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Evaluating the effectiveness of the pedestrian safety intervention program: Behavioral and observational approach

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EVALUATING THE EFFECTIVENESS OF THE PEDESTRIAN SAFETY INTERVENTION PROGRAM: BEHAVIORAL AND OBSERVATIONAL APPROACH

By

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Dedications

I would like to dedicate this work to my parents, my thesis chair professor Mohammad Jalayer, Ph.D., my friends, and all the people who have supported me in my academic career.

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Abstract

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EVALUATING THE EFFECTIVENESS OF THE PEDESTRIAN SAFETY INTERVENTION PROGRAM: BEHAVIORAL AND OBSERVATIONAL APPROACH

2018-2020
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Master of Science in Civil Engineering

Pedestrians are considered the most vulnerable road users. In the United States, according to the National Highway Traffic Safety Administration, there were 6,075 pedestrian fatalities and more than 85,000 pedestrian injuries as a result of traffic crashes in 2017. This study provides national and state pedestrian fatality statistics, a systematic literature review of pedestrian injury severity, as well as observational (video-based) and behavioral (survey-based) evaluation of the Street-Smart NJ pedestrian safety intervention campaign. The Street-Smart NJ program is a public education, awareness, and behavioral change campaign program that aims to improve pedestrian safety by increasing awareness of pedestrian safety risks and improving compliance with pedestrian and motorist laws. To evaluate this program, before and after campaign data was collected, and several statistical analyses were performed. In terms of the behavioral study, significant improvements were found in pedestrian behaviors (i.e., crossing against the signal or outside the crosswalk) and driver behaviors (e.g., drivers not stopping for pedestrians in crosswalk) after the Street-Smart NJ campaign was reported. The observational study also showed significant improvements in pedestrian behaviors (i.e., crossing against the signal or outside the crosswalk) and driver behaviors (e.g., drivers not stopping for pedestrians in crosswalk) in most of the study communities following the Street-Smart NJ campaign.

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Chapter 1

Introduction

1.1 Background

A person walking for any distance as part of their journey is considered a pedestrian (WHO, 2010). According to the Bureau of Transportation Statistics, 35 percent of the U.S. population takes walking trips as part of their daily routine. (BOTS, 2018). Moreover, based on the National Household Travel Survey (NHTS), in 2017, approximately 10.5 percent out of 371 billion annual person trips in the United States were walking trips (NHTS, 2017). In detail, 47.5 percent of walking trips were for recreational and social purposes, 29.5 percent were for shopping and errands, 10.6 percent were for church and school visits, and the remaining 13.4 percent were for other miscellaneous tasks (USDOT, 2018).

Pedestrian deaths on roadways have been continually increasing across the nation, raising concerns among the government and citizens alike. According to the National Highway Traffic Safety Administration (NHTSA) statistics for 2017, 6,075 pedestrians were killed, and more than 85,000 were injured. (NHTSA, 2017). The report also stated that, on average, a pedestrian was killed every two hours and injured every eight minutes in traffic crashes. Figure 1 illustrates the trend of pedestrian fatalities in the United States for the years 2000-2018. Overall, traffic fatality rates have declined over the last two decades, while the proportion of pedestrian fatalities has increased (GHSA, 2018). As a result, pedestrians are more likely than other road users to incur fatal and severe injuries.

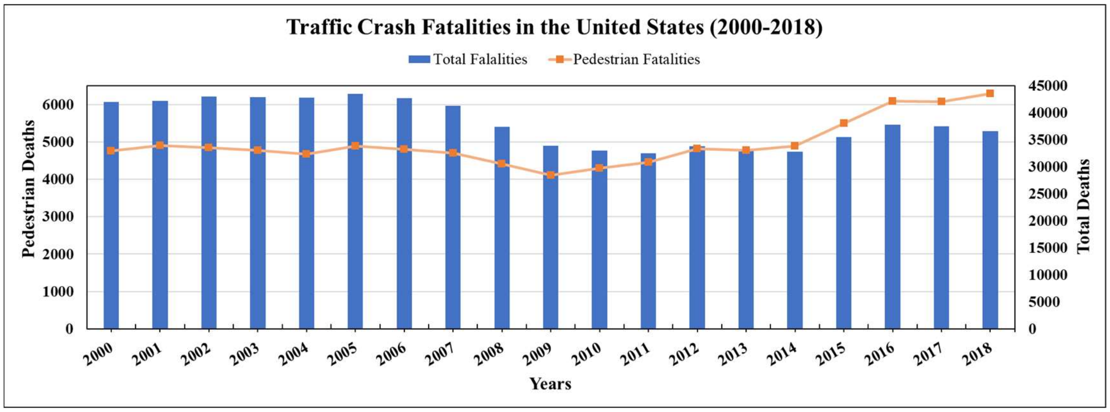

Figure 1. Total crash fatalities in the United States (2000-2018)

Motor vehicle crashes involving pedestrians are also a major roadway safety concern in New Jersey. New Jersey ranks second in the nation for the percentage of pedestrian fatalities among all traffic fatalities, with nearly 30 percent of all fatalities associated with pedestrian crashes (NHTSA, 2017). Figure 2 depicts the trends of pedestrian fatalities in the state of New Jersey (from 2000 to 2018).

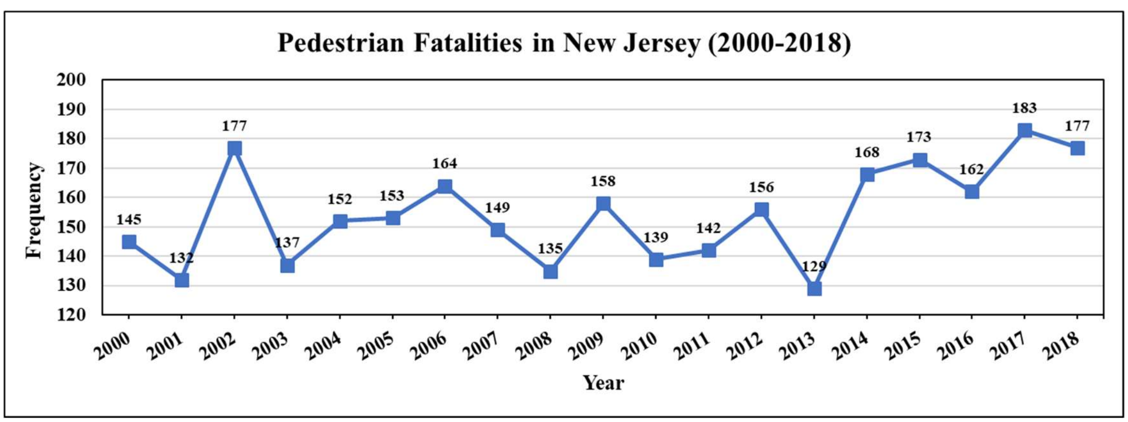

Figure 2. Pedestrian fatalities in New Jersey (2000-2018)

