.58	38.11	24.85	100.00
2013	2.24	11.92	25.67	38.01	22.16	100.00
Total	2.48	12.26	24.47	39.85	20.93	100.00

ASC is desirable on balance

-> boltage_d = Control Schools

Year	On Balance ASC is desirable: Undesirab	Neutral	Desirable	Total
2012	3.57	18.57	77.86	100.00
2013	12.35	29.33	58.31	100.00
Total	11.10	27.80	61.10	100.00

Pearson chi2(2) = 20.8436 Pr = 0.000

-> boltage_d = Boltage Schools

Year	On Balance ASC is desirable: Undesirab	Neutral	Desirable	Total
2011	10.00	37.58	52.42	100.00
2012	15.10	38.49	46.41	100.00
2013	11.73	32.40	55.87	100.00
Total	12.91	36.04	51.04	100.00

Pearson chi2(4) = 16.5867 Pr = 0.002

The survey returns show that parents from the Boltage experiment schools, in general, had lower levels of attitudes toward ASC compared with the control schools, as suggested by the higher percentage of parents in the latter group who believed in the positive outcomes associated with ASC and the lower percentage of the same group of parents who believed in the negative outcomes associated with ASC. Over the study period, the ASC-attitude of parents from the Boltage experimental schools appeared to have improved. The most evident may be seen in the greater percentage of parents from the Boltage schools who believed ASC is a good way to increase child social interactions. ASC-attitudes of parents from the control schools, on the other hand, declined during the same period. The largest decline is in the percentages of parents who believed ASC is fun for their child (10 percent decline), followed by that in the percentages of parents who believed ASC is good way to increase children's physical activities (8 percent). Among parent groups from control schools or Boltage schools, the percentage who perceived ASC as risky increased during the study period.

Overall, parents from the control schools reported declining assessments of ASC in terms of its perceived desirability. From 2012 to 2013, the percentage of parents who perceived ASC as undesirable increased from 3.5 percent to 12.35 percent, and the percentage of parents who perceived ASC as desirable declined from 77.9 percent to 58.3 percent. During the same period, survey responses from the Boltage school parents exhibit an opposite trend. There was an increase in the proportion of parents from the Boltage schools who considered ASC desirable, and a decrease in the proportion of parents who considered ASC undesirable.

Changes in Active School Commuting (ASC) Behavior

We defined that a student adopted "active school commuting (ASC)" if his or her parent indicated in the survey that "on most days the student walks or bikes" either arriving at school or leaving from school. Using the parent survey data, we computed the percentages of students who used an ASC mode for each school over the years in our study period. Table 5.9 summarizes changes in rates of ASC by Boltage treatment over the study period. Table 5.10 provides a more detailed comparison of ASC rate change among matched experimental and control schools.

Table 5.9: Summary of ASC Rate Changes by the Presence of Boltage Intervention (2011-2013)

-> boltage_d = Control Schools

Key
frequency *row percentage*

Year	Active Travel to School: No	Yes	Total
2011	669 60.87	430 39.13	1,099 100.00
2012	243 66.94	120 33.06	363 100.00
2013	591 64.80	321 35.20	912 100.00
Total	1,503 63.31	871 36.69	2,374 100.00

Pearson chi2(2) = 5.7451 Pr = 0.057

-> boltage_d = Boltage Schools

Key
frequency *row percentage*

Year	Active Travel to School: No	Yes	Total
2011	441 75.26	145 24.74	586 100.00
2012	635 73.67	227 26.33	862 100.00
2013	511 69.71	222 30.29	733 100.00
Total	1,587 72.76	594 27.24	2,181 100.00

Pearson chi2(2) = 5.6319 Pr = 0.060

Similar to the pattern observed for the ASC-attitude measures, the Boltage schools had generally low rates of ASC compared to the control schools. However, the Boltage schools experienced an increase in ASC rates during the study period, while the control schools' ASC rates appeared to have declined.

Table 5.10: Summary of ASC Rate Changes by School (2011-2013)

Intra-subject Analysis								
		2011-12 (year 0)		**2012-13 (year 1)**		**2013-14 (year 2)**		Total
		N	**active travel rate**	N	**active travel rate**	N	**active travel rate**	survey returns
Group 1	**Adams Elementary**	233	**25%**	108	**30%**	184	**24%**	**525**
	Edison ES	161	**42%**	83	**33%***	82	**30%****	**326**
	Camas Ridge ES	168	**31%**	-	**-**	138	**29%***	**306**
Group 2	**Cal Young Middle School**	353	**25%**	401	**26%**	271	**31% ****	**1025**
	Roosevelt MS	196	**53%**	149	**40%****	199	**36%****	**544**
	Monroe MS	133	**42%**	-	**-**	197	**35%**	**330**
Group 3	**Clear Lake Elementary**	-	**-**	154	**10%**	90	**16%**	**244**
	Malabon ES	123	**29%**	60	**18%**	73	**21%**	**256**
Group 4	**Cascade Middle School**	-	**-**	199	**38%**	188	**42%**	**387**
	Meadow View ES	318	**36%**	71	**32%**	223	**45%***	**612**
	Total	1685		1225		1249		**4555**
Using 2011 active travel rate as reference group.								
*.p<0.1, **.p<0.05,***.p<0.01								
Inter-subject Analysis								
		2011-12 (year 0)		**2012-13 (year 1)**		**2013-14 (year 2)**		Total
		N	**active travel rate**	N	**active travel rate**	N	**active travel rate**	survey returns
Group 1	**Adams Elementary**	233	**25%**	108	**30%**	184	**24%**	**525**
	Edison ES	161	**42%*****	83	**33%**	82	**30%**	**326**
	Camas Ridge ES	168	**31%**	-	**-**	138	**29%**	**306**
Group 2	**Cal Young Middle School**	353	**25%**	401	**26%**	271	**31%**	**1025**
	Roosevelt MS	196	**53%***	149	**40%***	199	**36%**	**544**
	Monroe MS	133	**42%****	-	**-**	197	**35%**	**330**
Group 3	**Clear Lake Elementary**	-	**-**	154	**10%**	90	**16%**	**244**
	Malabon ES	123	**29%**	60	**18%**	73	**21%**	**256**
Group 4	**Cascade Middle School**	-	**-**	199	**38%**	188	**42%**	**387**
	Meadow View ES	318	**36%**	71	**32%**	223	**45%**	**612**
	Total	1685		1225		1249		**4555**
Using experimental school as reference group								
*.p<0.1, **.p<0.05,***.p<0.01								

We conducted further analysis of ASC rates by each participating school. Among the four experimental schools, three schools - Cal Young Middle School, Clear Lake Elementary School, and Cascade Middle School - showed steady increase in the rates of active school travel in the 2011 (2012) to 2014 period. The rate increase for Cal Young Middle School from year 0 (2011) to year 2 was statistically significant (p=0.05).