Furthermore, with the increasing usage of automobiles in the upcoming years, pedestrians and other non-motorized road users are expected to become more vulnerable to traffic crashes (Zegeer and Bushell, 2012). Over the past several years, many safety countermeasures have been developed and implemented by state departments of transportation and local agencies across the nation, with the aim of reducing the frequency and severity of pedestrian-related crashes. These countermeasures include implementation of the 4Es (Engineering, Education, Enforcement, and Emergency Response). In response to the high rate of pedestrian fatalities in New Jersey, the Federal Highway Administration (FHWA) designated New Jersey a pedestrian safety focus state. The North Jersey Transportation and Planning Authority (NJTPA) developed and started a Street Smart NJ campaign in 2013. The main goal of the Street Smart NJ public education campaign, as an educational safety program, is to enhance pedestrian safety by increasing awareness of safety risks and improving compliance with pedestrian and motorist laws.

1.2 Research Hypothesis

A Street Smart NJ pedestrian safety campaign can be a useful educational and awareness methodology to improve non-compliance behaviors of pedestrians and drivers at the campaign locations

1.3 Objectives

The primary objective of this study is to evaluate the effectiveness of the pedestrian safety educational campaign in reducing risky behaviors among drivers and pedestrians. To achieve this goal, observational and behavioral studies were conducted to gauge the effectiveness of the program with respect to behavioral changes. A web-based survey was designed and distributed to eight communities (i.e., Asbury Park, Morris Plains, Garfield, Newark, Princeton, Rutherford, Teaneck, and Woodbridge) across New Jersey. Video data also was captured at multiple intersections to record the behaviors of both drivers and pedestrians. Furthermore, several statistical analyses were also performed to identify any statistically significant changes before and after the Street Smart NJ campaign.

1.4 Organization of Dissertation

This study is organized into five chapters, as follows:

Chapter 2 provides a systematic literature review on identifying the contributing factors to pedestrian crashes and appropriate safety countermeasures. A brief discussion describing the novelty of the study, data year, and region specifics, methodology, and the results are provided in this chapter. Further, to better understand the impact of confounding contributing factors on pedestrian injury severity, the study clustered the factors into several groups such as pedestrian characteristics, driver characteristics, vehicle characteristics, environmental and temporal characteristics, and roadway characteristics, among others. This review provides valuable information for practitioners and researchers to understand the factors impacting pedestrian injuries.

Chapter 3 reports the outcomes of the conducted observational study in eight New Jersey communities (i.e., Asbury Park, Morris Plains, Garfield, Newark, Princeton, Rutherford, Teaneck, and Woodbridge) to gauge the effectiveness of the Street Smart NJ pedestrian safety campaign by comparing the rates of non-compliant pedestrian and driver behaviors before and after the campaign. The studied non-compliant behaviors include unsafe crossing and crossing against a signal, failing to stop before turning at a red light or stop sign, failing to stop for pedestrians when turning, and running the red-light signal or stop sign.

Chapter 4 discusses the results of pre- and post-campaign surveys, which were conducted in seven New Jersey communities (i.e., Asbury Park, Garfield, Morris Plains, Newark, Princeton, Rutherford, and Woodbridge). The survey evaluates the success of the campaign in changing behaviors among both pedestrians and drivers, how the campaign has shaped public awareness and attitudes about pedestrian safety, and which campaign activities are most effective. The effectiveness of the campaign was explored by comparing the pre- and post-campaign data collected by various methods, including in-person flyer distribution, direct mail advertisements, social media advertisements, and intercept surveys using tablet devices in 2018-2019.

Chapter 5 summarizes the findings of the observation and behavioral studies conducted for gauging the effectiveness of the Street Smart NJ campaign. Furthermore, this chapter acknowledges limitations and makes recommendations for future study.

Chapter 2

Pedestrian Injury Severity: A Review of Literature on Contributing Factors and Safety Countermeasures

2.1 Introduction

Motor vehicle crashes involving pedestrians are a major roadway safety concern in the United States and across the globe. While overall traffic fatality rates have declined over the last two decades, the proportion of pedestrian crashes has substantially increased over the past few years (IIHS, 2018). According to the Governors Highway Safety Association (GHSA), 6,227 pedestrian fatalities occurred in the United States in 2018. Compared to 2017, a four percent increase in pedestrian deaths was reported in the United States (GHSA, 2018). Over the past years, numerous studies have been conducted to identify the factors associated with pedestrian crashes and develop safety countermeasures.

Zajac and Ivan (2003) analyzed the effect of area type and roadway conditions on the injury severity of pedestrian crashes. Ordered probit model analysis was performed on the pedestrian crash data from Connecticut for the years 1989 to 1998. The results indicated that older pedestrians (64 years of age and older), pedestrians under the influence of alcohol, drivers under the influence of alcohol, road width, and vehicle type significantly impacted the pedestrian injury severity. Lee and Abdel-Aty (2005) examined the vehicle-pedestrian crashes occurring at intersections in Florida for the years 1999-2002, using an ordered probit model. The results of this study indicated several factors that contributed to the injury severity of pedestrians, including older pedestrians,

pedestrians under the influence of alcohol, adverse weather, dark lighting conditions, and large vehicles.

Siddiqui et al. (2006) examined the impact of light conditions and crossing locations, along with other variables, on the severity of pedestrian injuries in Florida. The study showed that pedestrian crashes at midblock locations during dark light conditions without streetlights increases the odds of fatal injuries. Additionally, the study also determined that the odds of fatal injuries to elderly pedestrians (64 years and above) is 68 percent higher than other age groups, 60 percent higher when struck by a driver driving under the influence of alcohol, 40 percent higher for pedestrians under the influence of alcohol than sober pedestrians, and 42 percent higher for foggy weather when keeping other factors constant. Eluru et al. (2008) conducted an injury severity analysis of pedestrian crashes using a mixed generalized ordered response logit model. The findings suggested that older-aged pedestrians, the higher speed limit (greater than 50 mph) on the roadway, intersections without traffic signals, and dark condition (12:00 a.m. – 6:00 a.m.) significantly contributed to the injury severity levels.

Taking advantage of the mixed logit model, Kim et al. (2010) analyzed pedestrian injury severity using the police-reported crash data from North Carolina for the years 1997 to 2000. The results indicated that increasing pedestrian age, vehicle size, roadway speed, and driving under the influence of alcohol increase the probability of fatal injuries in pedestrians. Maybury et al. (2010) analyzed five years (2002-2006) of motor vehicle crashes across the U.S. involving pedestrians from the National Trauma Data Bank. Multivariable logistic regression was used to determine the effects of various factors influencing pedestrian injury severity. The results demonstrated that such factors as race played a role (i.e., African Americans and Hispanics had higher odds of mortality compared to other race categories). Moudon et al. (2011) used pedestrian-motor-vehicles collision data (2000-2004) for the city streets and state routes in Kings County, Washington, to evaluate pedestrian injury severity. Binary logistic regression was performed to predict the risk of pedestrian fatal and severe injuries. Younger (5 years or fewer) and older-aged (more than 65 years) pedestrians, the involvement of more than two pedestrians in the crash, vehicle moving in straight direction, and driver under the influence of alcohol were the significant factors contributing to the pedestrian injury severity.

Rifaat et al. (2011) assessed the effect of street patterns on the severity of pedestrian-related crashes. A multinomial logit model was developed using three years (2003-2005) of pedestrian crashes in the city of Calgary, Canada. The study showed that the modern loops and lollipops designs increase injury severity among vulnerable road users, including pedestrians. Tarko and Azam (2011) performed an ordered probit model analysis of factors influencing pedestrian injury severity by linking crash data and medical records. According to this study, factors such as male pedestrians, older pedestrians, rural roads, and mid-block crossing increase the likelihood of severe crashes. Jang et al. (2013) examined the severity of pedestrian-involved crashes in the city of San Francisco using an ordered probit model. The finding of this study demonstrated that young and elderly pedestrians, consumption of alcohol by pedestrian and drivers, using a cell phone while crossing, large vehicles (pickups, trucks, and buses), nighttime conditions, rainy weather conditions, and weekends were the noteworthy factors increasing the severity of pedestrian injuries.

Mohammed et al. (2013) conducted a pedestrian injury severity analysis using two datasets (Montreal City, Canada, from 2003 to 2006, and New York City, from 2002 to 2006). The authors used ordered probit and multinomial logit models to conduct the analysis. The results of the study demonstrated that dark lighting conditions, arterials, prevalence of mixed land use, and heavy vehicles increase the chance of fatal injuries. Tefft (2013) predicted severe injuries and fatalities for pedestrian-vehicle crashes using a multivariant logit regression. It should be noted that the authors added the weights to the crash data to minimize the oversampling of the killed or severely injured pedestrians. With respect to impact speed, findings showed that the risk of severe or fatal injury is lower at low speed (i.e., below 20 mph), and increases with the increase in speed. Furthermore, older pedestrians have a higher risk of injury severity compared to young (below15 years of age) pedestrians. Islan and Jones (2014) examined the injury severity of crashes in which pedestrians were at fault. A mixed logit model was performed on the police reported crash database (2006-2010) for the state of Alabama. The results show that pedestrians below 12 years of age, two-lane roadways, and dark lighting conditions were the significant factors that contributed to the severity of pedestrian injuries for both rural and urban locations. Das and Sun (2015) used the multiple correspondence analysis method to determine the significant contributing factors and their relationship with respect to pedestrian injury severity, using eight years (2004-2011) of vehicle-pedestrian crashes in Louisiana. According to the results, pedestrian deaths were most likely to occur on two-lane roadways and at night with no lighting.

Haleem et al. (2015) used three years (2008-2010) of pedestrian crash data from the state of Florida to identify the significant factors affecting the pedestrian crash injury severity considering intersection traffic control (signalized and unsignalized intersections). Using a mixed logit model, the authors confirmed that middle-aged and elderly pedestrians, vehicle type (i.e., vans), dark lighting conditions, a pedestrian walking along the roadway, and a high speed limit significantly contributed to the pedestrian injury severity at unsignalized intersections. With respect to signalized intersections, rainy weather, elderly pedestrians, high annual average daily traffic, high speed limit, dark lighting conditions, and a high percentage of trucks were associated with more severe crashes. Khattak and Tung (2015) investigated the impact of several factors on the severity of pedestrian injuries reported in highway-rail grade crossings between 2007 and 2010. Ordered probit analysis predicted variables that affect the severity of pedestrian injuries, including female pedestrians, adverse weather conditions, and no flashing light signals.

Pour-Rouholamin and Zhou (2016) examined the confounding factors that influence the injury severity of pedestrians in single-pedestrian and single-vehicle crashes. The study conducted ordered-response models using four years (2010-2013) of pedestrian crash data from the state of Illinois. According to the results, factors such as older pedestrian, adult drivers, pedestrians not wearing color-contrasting clothes, nighttime conditions, drivers under the influence of alcohol, multilane highways, divided highways, and heavy vehicles are associated with the probability of severe injuries. Guo et al. (2017) assessed the effect of neighborhood environment and demographics on pedestrian injury severity. A mixed-effects logistic model was developed to examine the crashes, from 2011 to 2014, involving pedestrians in Florida. Findings of the study showed that low-income areas have more unsafe behaviors, resulting in increased pedestrian injury severity. Additionally, factors that increased the probability of sustaining severe injuries were as follows: older pedestrians by 0.09, intersections with no light by 0.17, distracted drivers by 0.13, at pedestrian crossings by 0.11, pedestrians under the influence of alcohol by 0.69, no traffic light by 0.07.

Uddin and Ahmed (2018) examined the contributing factors affecting the pedestrian injury severity in Ohio. Fixed and random parameter ordered probit models were performed on the Highway Safety Information System (HSIS) database from 2009 to 2013. Outcomes of the study stated that older pedestrians (65 years and above), young drivers (below 24 years of age), vehicle type (i.e., trucks), dark-unlighted roadways, speed limit above 40 mph, six-lane roadways, and drivers under the influence of alcohol increased the severity of pedestrian injuries. In another study, Chen and Fan (2019) developed a multinomial logit model to explore and classify the important contributing factors associated with pedestrian-vehicle crash injury severity. The study used the North Carolina crash data (between 2005 and 2012) obtained from the HSIS database. The finding of the marginal effect demonstrated significant factors that increased the likelihood of fatal injuries for middle-aged and older pedestrians by 0.06 and 0.22, during the weekend by 0.02, for vehicle type (i.e., heavy trucks) by 0.22, at curve roadway sections by 0.03, higher speed limit by 0.12, during the dark- lighting conditions by 0.09 and during dusk and dawn lighting conditions by 0.10. Liu et al. (2019) introduced an integrated spatiotemporal modeling tactic to separate the pedestrian injury severity from other motor vehicle crashes. A geographically- and temporally-weighted ordinal logistic regression was performed on pedestrian-motor vehicle crash data (2007-2014) in North Carolina. The results showed that an increase in the injury severity of pedestrians was significantly influenced by factors including pedestrians under the influence of alcohol, pedestrian's age, driver's age (teenagers 20-year-old or younger and adults between 20 to 30 years age), driver's gender, the involvement of alcohol in drivers, no streetlights, vehicle type (SUV, bus or truck), and time of crashes.