Interestingly, all but three control schools exhibited a steady decline in their ASC rates over the same period. The decline in active travel rates is statistically significant for at least three schools (Edison, Roosevelt and Camas Ridge). The decline was highest for Roosevelt Middle School, with a 16 percent decline from 2011 to 2013, and smallest for Camas Ridge Elementary School, with a 2 percent decline from 2011 to 2013. Two control schools didn't show significant changes in their active travel rates during the same period (Monroe and Malabon), and a third control school had an increase in its active travel rate (Meadow View).

Comparing an experimental school with its control schools in each of the four matched groups, it is clear that the control schools had higher rates of active school travel at the beginning. In group 1, the gap between the experimental school (Adams) and the control schools (Edison and Camas Ridge) decreased in the following years, and the differences became no longer significant. The difference between Edison and Adams declined from 17 percent ($p<0.01$) in 2011 to 6 percent ($p=0.15$) in 2013. Similarly, in group 2, the gap between the experimental school (Cal Young) and the control schools (Roosevelt and Monroe) declined from 2011-2013.

5.2.3 Boltage Program Effects – Individual-level Analysis

Perceptions and Attitudes Affecting ASC Probability

We used a series of logistic regressions to examine whether the psychological factors identified in our conceptual framework affect the probability of ASC adoption as hypothesized. Each of the attitudinal and perception measures was examined, while controlling for the fixed effects of schools. We used these regression analyses to test our hypothesis that the adoption of ASC behavior is correlated with parents' attitudes and perceptions. Results from these analyses help us identify important psychological measures to include in the subsequent regression analysis where we investigate Boltage's independent effects on ASC probability.

We reported these measures' respective impacts on ASC probability in Table 5.11. Each of the measures was treated as an ordinal variable in their respective regression model, and the lowest value level was used as the reference group. All but the ASC-desirability measure have values ranging from 1 to 5; the ASC-desirability measure has values from 1 to 3.

Table 5.11: Impacts of Perceived Social Norm and Attitude Measures on ASC Probability

Odds Ratio from Individual Logistical Regression Models Predicting ACS Probability										
	Value levels (1 = reference)									
Preditors	1	2		3		4		5		**N**
Belief in ACS overall desirability	-	1.42	**	3.91	***	n/a		n/a		**2802**
Belief in ACS being fun	-	1.92	**	1.61	*	2.52	***	3.48	***	**4179**
Belief in ACS increasing social interaction	-	0.67		1.32		1.89	*	3.44	***	**2895**
Belief in ACS increasing physical activities	-	0.62		1.22		1.61		2.48	**	**2892**
Belief in ACS being risky	-	1.03		0.58	**	0.23	***	0.10	***	**2930**
Perceived family/friend acceptance	-	0.89		5.14	***	16.20	***	31.99	***	**2872**
Perceived ACS use among peers	-	1.47	*	3.12	***	7.44	***	8.01	***	**2837**
Perceived school encouragement for ACS	-	1.45		4.18	**	6.17	***	7.02	***	**4350**
Each logistic regression has one predictor while controlling for the fixed effects of schools										
*. P<0.1; **.p<0.05; ***.p<0.01										

Among the measures we have examined, parents' perception of social acceptance, perceived ASC adoption among peers, as well as ASC-related safety issues seem to have the strongest impacts on actual probability of ASC. Odds ratio (OR = Exp(B)) for the perceived "social acceptance" measure had the largest odds ratio of almost 32, suggesting that parents who perceived there is strong social acceptance toward ASC were 32 times more likely to let their child walk or bike to school. The odds ratio for the measure of perceived peer use of ASC is 8.01, indicating that parents who believed that most of their friends adopted ASC were eight times more likely to let their own child to use ASC as well.

Parental attitude measures, on the other hand, seem to have generally weaker impacts on the ASC probability. Parents' belief in the risky outcome of ASC shows the strongest impact on ASC probability among the attitude measures (OR = 0.1). Parents who believed strongly that ASC is risky were 10 times less likely to use ASC compared with those who strongly disagreed with that statement.

Boltage Treatment Affecting the ASC-related Perceptions and Attitudes

Our theoretic framework suggests Boltage treatment could improve students' and parents' attitudes toward ASC and perception of ASC support, thus increasing the likelihood of ASC adoption. We use a series of OLS regression models to test the relationship of Boltage treatment to the several measures of parents' attitudes and ASC's social support, while controlling for characteristics of student family and the environment. The hypothesis underlying the following functional form is that a family's exposure to a Boltage program (i.e., the family has a student in a Boltage experiment school), together with the family's background characteristics and their environment characteristics, can be used to predict the parents' ASC-attitude and perceived social support for ASC.

Y = F (Boltage, family characteristics, environment characteristics, school effects)
Where:

- Y is one of the social support and attitudinal measures considered in this study: Four scales of social support measures - school encouragement of ASC, friends and family consider ASC a good idea, proportion of peers use ASC, child uses ASC as often as peers. Five scales of ASC-attitude measures - ASC is fun for child, ASC is risky, ASC increases social interaction, ASC increases a child's physical activity, and ASC desirability on balance.
- Family characteristics include parent education level, child's sex, grade level, and number of children in a family.
- Environment characteristics include travel distance and walkscore for the neighborhood around a student's reported residence.
- Schools are controlled as fixed effects to account for any school-based differences.

In total, we ran seven regression models separately. The only significant associations these models revealed are that of Boltage treatment with the measure of school support/encouragement ($B=0.22$, $p<0.01$) and the measure of ASC being "fun" for one's child ($B=0.122$, $p<0.05$). This suggests that when everything else is the same, being in a Boltage school increased parents' perception of the school's ASC encouragement and the level of fun they believed their child had with ASC.

The other attitude measures, such as parents' belief in ASC's benefits (increasing social interaction, physical activities, and overall desirability) and ASC's negative outcomes (risky), were not found to be affected by the Boltage treatment. Measures of perceived social acceptance were not found to be affected by Boltage treatment either. These individual-level analysis results are similar to those revealed in the school-level analysis.

Boltage Treatment Affecting Probability of ASC

We analyzed whether the probability of a student walking or biking to school is affected by the Boltage treatment, controlling for many other factors that could affect school travel behavior (e.g., home-school distance, walkability and student characteristics). We also controlled for the fixed effects of schools.
The logistic regression model takes the following functional form:

$$\text{Ln}[P/(1-P)] = a + b\,X + e$$

Where

- P is the probability of a student using ASC, p(ASC=1)
- X includes the following variables: Boltage treatment, travel distance, walkscore for one's residence location, parent education, child's grade, number of children at home, gender (male=1), year, and school (as fixed effect variable)

Table 5.12 displays the logistic regression results. The overall model is statistically significant at the 0.01 level according to the model chi-square statistic. The effect of Boltage treatment on ASC odd ratio is 1.57 ($p<0.01$), suggesting a student who has received Boltage treatment is 1.5 times more likely to use ASC than a similar child who did not receive the Boltage treatment. Other variables exhibiting positive impacts on ASC include parent education, child's grade (as a

proxy for a child's age), child being a male, and number of children at home. These findings are consistent with those reported in other empirical studies.