Mokhtarimousavi (2019) analyzed pedestrian-involved crashes in California using five years (2010 to 2014) of crashes. To estimate the factors significantly impacting the pedestrian injury severity during the daytime and nighttime conditions, a support vector machine (SVM) and multinomial logit (MNL) estimation was used and compared. For the daytime condition, parked vehicles have 0.073 lower probability for fatal injuries, dusk-dawn weather conditions increased the injury severity by 0.053, rural freeways showed 0.110 higher probability of causing fatal injury, and drivers under the influence of alcohol during dark with no street light condition significantly increased the property damage only crashes (PDO). While for the nighttime condition, rainy weather decreases the probability of severe injuries by 0.352, head-on collision estimated a decrease in chances of fatal crash by 0.132, and pedestrian crossing a crosswalk at an intersection showed an increase in injury severity by 0.064. Sun et al. (2019) used 10 years (2006-2015) of the Louisiana Department of Transportation and Development (LADOTD) highway crash data to identify the main factors in pedestrian crash severity. This study segmentized the pedestrian crashes with the Latent Class Clusters (LLC) model and then used the multinomial logit (MNL) models to determine the contributing factors. Results of this study showed that older pedestrians, alcohol and drug involvement in pedestrians, adverse weather conditions, winter season, the timing between 6 p.m. and midnight, the involvement of high speed, rural area, dark-lighted condition, dark-unlighted condition, and non-intersection location significantly increase the likelihood of pedestrian injury severity.

2.2 Discussion and Summary of Prior Works

To better understand factors influencing pedestrian injury severity, this section summarizes the outcomes of the selected studies by clustering the significant factors observed. Table 1. shows the list of the papers and the characteristics that showed a significant impact on pedestrian injury severity. It should be noted that the significance results of all the characteristics are highly influenced by raw data and the analysis method performed, depending on the scope of their work.

Table 1

Studies identifying significant factors contributing to pedestrian injury severity

Studies	Year	Pedestrian Characteristics	Driver Characteristics	Vehicle Characteristics	Temporal and Environmental Characteristics	Roadway Characteristics
Zajac and Ivan	2003	X	X	-	-	-
Lee and Abdel-Aty	2005	X	-	-	X	-
Siddiqui et al.	2006	X	X	-	X	-
Eluru et al.	2008	X	-	-	X	X
Kim et al.	2008	X	X	X	X	-
Kim et al.	2010	X	X	X	-	-
Maybury et al.	2010	X	-	-	-	-
Kwigizile et al.	2011	-	-	-	X	-
Moudon et al.	2011	X	X	X	-	-
Tarko and Azam	2011	X	-	-	-	X
Zahabi et al.	2011	-	X	X	-	-
Dai	2012	X	-	-	X	-
Abdul Aziz et al.	2013	-	-	-	X	-
Jang et al.	2013	X	X	X	X	-
Mohamed et al.	2013	-	-	X	X	X
Tefft	2013	X	-	-	-	X
Islam and Jones	2014	-	-	-	-	X
Yasmin et al.	2014	-	-	-	X	-
Das and sun	2015	-	-	-	X	X
Haleem et al.	2015	X	-	X	X	X
Khattak and Tung	2015	-	-	-	X	-
Pour-Rouholamin and Zhou	2016	X	X	X	X	-
Guo et al.	2017	X	X	-	-	X
Salon and McLntyre	2018	-	X	-	-	-
Uddin and Ahmed	2018	X	X	X	-	X
Chen and Fan	2019	X	-	X	X	X
Liu et al.	2019	X	X	X	-	-
Mokhtarimousavi	2019	-	X	X	X	-
Sun et al.	2019	X	-	X	X	-

(Note: "X" denotes the significant factors identified by each study with respect to their objective and raw data set)

2.2.1 Pedestrian characteristics. Factors such as pedestrian age, gender, and the influence of alcohol are the factors significantly contributing to pedestrian injury severity. Older pedestrians (over age 65 years) increase the probability of fatal or severe injuries in motor vehicle crashes involving pedestrians (Haleem et al., 2015; Pour-Rouholamin and Zhou, 2016; Tefft, 2013; Tarko and Azam, 2011; Moudon et al., 2011; Jang et al., 2013; Sun et al., 2019; Chen and Fan, 2019; Uddin and Ahmed, 2018; Eluru et al., 2018; Siddiqui et al., 2006; Lee and Abdel-Aty, 2005; Zajac and Ivan, 2003; Kim et al., 2010; Kim et al., 2008; Guo et al.). Numerous studies (Jang et al., 2013; Sun et al., 2019; Siddiqui et al., 2006; Lee and Abdel-Aty, 2005; Liu et al., 2019; Zajac and Ivan, 2003) have stated that the likelihood of injury severity increases for the pedestrian under the influence of alcohol or drugs. Furthermore, some studies (Tarko and Azam, 2011; Khttak and Tung, 2015) have identified gender as a significant factor in pedestrian injury severity.

2.2.2 Driver characteristics. Factors such as driver's age, driver's gender, driver's disability, and driving under the influence of alcohol were the significant factors associated with the pedestrian crashes. Several studies (Pour-Rouholamin and Zhou, 2016; Moudon et al., 2011; Jang et al., 2013; Mokhtarimousavi, 2019; Liu et al., 2019; Sun et al., 2019; Uddin and Ahmed, 2018; Salon and Mclntyre, 2018; Kim et al., 2008; Siddiqui et al., 2006; Kim et al., 2010; Kwingzile et al., 2011; Zajac and Ivan, 2003; Guo et al., 2017) have indicated that the drivers' consumption of alcohol has a significant impact on the injury severity level of pedestrians. A study conducted by Siddiqui et al. (2006) reported that crashes in which drivers have physical disabilities significantly impact pedestrian injury severity. This may be due to longer reaction time requirements

(Siddiqui et al., 2006). Pour-Rouholamin and Zhou (2016) investigated the effect of drivers' age on pedestrian injury severity. The results showed that adult drivers (younger than 24 years) resulted in severe injuries to pedestrians, and older drivers (65 years old and above) are prone to causing in no/possible injuries. This finding is also consistent with the studies of Uddin and Ahmed (2018) and Kim et al. (2008).