Table 5.12: Logistic Model: Predicting Probability of ASC (Without Socio-psychological Measures)

Logistic regression				N=		3377
				LR chi2(18) =		1128.97
				Prob > chi2 =		0
Log likelihood = -1565.3345				Pseudo R2 =		0.265
active	Odds Ratio	Std. Err.	z	P>z	[95%	Conf.
boltage	1.57	0.25	2.79	0.01	1.14	2.15
parent_ed	1.06	0.03	2.31	0.02	1.01	1.12
distance	0.19	0.01	-22.37	0.00	0.17	0.22
walkscore	1.00	0.00	1.07	0.28	1.00	1.01
child_grade	1.14	0.03	4.47	0.00	1.08	1.21
num_kids	1.10	0.06	1.79	0.07	0.99	1.23
male	1.24	0.11	2.44	0.02	1.04	1.47
year1						
2012	0.80	0.10	-1.72	0.09	0.62	1.03
2013	0.71	0.09	-2.76	0.01	0.56	0.91
school_id						
437	0.46	0.10	-3.69	0.00	0.31	0.70
1664	0.08	0.02	-8.48	0.00	0.05	0.14
1668	0.25	0.07	-5.29	0.00	0.15	0.42
1669	0.49	0.12	-3.03	0.00	0.30	0.78
1931	0.69	0.16	-1.59	0.11	0.44	1.09
2022	0.56	0.14	-2.36	0.02	0.34	0.91
6253	0.37	0.09	-4.16	0.00	0.24	0.59
6933	0.20	0.04	-7.99	0.00	0.14	0.30
8319	0.28	0.07	-5.48	0.00	0.18	0.44

Consistent with other studies, the distance variable displays the strongest discouraging effects on ASC (OR = 0.19, $p<0.01$). One mile of increase in school travel distance would make a student five times less likely to use ASC. The walkscore variable that indicates the level of environment walkability for a neighborhood around a student's residence did not exhibit statistically significant impacts on ASC. It should be noted that the year variable has a negative coefficient exhibit with statistically significant impacts on ASC probability, suggesting a declining trend of ASC use among the schools after family background characteristics and environment conditions have been controlled for.

When all other factors are held at mean values, having a Boltage treatment increased ASC probability by 7 percent. Since distance is such a strong factor affecting ASC we further

examined the Boltage program's impacts on ASC probability based on school travel distance (see Figure 5.2). Figure 5.2 shows that the impacts of Boltage treatment is higher when the travel distance is shorter than one mile. For students who travel within that distance, receiving Boltage treatment increased ASC probability by 9 percent. It seems that the Boltage program's impacts were the strongest for students who lived around a half-mile distance to school – ASC increased by 10 percent with Boltage treatment. But for those who live farther than 1.5 miles from school, the impacts of Boltage treatment decrease dramatically.

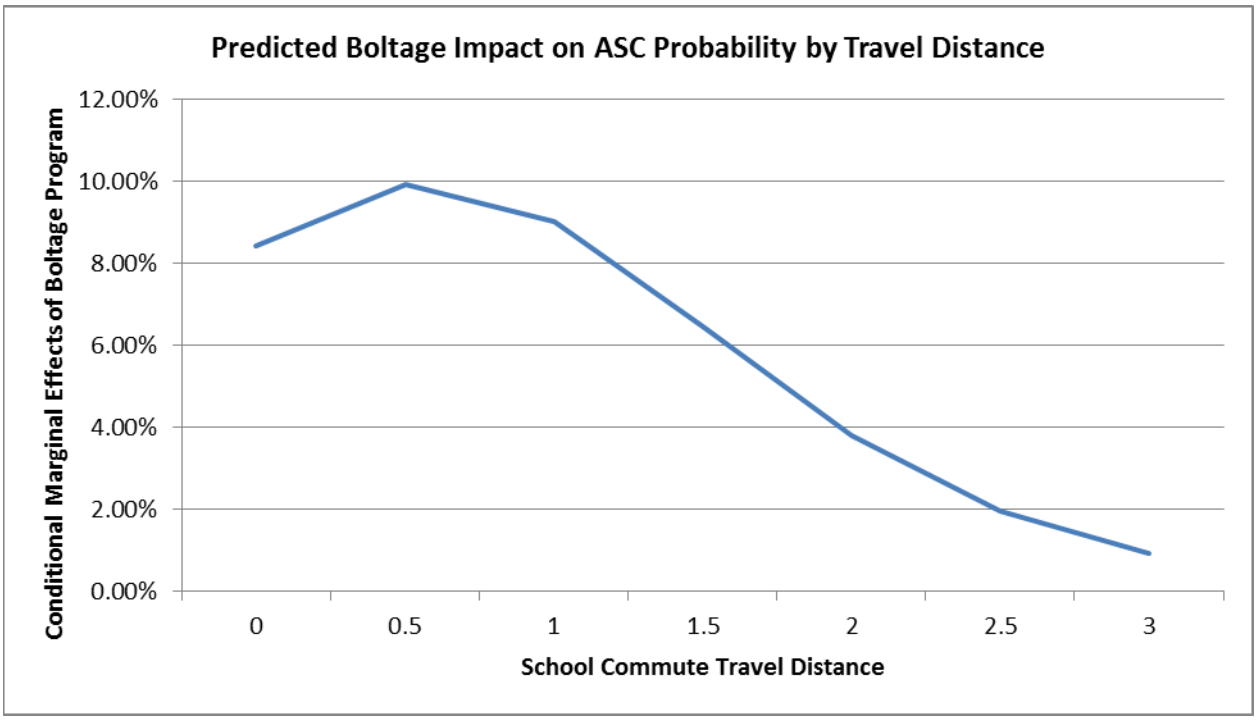


Figure 5.2: Predicted Boltage Program Impact on ASC Probability Conditioned on Travel Distance

We also examined school travel distance's marginal effects on ASC probability depending on the presence of Boltage. The distance's marginal effects are stronger in a Boltage treatment situation (-34 percent) than in no-treatment conditions (-26 percent), suggesting that in the presence of Boltage treatment, a unit (mile) increase of distance could reduce ASC probability by 34 percent, compared with 26 percent in the absence of Botlage treatment. Since earlier findings have indicated that Boltage's impacts are only evident when school travel distance is short (<1.5mile), these new findings mean that reduction in travel distance will have higher impacts on ASC probability when there is Boltage treatment. In other words, parents' adoption of ASC behavior was more sensitive to distance changes in the context of Boltage treatment, which is similar to the results found in Yang et al. (2012) – distance has greater impacts in places where ASC-attitudes are more positive.

Full Regression Model Predicting Probability of ASC

Finally, we include both Boltage treatment and psychological measures in logistic regression models to examine each measure's independent impacts on ASC probability. We also test Boltage's impacts by student age and gender and travel distance by adding interaction terms into the regression model. The full model of logistic regression takes the following functional form:

$$Ln[P/(1-P)] = a + b\,X + cY + dZ + e$$

Where

- P is the probability of student using ASC, p(ASC=1)
- X includes the following variables: Boltage treatment, travel distance, walkscore for one's residence location, parent education, child's grade, number of children at home, gender (male=1), year, school (as fixed effect variable)
- Y includes the following variables: ASC desirability, ASC is risky, friends and family consider ASC a good idea, and proportion of peers use ASC. Inclusion of these variables was based on findings from analysis reported in Table 5.13. These attitudinal and social support measures were also rescaled to balance the value distribution and in light of the findings reported in Table 5.11. Specifically, for the three variables, ASC is risky; friends and family consider ASC a good idea; proportion of peers who use ASC; values of 1 and 2 (strongly disagree and disagree) were combined into category 1 (new value =1); value of 3 (neutral) became the second category (new value = 2); and values of 4 and 5 (agree and strongly agree) were combined into category 3 (new value =3)
- Z includes four interaction variables: Boltage and sex (male=1) interaction, Boltage and age interaction, Boltage and walkscore interaction, and Boltage and distance interaction

Table 5.13 reports the output from the full regression model. The full model is statistically significant at the 0.01 level, according to the model chi-square statistic. Compared to the model reported in Table 5.12, the effect of Boltage treatment on ASC in the full model is stronger – its odd ratio is 8.29 ($p<0.01$), suggesting a student who has received Boltage treatment is eight times more likely to use ASC than a similar child who did not receive the Boltage treatment, when everything else is equal. It is worth noting that the Boltage program's effects are statistically significant and strong in the full model after the attitude and social support measures are controlled for.

The two attitude variables – overall ASC desirability and believing ASC is risky – exhibit statistically significant impacts on the probability of ASC in the anticipated manner. The former is associated with higher ASC probability and the latter with lower ASC probability. Social support measures – perceived family/friend ASC approval and the use of ASC among peers – are both found to increase ASC probability. Parents who reported family/friend ASC approval (i.e., family/friends consider ASC a good idea) were six times more likely to let their child walk or bike to school, compared with those who didn't agree that their family/friend approved of ASC.

In the full model, environment variables show statistically significant impacts on ASC probability. Travel distance remains the strongest discouraging factor, although its strength appears weaker compared to the partial model reported in Table 5.12. A one-mile increase in

distance reduced the likelihood of ASC by about three times, compared to five times from the earlier model (see Table 5.12). Neighborhood walkscore shows positive, albeit marginally significant, impacts on ASC probability, which is an improvement from the earlier model. It is worth noting that none of the variables for the family and student background characteristics registered significant impacts on ASC probability in the full model.

The full model included four interaction variables. The interaction between the Boltage program and distance showed significant and negative impacts on ASC probability, suggesting that in the presence of Boltage treatment, the distance variable displayed even stronger effects on ASC probability. This finding is consistent with what was revealed in analysis reported in Figure 5.3. The interaction variable between Boltage and walkscore also has a negative coefficient (but insignificant), which, in light of the positive coefficient associated with the walkscore variable, suggests that the presence of Boltage treatment reduced the overall walkscore's impacts on ASC probability.

The other interaction variable that has statistically significant impacts on ASC probability is Boltage treatment interacting with a student's grade. The negative coefficient of the interaction variable, together with the positive (but insignificant) coefficient associated with the "grade" variable, suggests that the presence of Boltage reduced the effect of age on ASC probability. Similarly, the presence of Boltage treatment also seems to reduce the effects of gender on ASC probability.

Table 5.13: Logistic Model: Predicting Probability of ASC (Full Model)

Logistic regression — Number of obs = 1896; LR chi2(30) = 891.09; Prob > chi2 = 0.0000; Log likelihood = -725.24206; Pseudo R2 = 0.3806

active	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
boltage	8.292364	6.56685	2.67	0.008	1.756301	39.15236
parent_ed	.9914166	.0359137	-0.24	0.812	.9234676	1.064365
distance	.2991119	.0387914	-9.31	0.000	.2319757	.385678
walkscore	1.010775	.0063531	1.71	0.088	.9983996	1.023304
child_grade	1.050193	.0624799	0.82	0.410	.9346049	1.180077
num_kids	1.116318	.0915139	1.34	0.180	.9506221	1.310895
male	1.249357	.21118	1.32	0.188	.8970303	1.740067
year1						
2012	1.905582	.8097791	1.52	0.129	.8285304	4.382749
2013	1.46047	.7498923	0.74	0.461	.5338696	3.995307
n_desirable						
2	1.247129	.3394993	0.81	0.417	.7314647	2.126324
3	2.441749	.6344477	3.44	0.001	1.467339	4.063231
c_risky						
2	.6693938	.1239008	-2.17	0.030	.4657247	.9621306
3	.3401512	.0615927	-5.96	0.000	.2385289	.4850684
c_gidea						
2	2.940894	.6892894	4.60	0.000	1.857693	4.655697
3	6.705487	1.603859	7.96	0.000	4.195993	10.71583
c_proportion						
2	1.536402	.2681034	2.46	0.014	1.091363	2.162918
3	2.237094	.4188749	4.30	0.000	1.549904	3.228968
school_id						
437	1.166453	.4065973	0.44	0.659	.5890589	2.309806
1664	.323677	.1391661	-2.62	0.009	.1393588	.7517772
1668	1.35475	.7536114	0.55	0.585	.4553637	4.03051
1669	1.958809	.8330197	1.58	0.114	.8511436	4.507973
1931	1.674329	.7929836	1.09	0.276	.6617602	4.236241
2022	1.12127	.4758919	0.27	0.787	.4880244	2.576197
6253	.7362779	.4088125	-0.55	0.581	.2479812	2.186073
6933	1.388845	.6674179	0.68	0.494	.5415064	3.562082
8319	1.2375	.4427479	0.60	0.551	.6137702	2.495082
bolt_male	.887562	.2424109	-0.44	0.662	.5196592	1.515929
bolt_age	.8449212	.0775906	-1.84	0.067	.7057468	1.011541
bolt_walk	.9897956	.0100773	-1.01	0.314	.9702401	1.009745
bolt_dis	.5576728	.1255116	-2.59	0.009	.358761	.8668693

.