2.2.3 Vehicle characteristics. The type of vehicle was identified as a significant contributing factor in pedestrian injury severity. A number of studies (Haleem et al.,2015; Jang et al., 2013; Mokhtarimousavi 2019; Pour-Rouholamin and Zhou, 2016; Liu et al., 2019; Chen and Fan, 2019; Mohammed et al., 2013; Uddin and Ahmed, 2018; Kim et al., 2010; and Kim et al., 2008) depicted that pedestrians struck by trucks or buses have a higher probability of fatal and severe injury. In terms of the vehicle movement, several studies showed that a vehicle going in a straight direction has a significant influence on the injury severity of pedestrians during the crash (Zahabi et al., 2011; Moudon et al., 2011; Jang et al., 2013).

2.2.4 Temporal or environmental characteristics. Factors like seasons, weekdays or weekends, lighting conditions, weather conditions, and time of day were determined as significant factors involved in pedestrian crashes. In terms of weather, the majority of studies stated that adverse weather condition increases the severity level of pedestrian injuries (Mokhtarimousavi, 2019; Haleem et al., 2015; Jang et al., 2013; Yasmin et al., 2014; Khattak and Tung, 2015; Sun et al., 2019; Siddiqui et al., 2006; Lee and Abdel-Aty, 2005). Similarly, various studies also stated that dark lighting conditions increase the likelihood of fatal or severe pedestrian injuries (Haleem et al., 2015; Mohammed et al., 2013; Zahabi et al. 2011; Islam and Jones, 2014; Jang et al., 2013; Sun et al., 2019; Chen and Fan, 2019; Kim et al., 2008; Siddiqui et al., 2006; Lee and Abdel-Aty, 2005). Further, in terms of the season, a study conducted by Sun et al. (2019) reported that the likelihood of having fatal and severe injuries during the winter is higher compared to the rest of the year. Similarly, another study reported that during the spring season, there are fewer chances of higher injury severity for pedestrians (Yasmin et al., 2014). Per the weekdays and weekends as a significant contributing factor, the results of several studies (Eulur et al., 2008; Jang et al., 2013; Chen and Fan, 2019; Kwigizile et al., 2011) showed that on weekends, the probability of fatal injury increases compared to weekdays. With respect to the time of day, which is generally categorized as daytime (6:00 a.m. to 6:00 p.m.), evening (6 p.m. to 12:00 a.m.), and nighttime (12:00 a.m. to 6:00 a.m.), the results showed that nighttime conditions significantly increased the pedestrian injury severity (Eluru et al., 2008; Jang et al., 2013; Das and Sun, 2015; Kim et al., 2008; Aziz et al., 2013; Pour-Rouholamin and Zhou 2016).

2.2.5 Roadway characteristics. In terms of the roadway characteristics, several attributes, such as posted speed limit, roadway type, roadway functional class, surface condition, and road width were observed as significant factors contributing to pedestrian crashes. The results showed that road segments with a higher speed limit increased the probability of pedestrian injury severity level (Haleem et al., 2015; Tefft, 2013; Chen and Fan, 2019; Uddin and Ahmed, 2018; Eluru et al., 2008; Guo et al., 2017).

It should be noted that, in addition to the above-categorized factors, there are several other factors, such as traffic volume, land use mixtures, street patterns, traffic control devices, visibility, pedestrian location, and crash type that significantly impact pedestrian injury severity.

An extensive literature review was also carried out to explore the studies that evaluated the factors affecting pedestrian behaviors and evaluating pedestrian safety programs. Zhao et al. (2019) explored the pedestrian crossing behavior at an un-signalized crosswalk, considering gap size, crossing distance, platoon size, waiting time, traffic volume, and position of pedestrians. The results showed that gap size and crossing distance profoundly influenced pedestrian crossing behavior. Oxley et al. (2005) examined the relationship between the age of pedestrians and the risk of their crossing decisions. Pedestrians aged 75 years and older made more made dangerous crossing decisions than the other age groups.

Several other studies have also focused on countermeasure development to mitigate risky behaviors. Although several engineering countermeasures (e.g., traffic signs, traffic signal controls, pavement markings, and roadway geometry) can be employed to enhance pedestrian safety, the behavior of pedestrians and drivers plays a vital role in mitigating crash risk (Lin et al., 2019; Shi et al., 2019; Chen and Fan, 2019; Kang 2019). Educational programs and public outreach efforts provide an opportunity for motorists and pedestrians to address observed or documented high-risk behaviors, such as speeding and improper crossing. Zhang et al. (2013) explored the effectiveness of a university-based pedestrian safety education program, called "USF Bull Walk and Bike campaign," by surveying pedestrians, drivers, and bicyclists. The outcome showed that drivers' yielding behavior increased from 6.6 to 12.8 percent following this program. In another study, Twisk et al. (2014) highlighted the effectiveness of a road safety education (RSE) program based on self-reported behavior of young teenagers. The results demonstrated that the RSE program could reduce risky behaviors by up to 20 percent.

Another study by Hoye and Laureshyn (2019) investigated the effect of the "SeeMe campaign" on pedestrian and motorist behavior in Norway. The results revealed a 14 percent increase in the motorist yielding behavior at pedestrian crossings.

2.3 Conclusion

Contributing factors influencing the pedestrian injuries severity have been explored with a systematic literature review that focuses only on the 21^{st} - century publications that used raw data from the regions of the United States and Canada. The results of this study draw attention to the majorities of factors that significantly impacted the severity level of pedestrian injuries. Factors such as pedestrian age, pedestrian under the influence of alcohol, a driver under the influence of alcohol, type of vehicle, weather conditions, lighting conditions, and roadway speed limit all affected pedestrian injury severity. Additionally, several studies have recommended implementing the 4Es of safety (Engineering, Enforcement, Education, and Emergency response) to reduce the severity of pedestrian injuries.

Additionally, the literature review also shows that providing education, outreach campaigns, and training are all essential strategies in increasing motorist and pedestrian awareness and behavior. To be specific, programs on speeding awareness, such as "Click it or Ticket" and "Drive Sober or Get Pulled Over" were remarkably effective in changing driver behaviors (NHTSA, 2019). However numerous bicycle and pedestrian safety campaigns that have been conducted in New Mexico, Florida, Maine, Massachusetts, Washington State, and Illinois have not been evaluated thoroughly. This study tries to address and provide a method for evaluating pedestrian safety campaigns, focusing on education and enforcement countermeasures.

Chapter 3

Evaluating the Effectiveness of Street Smart Safety Campaign: Observational Pedestrian Safety Analysis

3.1 Introduction

Motor vehicle crashes involving pedestrians are a major roadway safety concern across the United States. While the overall traffic fatality rates have declined over the last two decades, the proportion of pedestrian fatalities has increased, resulting in pedestrians remaining the most vulnerable roadway users (GHSA, 2019). As a result, the Federal Highway Administration (FHWA) designated New Jersey a pedestrian focus state and Newark a pedestrian safety focus city. In response, the North Jersey Transportation Planning Authority (NJTPA) collaborated with public, private, and non-profit partners in 2013 to form a "Street Smart NJ" program that was piloted in five communities. The Street Smart NJ program is a public education, awareness, and behavioral change campaign program that was built on initial successes and expanded to more than 140 municipalities throughout the state with the help of a growing network of partners, including NJ TRANSIT, New Jersey Division of Highway Traffic Safety, and the Transportation Management Associations (NJTPA, 2019). The ultimate goal of this program is to improve pedestrian safety by increasing awareness of pedestrian safety risks and improving compliance with pedestrian and motorist laws. It should be noted that the NJTPA also periodically evaluates the effectiveness of the Street Smart NJ campaign to analyze the behavioral change and awareness of pedestrian safety law intended by the campaign. By using messages such as "Obey the Speed Limit," "Stop for

Pedestrians," "Use Crosswalk," "Heads Up, Phones Down," and "Wait for the Walk," the campaign uses public outreach to educate motorists and pedestrians on the importance of obeying traffic rules. The safety campaign promotes educational materials through paid advertising, earned media, signage, and social media.

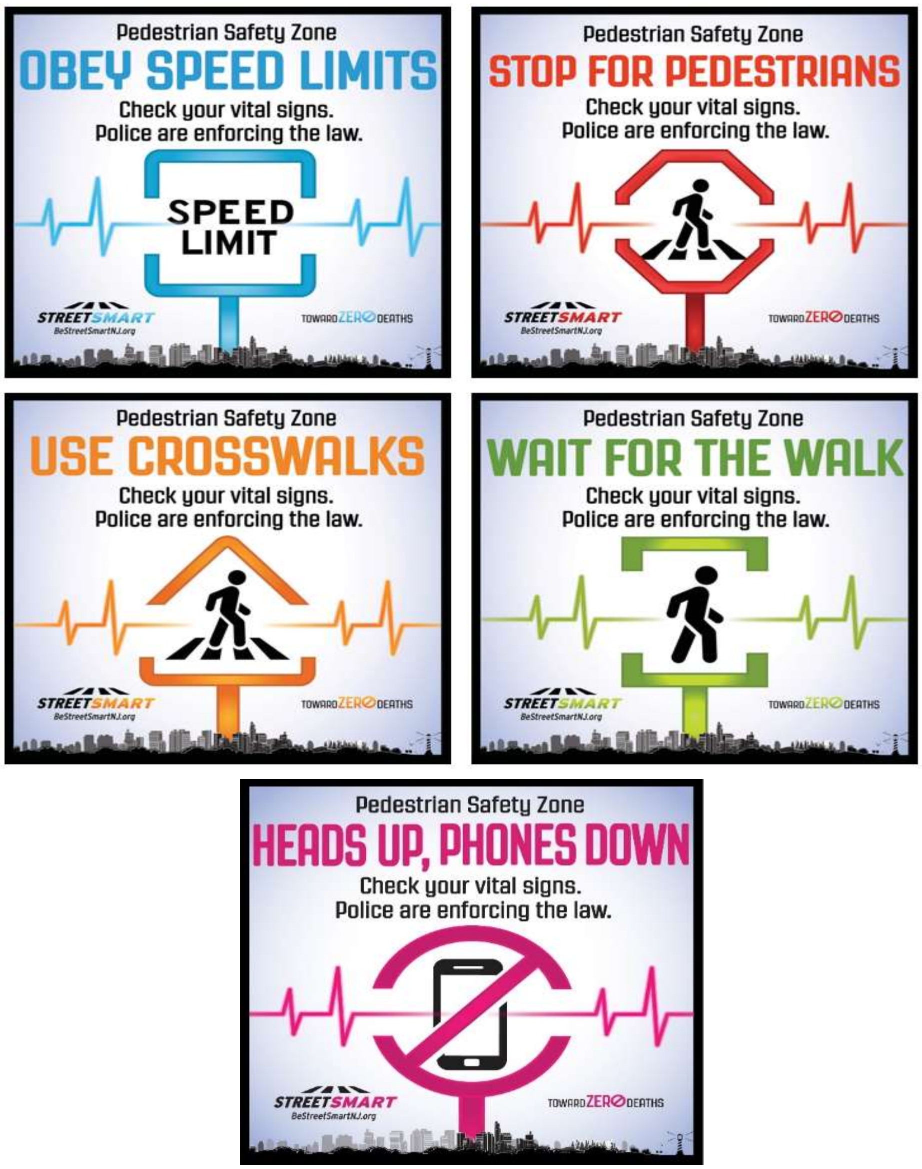

Figure 3. Graphical Messages Used in the Street Smart NJ Campaign to Change Driver and Pedestrian Behaviors. (NJTPA, 2019)

This chapter provides the results of an observational study to compare the rates of unsafe pedestrian and driver behaviors before and after the NJTPA pedestrian safety education and enforcement campaign, called "Street Smart NJ," in several communities across the state of New Jersey. The behaviors, including unsafe crossing and crossing against a signal, failing to stop for pedestrians when turning, failing to stop before turning at a red light or stop sign, and running the red light or stop sign were compared and measured in eight communities in 2018-2019.

3.2 Method and Data

3.2.1 Site selection. The goal of selecting sites for the Street Smart NJ campaign and observational study was to identify locations that could benefit from an improvement in driver and pedestrian behavior and may exhibit measurable changes as a result of the campaign. Historical crash data is one of the key criteria for site selection, since locations with a high number of previous crashes are likely to continue to have the highest number of future pedestrian crashes, in the absence of intervention. Additional considerations for site selection may include different community types (e.g., urban and suburban) and diverse geographic coverage of the region. It was also essential for locations to have large enough traffic and pedestrian flow in order to provide sufficient data for comparison, and the communities had to express an interest in participating in the Street Smart NJ campaign. Notably, the state's eight Transportation Management Associations (TMA's) are critical partners in selecting and leading local campaigns. In this study, eight geographically and demographically diverse communities in northern, central, and southern New Jersey were selected for further analysis. These campaign communities include Teaneck, Asbury

Park, Garfield, Morris Plains, Newark, Princeton, Rutherford, and Woodbridge as shown in Figure 5.