5.3 SUMMARY OF FINDINGS

This research project adopts a longitudinal, quasi-experimental design to study the impacts of socio-psychological factors (attitudes and perceived social support) on children's active school travel. The research project involves implementation of an intervention treatment called the Boltage program to investigate whether incentives can change parents' attitudes and social support and, in turn, increase the rates of children's active travel to school. We applied mixed methodology to collect both qualitative and quantitative data, and used multiple analytical methods to develop a fuller understanding of children's travel behavior by using triangulation.

The research findings provide evidence for the effectiveness of the incentive program in improving the rates of ASC. Data collected through the Boltage RFID scanner indicated that participation in Boltage programs was consistent or increasing over the study years, and there were increasing numbers of trips per student recorded in the Boltage programs. Quantitative analysis, at both school and individual levels, showed that the Boltage treatment exhibited statistically significant impacts on the probability of ASC behavior. The Boltage program's independent impacts were significant even after the control of many other factors.

Additional evidence for Boltage treatment's effects can be found in the interviews we conducted with students and school staff. Students, especially at a younger age, expressed excitement for participating in the Boltage programs. Interviews with parents revealed that children's interest in the Boltage program had affected some parents' decisions to let their child to walk or bike to school. In some cases, parents made special arrangements to make ASC possible for their child.

The research project examined two aspects of the psychological conditions theorized to affect ASC use – parents' attitudes (beliefs in the ASC's behavioral outcome) and parents' perceived social norm. Analysis of quantitative data suggests that schools that have received Boltage treatment witnessed some improvements in their parents' ASC attitudes over the study period. The perceived social norm, however, did not appear to have been affected by the implementation of Boltage programs, although parents perceived stronger school support for ASC in light of the Boltage programs.

6.0 CONCLUSION AND DISCUSSION

6.1 LIMITATION OF THE STUDY

Admittedly this research project was confined to a relatively small community, which presents challenges to generalize the findings to a broader context of school travel behavior studies. There was also difficulty in finding comparable experiment-control pairs. The control schools had generally higher ASC rates and attitudes, and the Boltage treatment schools had lower ASC rates and attitudes. While this is a limitation of research design, it did provide an interesting setting for us to see the significance of Boltage treatment's effects because the control schools had received continuous support from the local SRTS program. The declining ASC rates in the control schools may reflect a general secular trend, which makes the fact that the Boltage schools still had increases in ASC rates worth noting.

6.2 THE IMPORTANCE OF ATTITUDES AND SOCIAL SUPPORT

Not only did the research show that Boltage treatment worked, it also generated evidence that partially supports the theory we developed to explain how it should have worked. The research shows that social norm measures were very strong predictors of ASC behavior, more so than the attitude factors. The full model shows that family background characteristics may not have any effects if the social support factor is controlled for. Family and friend's support obviously matters to parents significantly.

Boltage apparently affected some aspects of parents' and students' attitudes effectively. Receiving prizes and triggering beeping sounds apparently made children more excited about walking to school. It seems that the Boltage intervention resulted in a stronger belief by the parents in ASC's benefits in improving social interactions and a higher desirability of ASC.

Boltage treatment also affected some aspects of parents' perceived social support. A school's efforts in implementing the program made parents feel the encouragement from school was evident and strong. But Boltage treatment within a limited number of schools and within such a short period of time did not have the sufficient effects to change parents' perceived social approval. The distance and safety concerns remained the most difficult to overcome.

6.3 STRATEGIES TO MAKE INTERVENTION MORE EFFECTIVE

The research team has close interactions with the four schools and witnessed the challenges in the implementation process and differences in the outcome. We consider three factors to have affected the performance of the Boltage programs in those schools:

1. The suitability of the built environments and the neighborhood contexts for an experimental school,
2. Positive attitudes of students toward walking or biking to school and interest in participating the Boltage program, and
3. The support and resources that a school can devote to program implementation.

Interventions should target students living within a short distance to schools (less than one mile or so) and parents who exhibit favorable attitudes. To motivate students, the focus of the intervention should be placed on the socializing benefits afforded by children walking or biking to school together, and on creating socializing opportunities in the intervention programs. Combining incentive-based intervention with other strategies such as a Walking School Bus has great potential to increase participation and long-term sustainability.

Incentive-based interventions have greater effects on younger children, and the design of an intervention program should focus on helping children and parents identify suitable approaches to active school travel. The excitement that younger kids expressed about the program was obvious, which helps us understand why Boltage treatment may reduce the effects of age on ASC. Younger children were more responsive to the program; parents of younger children may be more inclined to accommodate their child after seeing their children's excitement and school's encouragement.

Besides the initial costs of setting up the program and the need to overcome technical challenges, program implementation requires school commitment, which can be challenging in schools that are understaffed and lack resources. Working with parents and community advocates can be an effective way to overcome some of the barriers.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179-211.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Black, Colin, Alan Collins, and Martin Snell. 2001. Encouraging walking: The case of journey-to-school trips in compact urban areas. *Urban Studies* 38: 1121-1141

Booth, M. L., Chey, T., Wake, M., Norton, K., Hesketh, K., Dollman, J., & Robertson, I. (2003). Change in the prevalence of overweight and obesity among young Australians, 1969–1997. *The American Journal of Clinical Nutrition, 77*(1), 29-36.

Boarnet, Marlon G., Kristen Day, Craig Anderson, Tracy McMillan and Mariela Alfonzo. 2005. California's Safe Routes to School Program: Impact on walking, bicycling, and pedestrian safety. *Journal of American Planning Association* 71: 301-317.

Bureau of Transportation Statistics (2003). *National Household Travel Survey*, NHTS Version 1.0 CD.

Center of Disease Control. *Kids walk to School- A guide to promote walking to school*. Available at http://www.cdc.gov/nccdphp/dnpa/kidswalk/pdf/kiswalk.pdf.

Cole, K., Waldrop, J., D'Auria, J., & Garner, H. (2006). An integrative research review: Effective school-based childhood overweight interventions. Journal for Specialist in Pediatric Nursing, 11(3), 166-177.

Ewing, R. Schroeer, W. and Greene, W; (2004) School location and student travel. *Transportation Research Record*. No. 1895. Pp55-63.

Eyler, A., Baldwin, J., Carnoske, C., Nickelson, J., Troped, P., Steinman, L., Pluto, D., et al. (2008). Parental involvement in active transport to school initiatives: A multi-site case study. American Journal of Health Education, 39(3), 138-147.

Eyler, A., Brownson, R., Doescher, M., Evenson, K., Fesperman, C., Litt, J., et al. (2008). Policies related to active transport to and from school: A multisite case study. Health Education Research, 23(6), 963-975.

Mackett, R. L., Lucas, L., Paskins, J., & Turbin, J. The therapeutic value of children's everyday travel. *Transportation Research Part A: Policy and Practice, 39*(2-3), 205-219. doi: 10.1016/j.tra.2004.09.003

McDonald, Noreen C. 2006. Exploratory analysis of children's travel patterns. *Transportation Research Record* 1997: 1-7.

McDonald, Noreen C. 2007a. Active transportation to school: Trends among U.S. schoolchildren, 1969-2001. *American Journal of Preventive Medicine* 32: 509-516.

McDonald, Noreen C. 2007b. Children's mode choice for the school trip: the role of distance and school location in walking to school. *Transportation* 35: 23-35.

McDonald, Noreen C. 2007c. Travel and the social environment: Evidence from Alameda County, California. *Transportation research part D: Transport and environment* 12: 53-63.

McDonald, N. C. (2010). School Siting -- Contested Visions of the Community School. *Journal of the American Planning Association, 76*(2), 184 - 198.

McDonald, N. R. Steiner, C. Lee, T. Smith, X. Zhu, and Y. Yang. Impact of the Safe Routes to School Program on Walking and Bicycling, *Journal of American Planning Association*. Vol 80, No.2, 2014 pp153-167

McMillan, T. E. (2007). The relative influence of urban form on a child's travel mode to school. *Transportation Research Part A: Policy and Practice, 41*(1), 69-79. doi: 10.1016/j.tra.2006.05.011

Miller-Kahn, L. S., M. (2001). School Choice Policies in the Political Spectacle. *Education Policy Analysis Archives, 9*(50).

McMillan, Tracy E. 2005. Urban form and a child's trip to school: The current literature and a framework for future research. *Journal of Planning Literature* 19:440-456.

National Center for Safe Routes to School, School bicycling and walking policies: Addressing policies that hinder and implementing policies that help. Accessed May 16, 2011 at http://can.org.nz/system/files/barrier_policy_tip_sheet.pdf.

Rodriguez, A., & Vogt, C. A. (2009). Demographic, Environmental, Access, and Attitude Factors That Influence Walking to School by Elementary School-Aged Children. [Article]. *Journal of school health, 79*(6), 255-261. doi: 10.1111/j.1746-1561.2009.00407.x

Rhodes, R., Plotnikoff, R., & Courneya, K. (2008). Predicting the physical activity intention-behavior profiles of adopters and maintainers using three social cognition models. Annals of Behavioral Medicine, 36(3), 244-252.

Renzulli, L. A. a. E., Lorraine. (2005). School Choice, Charter Schools, and White Flight. *Social Problems, 52*(3), 398-418.

Ryan, J. E., Heise, Michael. (2002). The Political Economy of School Choice. *Yale Law Journal, 111*(8), 2043-2136.

Teske, P., Schneider, Mark. (2001). What Research Can Tell Policymakers about School Choice. *Journal of Policy Analysis and Management, 20*(4), 609-631.

Sallis, James F. and Neville Owen. 1999. *Physical activity and behavioral medicine*. Thousand Oaks, CA: Sage

Schlossberg, Marc, Page Paulsen Philips, Bethany Johnson, and Robert M. Parker. 2005. "How do they get there? A spatial analysis of a "sprawl school in Oregon. *Planning Practice and Research*, 20: 147-162.

Sirard, J. R., & Slater, M. E. (2008). Walking and Bicycling to School: A Review. *American Journal of Lifestyle Medicine, 2*(5), 372-396. doi: 10.1177/1559827608320127

Strauss, R. S., & Pollack, H. A. (2001). Epidemic Increase in Childhood Overweight, 1986-1998. *JAMA: The Journal of the American Medical Association, 286*(22), 2845-2848. doi: 10.1001/jama.286.22.2845

US Department of Health and Human Services. 2001. *Health United States, 2001*. U.S. Washington, D.C.: Department of Health and Human Services. p. 1.

Wen, Li Ming, Denise Fry, Chris Rissel, Helen Dirkis, Angela Balafas, and Dafna Merom. 2008. Factors associated with children being driven to school: implications for walk to school programs. *Health Education Research* 23: 325-334.

Wechsler, Howell, Mary L McKenna, Sarah M. Lee, and William H. Dietz, "The role of schools in preventing childhood obesity", National Association of State Board of Education, 2004 summer, available at http://www.cdc.gov/healthyyouth/physicalactivity/pdf/roleofschools_obesity.pdf, accessed on January 17, 2011.

Wilson, E. J., Wilson, Ryan, Krizek, Kevin J. (2007). The implications of school choice on travel behavior and environmental emissions. *Transportation Research Part D: Transport and Environment, 12*, 506–518.

Yang, Y., S. Abbott, and M. Schlossberg. 2012. The influence of school choice policy on active school commuting: A case study of a middle-sized school district in Oregon. *Environment and Planning: A* 44 (8):1856-1874.

Yang, Y., and W. Markowitz. 2012. Integrating parental attitudes in research on children's school travel. *Transportation Research Record: Journal of the Transportation Research Board* (2318):116-127.

APPENDICES

Appendix A: Boltage Registration Form

BOLTAGE REGISTRATION FORM – ADAMS ELEMENTARY SCHOOL

Please fill out one form per family and drop off at the school office. They will give you your Boltage tag(s) and write the number(s) on the form. If you have questions, please contact your Boltage representative, Kim Morley, at 678-362-8071 or kmorley@uoregon.edu.

Parent Name _____

Phone _____ **Email (if available)** _____

Address (used to estimate distance from your home to the school)

_____

Home Address Zip + 4 _____ Zip + 4 is your 5 digit zip code plus an extra 4 digits that gives us a better idea of where you live. Your Zip + 4 can be found at http://zip4.usps.com or on some of your incoming mail.

Distance to School (one way miles) _____ Google Maps (www.google.com) can help you calculate your distance. If you can't access the internet, please put an X at your home on the map.

Student Name (First and Last) _____ **Teacher** _____ **Tag #** _____

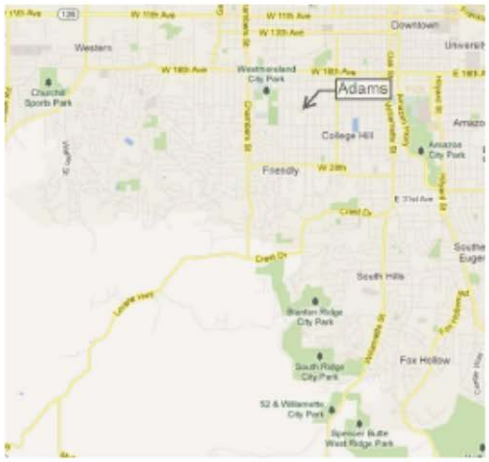
Student Name (First and Last) _____ **Teacher** _____ **Tag #** _____

Student Name (First and Last) _____ **Teacher** _____ **Tag #** _____

By signing and delivering this registration form, you:

- Acknowledge that you have read the KidCommute Terms of Service and Use (the "Terms of Service") and the KidCommute Privacy Policy (the "Privacy Policy"). To obtain a copy of the Terms of Service and Privacy Policy:
  - You can access them on the Boltage website at https://my.boltage.org/bp/Terms_of_Service and https://my.boltage.org/site/bp/Privacy_Policy;
  - Your school also has a printout of these documents that you can view; please contact the school's office or the lead volunteer to find out where you can review these documents; or
  - We will send you a printout of the Terms of Service and the Privacy Policy if you send a request, together with your name and mailing address, to Boltage, 2701 Iris Avenue, Ste. S, Boulder CO 80304, or via email to info@boltage.org.
- Accept and agree to the Terms of Service and the Privacy Policy, and acknowledge that you are entering into a legally binding agreement with Boltage, governed by the Terms of Service and the Privacy Policy.
- Agree and acknowledge that a representative or volunteer for the school will be entering the information you are providing in this form into the Boltage website.