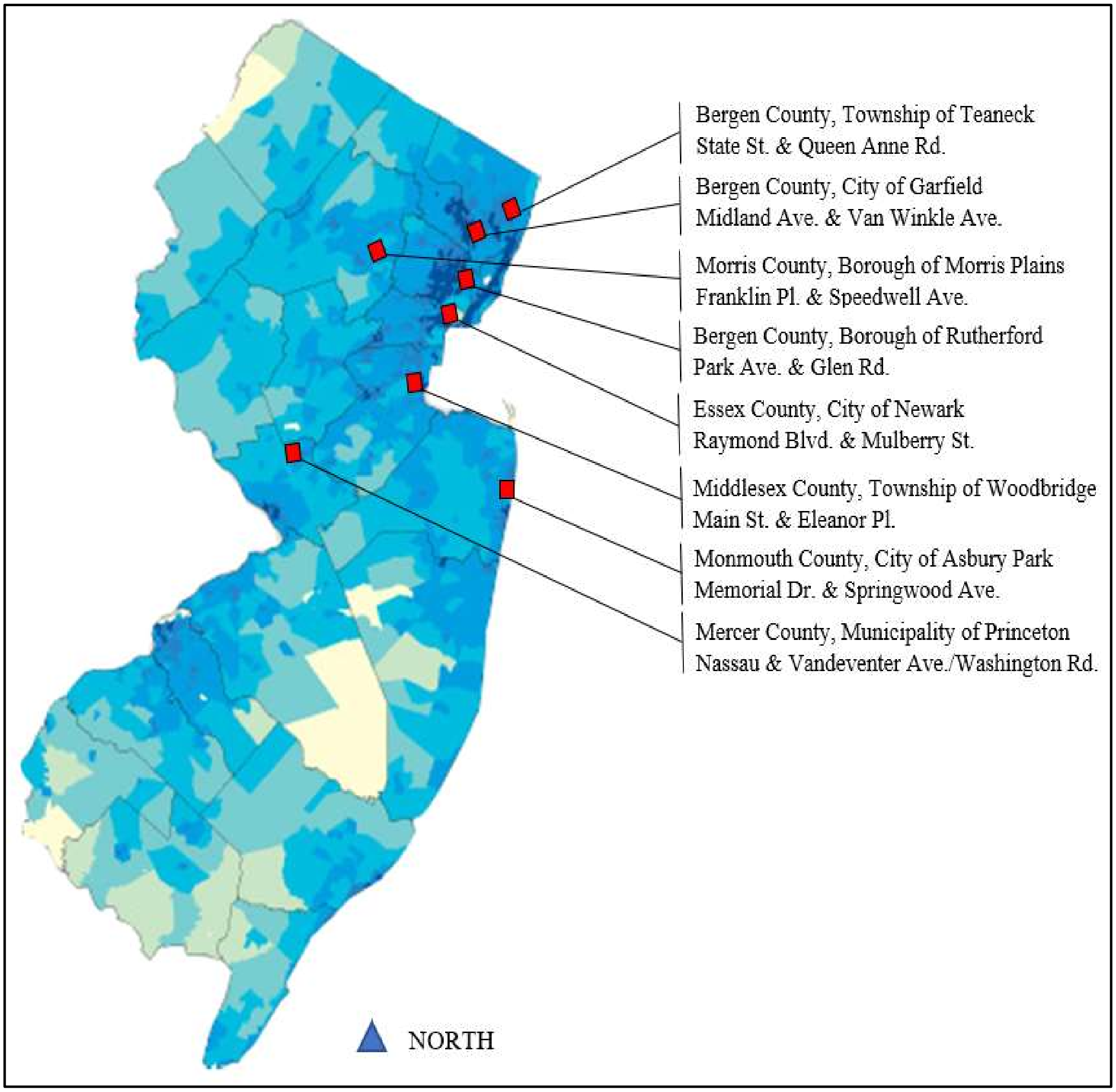

Figure 4. A Map of Observational Study Locations

3.2.2 Data collection. The primary objective of the observational study was to determine if the campaign is effective in mitigating non-compliant behaviors performed by drivers and pedestrians, resulting in enhanced safety for pedestrians at the study locations. Given the fact that crashes are not frequent events, it is more effective to observe the occurrence of risky non-compliant behaviors by motorists and pedestrians which can serve as proxy measures for safety. Safety improvement, by proxy, happens when there is a reduction in the occurrence of non-compliant behaviors. Therefore, the data collection efforts include conducting observations at the study locations to document the behaviors of pedestrians and drivers+ both pre- and post-campaign. This requires identifying the necessary data type, the field collection method, and how to process the raw data to provide a useful dataset for analysis purposes. Conducting observational evaluations for each proxy measure requires two types of data to be collected: 1) counts of non-compliant behavior event occurrences, and 2) total counts of pedestrians or drivers exposed at the intersection who had a chance either to comply with or violate the traffic rules. Using these two types of data, it is possible to measure a rate of non-compliance at each location for each proxy behavior of interest. This rate is very important for comparing the pre- and post-campaign datasets to identify if there is a statistically significant change in driver and pedestrian behavior. In this study, four core proxy behaviors to measure the impact of its Street Smart NJ campaign messaging were considered. These proxy behaviors allowed the evaluators to observe the non-compliant behavior and determine the relevant measure of exposure in each substantive area of focus for the Street Smart NJ campaign.

3.2.2.1 Proxy 1: Unsafe crossing and crossing against the signal. A pedestrian crossing more than half of the street outside of the crosswalk or begins crossing the street while the signal indicates “Don’t Walk.” The measure of exposure is the overall number of pedestrians crossing the street (Figure 6).

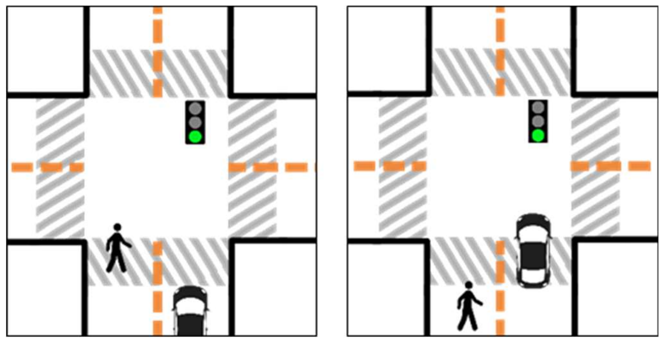

Figure 5. Unsafe Crossing and Crossing against the Signal (Proxy 1)

3.2.2.2 Proxy 2: Turning vehicle fails to stop for pedestrian. A vehicle making a left or right turn at a green signal or an unsigned intersection approach fails to stop for a pedestrian crossing parallel to the approach. The measure of exposure is the overall number of left or right turning vehicles when pedestrians are present so that turning vehicles have an opportunity to properly stop for pedestrians (Figure 7).