Parent/Guardian Signature _____ **Date** _____



Appendix B. Parent Survey Form

Parent Survey About Walking and Biking to School

School Name:

1. What is the grade of the child who brought home this survey? ☐☐ Grade (K,1,2,3…)

2. Is the child who brought home this survey male or female? ☐ Male ☐ Female

3. How many children do you have in Kindergarten through 8th grade? ☐☐

4. What is the street intersection nearest your home? (Provide the names of two intersecting streets)

_____ **and** _____

5. How far does your child live from school?

☐ Less than ¼ mile ☐ ½ mile up to 1 mile ☐ More than 2 miles
☐ ¼ mile up to ½ mile ☐ 1 mile up to 2 miles ☐ Don't know

6. On most days, how does your child arrive and leave for school? (Select one choice per column, mark box with X)

Arrive at school	Leave from school
☐ Walk	☐ Walk
☐ Bike	☐ Bike
☐ School Bus	☐ School Bus
☐ Family vehicle (only children in your family)	☐ Family vehicle (only children in your family)
☐ Carpool (Children from other families)	☐ Carpool (Children from other families)
☐ Transit (city bus, subway, etc.)	☐ Transit (city bus, subway, etc.)
☐ Other (skateboard, scooter, inline skates, etc.)	☐ Other (skateboard, scooter, inline skates, etc.)

7. How long does it normally take your child to get to/from school? (Select one choice per column, mark box with X)

Travel time to school	Travel time from school
☐ Less than 5 minutes	☐ Less than 5 minutes
☐ 5 – 10 minutes	☐ 5 – 10 minutes
☐ 11 – 20 minutes	☐ 11 – 20 minutes
☐ More than 20 minutes	☐ More than 20 minutes
☐ Don't know / Not sure	☐ Don't know / Not sure

8. Has your child asked you for permission to walk or bike to/from school in the last year? ☐ Yes ☐ No

9. What of the following issues affected your decision to allow, or not allow, your child to walk or bike to/from school? (Select ALL that apply)	**10. Would you probably let your child walk or bike to/from school if this problem were changed or improved?** (Select one choice per line, mark box with X)
	☐ My child already walks or bikes to/from school
☐ Distance	☐ Yes ☐ No ☐ Not Sure
☐ Convenience of driving	☐ Yes ☐ No ☐ Not Sure
☐ Time	☐ Yes ☐ No ☐ Not Sure
☐ Child's before or after-school activities	☐ Yes ☐ No ☐ Not Sure
☐ Speed of traffic along route	☐ Yes ☐ No ☐ Not Sure
☐ Amount of traffic along route	☐ Yes ☐ No ☐ Not Sure
☐ Adults to walk or bike with	☐ Yes ☐ No ☐ Not Sure
☐ Sidewalks or pathways	☐ Yes ☐ No ☐ Not Sure
☐ Safety of intersections and crossings	☐ Yes ☐ No ☐ Not Sure
☐ Crossing guards	☐ Yes ☐ No ☐ Not Sure
☐ Violence or crime	☐ Yes ☐ No ☐ Not Sure
☐ Weather or climate	☐ Yes ☐ No ☐ Not Sure

11. At what grade would you allow your child to walk or bike to/from school without an adult?

(Select a grade between PK,K,1,2,3...) ☐☐ grade **(or)** ☐ I would not feel comfortable at any grade

+ Place a clear 'X' inside box. If you make a mistake, fill the entire box, and then mark the correct box. If a question is not applicable, please leave it blank.

12. In your opinion, how much does your child's school encourage or discourage walking and biking

☐ Strongly Encourages ☐ Encourages ☐ Neither ☐ Discourages ☐ Strongly Discourages

13. How much fun is walking or biking to/from school for your child?

☐ Very Fun ☐ Fun ☐ Neutral ☐ Boring ☐ Very Boring

14. How healthy is walking or biking to/from school for your child?

☐ Very Healthy ☐ Healthy ☐ Neutral ☐ Unhealthy ☐ Very Unhealthy

15. Please estimate the proportion of families that you know of who... (select one choice per column, mark box with X)

Allow their children to walk or bike to school, with or without an accompanying adult	**Drive their children to school**
☐ None	☐ None
☐ Almost None	☐ Almost None
☐ Less than Half	☐ Less than Half
☐ More than Half	☐ More than Half
☐ Almost All	☐ Almost All

+ Place a clear 'X' inside box. If you make a mistake, fill the entire box, and then mark the correct box

16. Walking or biking to school is a good way for my child to get to know the neighborhood and interact with friends (social interaction).

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

17. Allowing my child to walk or bike to school is risky because bad things can happen along the way.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

18. My child walks or bikes to school as often as her friends do.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

19. Walking or biking to school is a good way to increase my child's physical activity.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

20. My family and friends think it is a good idea for me to let my child walk or bike to school.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

21. Compared with other families we know, our family drives...

☐ Less ☐ About the Same ☐ More

22. On balance, children walking or biking to school is...

☐ Mainly Desirable ☐ Mainly Undesirable ☐ About as Much Good as Bad

23. What is the highest grade or year of school you completed?

☐ Grades 1 through 8 (Elementary)	☐ College 1 to 3 years (Some college or technical school)
☐ Grades 9 through 11 (Some high school)	☐ College 4 years or more (College graduate)
☐ Grade 12 or GED (High school graduate)	☐ Prefer not to answer

24. In the space below, please provide your comments

Appendix C. Parent Focus Group Form

Parent Focus Group Instrument
School:
Date:
Time:
# of Parents:
Facilitator"
Good afternoon and welcome to our session. Thanks for taking the time to join us. My name is Kim and assisting me are Angela and Yizhao. We're all with the University of Oregon, and we're working on the Boltage program with four schools in Eugene.

Boltage is an incentive program to encourage walking and biking to school. Children have the opportunity to participate in the program, and can win prizes for walking and biking.

We are here to learn about how you feel about your child walking or biking to school, and understand your opinions about using different transportation methods to get to school. There are no wrong answers but rather differing points of view. Please feel free to share your point of view even if it differs from what others have said.

1. Before we get started, can we just go around the table and have you tell us your name, child's grade and gender.

Grade level:
K: 1st: 2nd: 3rd: 4th: 5th:
6th: 7th: 8th:
Gender : Male Female

2. Next, can you tell us how your children get to school?
bus to school:
driven to school:
w/b to school:

3. How do children in your neighborhood typically get to school?

Attitude Questions

4. In your opinion, what is good and bad about each of the following travel modes: walking/biking, car, bus? After some discussion, ask if parents are aware of w/b to school or other exercise before school affecting kids' school performance.
Walking/biking:

Car:

Bus:

5. What issues or factors do you consider when it comes to letting your child walk/bike, ride the bus, or ride in a car to/from school? (ex. Environment related, family/personal schedule and preference, kids' preference or readiness)

Subjective Norm Questions

6. Can you describe the attitude of your friends, school, and community toward different travel modes to school? Do you perceive your friends, family members, or neighborhood in general to have any reservations toward any of the three modes (w/b, bus, car)?

7. Can you describe your child's preference or attitude toward different travel modes in general, and travel modes to school. How about your child's friends?

Intervention Questions

8. What changes will make you consider changing your child's travel mode to school? (ex. Boltage day, dropping kids off a few blocks from school and letting them walk)

9. What do you think would make your child more interested in walking or biking to school?

10. If more of your child's friends start walking/biking to school, will that make them likely to do it too?

The Boltage program is offering three different individual incentives, medal recognition award, coupons for fun activities, $5 bills, and one end of the year pizza party incentive for the classroom that has the highest participation rate.

11. Do you think the incentives offered by the Boltage program will increase your child's desire to walk or bike?

12. If you child becomes more interested, will you be more likely to allow him or her to do so?

Thank you for taking the time to talk with use about travel modes to and from school. Your input is very useful to us in our research. We will be conducting focus groups again in the spring to see if attitudes or opinions have changed throughout the year. We have a spot for your email address on the sign up sheet; please fill this in so that we can contact you in the spring.

Appendix D. Parent Consent Form for Students' Participation in Focus Group at School

Dear Parent,

Your child is invited to participate in a research study conducted by Yizaho Yang, a faculty member from the Planning, Public Policy, and Management Program at the University of Oregon. I hope to learn how social learning can be used to increase the rates of children walking or biking to school. Your child was selected as a possible participant in this study because he/she attends ____ School.

If your child participates, he/she will participate in an informal classroom discussion focused around their feelings on biking or walking to school. The discussion will last 30 minutes and will only occur once (twice at certain schools). The purpose of the discussion is to understand what motivates children to walk or bike to school. There are no more risks or discomforts than those that are experienced in everyday life. The information will inform the national Safe Routes to Schools program, however, I cannot guarantee that you or your child will personally receive any benefits from this research.

Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission. Your child's identity will be kept confidential in a password-protected computer.

Your child's participation is voluntary. Your decision whether or not to let your child participate will not affect your relationship with [*name of school*] nor will it affect your child's participation in the Boltage program. If you decide to allow your child to participate, you are free to withdraw your consent and discontinue your child's participation at any time without penalty. If you do not want your child to participate please contact the school and accommodations will be made.

If you have any questions, please feel free to contact [*provide name, phone number, and department address. If student, also provide advisor name and phone, and identify as your advisor.*] If you have questions regarding your child's rights as a research subject, contact the **Research Compliance Services**, University of Oregon, Eugene, OR 97403, (541) 346-2510. This Office oversees the review of the research to protect your rights and is not involved with this study.

If you don't wish your student to participate, you can sign below and return this letter to your child's teacher by _____. Otherwise you are considered to give your consent to let your child participate in this activity.

Sign _____

Appendix E. Student Assent Form for Participating in Focus Group

Child Assent for Participation in Research Study (Ages 7-11)

This is a project that Kim and Angela are doing with elementary and middle school students to learn more about what makes children want to walk or bike to school. You can help with this project if you would like to. You do not have to help if you do not want to.

In the project we will talk to you about walking and biking to school. We will ask the class what you like about biking or walking to school. We will also ask you what you do not like about biking or walking. This will happen one or two times during this school year. Each time you are with Kim or Angela or their helpers. The conversation lasts 25 to 30 minute. The things you say will be typed into a laptop computer. Your name will not be typed.

If you decide to help with this project but then change your mind you can stop helping at any time.

If you do not understand what Kim or Angela would like you to do, please ask them questions.

If you want to help with this project, please write your name on the line at the bottom of this page.

Student's Name _____

Student's Signature _____

Witness in lieu of signature: In my judgment, the student understands the information in this consent form and agrees to be in the study.

Witness Signature _____Date _____

Appendix F. Student Focus Group Form

Kid Focus Groups (October, 2012)
Time:
Teacher:
School:
Date:
# of Students:
Grade:
Facilitator:
Good morning and welcome to our session. Thanks for taking the time to join us to talk about the Boltage program and walking or biking to school. My name is Kim Morley and assisting me are Angela San Filippo, Yizhao Yang, and Maddie Phillips. We're all with the University of Oregon. We are here to learn about how you feel about walking or biking to school and the Boltage program. We want to know what you like, what you don't like, and what prizes in the Boltage program might be interesting to you. We are having discussions like this with several groups in your school.

Split into three or four groups

There are no wrong answers but rather differing points of view. Please feel free to share your point of view even if it differs from what others have said.

Well, let's begin. We've placed name cards on the table in front of you to help us remember each other's names. Let's find out some more about each other by going around the table. Tell us your name and where you live, and tell us how far you live from the school, and how do you get to and leave school.

Count: (5 minutes)
bus to school:
driven to school:
w/b to school:
Gender :

Male	Female

Questions about walking or biking to school (15 minutes)

- Do you like to w/b to school – (yes/no question, offer percentage of yes answers)

Yes	No	Sometimes

- Is w/b to school fun? On a scale from 1 to 10, how fun is it?

- Is w/b to school safe?

Yes	No	I don't know

- Does w/b to school save time?

Yes	No	I don't know

- Can you tell me the reasons that why you walk/b to school? (spend some time on this, as we'd like to compare what parents think vs. the children think). List reasons below.

List all reasons for w/b to school:

List all reasons for not w/b to school:

- Do any of your friends w/b to school?

Yes	No	Maybe

<u>Questions about Boltage (5 minutes)</u>

Do you know about Boltage?

Yes	No

Have you registered for Boltage? (note some frequencies)

Yes	No	I don't know

Are you interested in winning prizes for w/b to school?

Yes	No	Maybe/Kind of

What types of prizes? List all prizes mentioned below.

Does having Boltage make w/b to school more fun and more exciting?

Yes	No	Maybe/Kind of/Sometimes

Ending question (5 minutes)

If more of your friends start walking/biking to school, would that make you more likely to do it too?

Yes	No	Maybe

Is there something that would make w/b to school more fun? (List all reasons mentioned below.