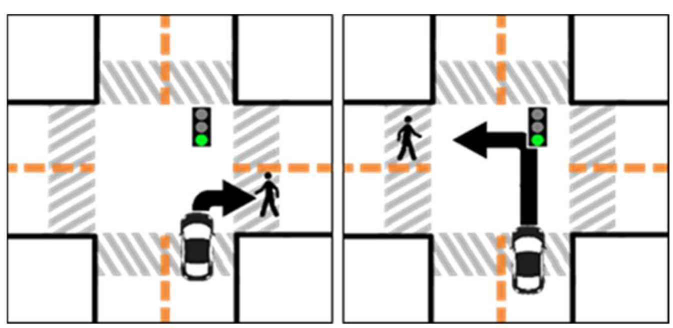

Figure *6*. Turning Vehicle Fails to Stop for Pedestrian (Proxy 2)

3.2.2.3 Proxy 3: Failure to stop before right turn at red signal or stop sign. A right-turning vehicle fails to make a complete stop and stay stopped for pedestrians before making a right turn on red. The measure of exposure is the overall number of right-turning vehicles that approach the stop bar on a red signal because all cars should stop before proceeding, whether or not a pedestrian is present. For unsignalized intersections, this proxy is a right turn vehicle fails to make a complete stop for pedestrians before making a right turn at a stop sign. The measure of exposure is the overall number of right-turning vehicles that approach the stop sign (Figure 8).

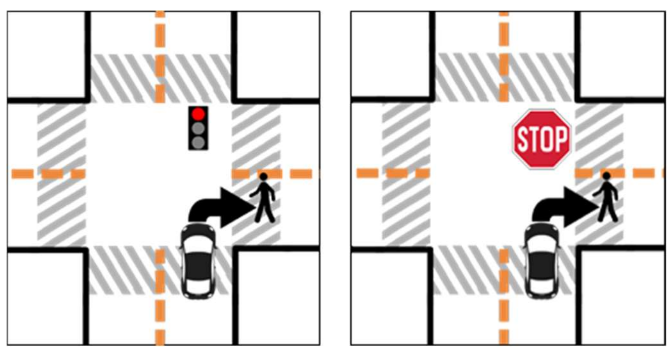

Figure *7*. Failure to Stop before Right Turn at Red Signal or Stop Sign (Proxy 3)

3.2.2.4 Proxy 4: Running red light signal or stop sign. A vehicle passing an intersection when the traffic signal is red. The measure of exposure is the sum of vehicles that enter the intersection, regardless of traffic signal color. For unsignalized intersections, this proxy is a vehicle passing the intersection fails to make a complete stop at the stop sign. The measure of exposure is the sum of vehicles that enter the intersection (Figure 9).

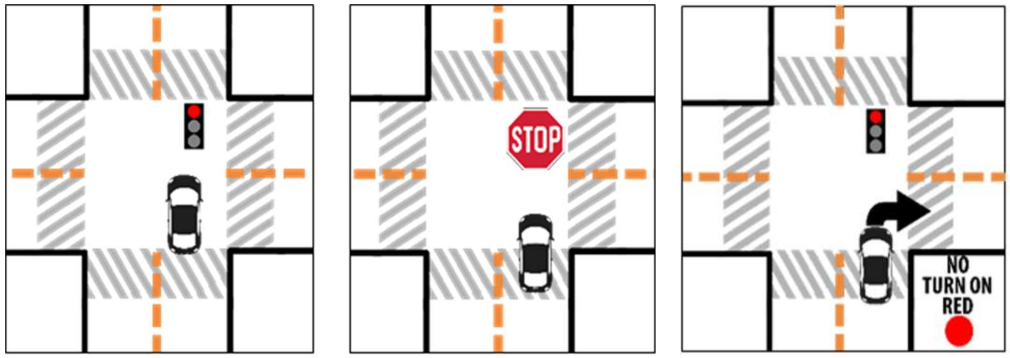

Figure 8. Running Red Light Signal or Stop Sign (Proxy 4)

To evaluate the safety proxy behaviors of community members before and after the Street Smart NJ campaign, four non-compliant behaviors and four measures of exposure for multiple intersections approach at each study site were observed and recorded. The video data enabled the extraction of behaviors of interest and represented the information in a manner that could be used for further analysis. The use of video cameras allowed the compilation of a comprehensive record of all vehicle and pedestrian movements at the study locations during the data collection period. Table 2 shows the pre- and post-campaign data collection locations.

Table 2

Pre- and Post-Campaign Data Collection Sites

Community and Intersection	Pre-Campaign	Post-Campaign
Teaneck – State Street and Queen Anne Road	Tuesday, May 1, 2018 10 a.m. to 2 p.m.	Tuesday, June 26, 2018 10 a.m. to 2 p.m.
Asbury Park – Memorial Drive and Springwood Avenue	Tuesday, August 14, 2018 10 a.m. to 1 p.m.	Tuesday, October 23, 2018 10 a.m. to 1 p.m.
Garfield – Midland Avenue and Van Winkle Avenue	Tuesday, August 21, 2018 9 a.m. to 1 p.m.	Wednesday, November 7, 2018 9 a.m. to 1 p.m.
Newark – Raymond Boulevard and Mulberry Street	Thursday, September 20, 2018 9 a.m. to 1 p.m.	Thursday, November 29, 2018 9 a.m. to 1 p.m.
Morris Plains – Speedwell Avenue and Franklin Road	Tuesday, October 2, 2018 7 a.m. to 11 a.m.	Monday, November 12, 2018 7 a.m. to 11 a.m.
Princeton – Nassau Street and Washington Road	Monday, October 8, 2018 10 a.m. to 1 p.m.	Monday, November 26, 2018 10 a.m. to 1 p.m.
Rutherford – Park Avenue and Glen Road	Monday, October 15, 2018 9 a.m. to 1 p.m.	Monday, December 3, 2018 9 a.m. to 1 p.m.
Woodbridge – Main Street and Eleanor Place	Thursday, March 7, 2019 9:30 a.m. to 1:30 p.m.	Thursday, May 9, 2019 9:30 a.m. to 1:30 p.m.

3.2.3 Study locations. In this study, eight geographically and demographically diverse communities in northern, central, and southern New Jersey were selected for further analysis as follows:

3.2.3.1 Bergen County, Township of Teaneck–State Street and Queen Anne Road. The Township of Teaneck has an estimated population of 40,284 and encompasses an area of six square miles. (U.S Census Bureau, 2019A) The intersection of State Street and Queen Anne Road is located approximately a half-mile from Benjamin Franklin Middle School and in the geographic center of the township. Three blocks to the south is Milton A. Votee Park, and Windsor Park is two blocks to the west of the intersection. Towards the north of Queen Anne Road, there is a Yeshivat He'Atid, a private middle school, which increases pedestrian activity in this area during its regular hours of operation. The intersection features small buildings that house businesses facing the sidewalk to the south and automotive service businesses to the north. A traffic signal controls the movement of pedestrians and drivers at the intersection. It should be noted that the cameras were positioned on the east and south corners of the intersection to record all pedestrian and vehicle movements (Figure 10).

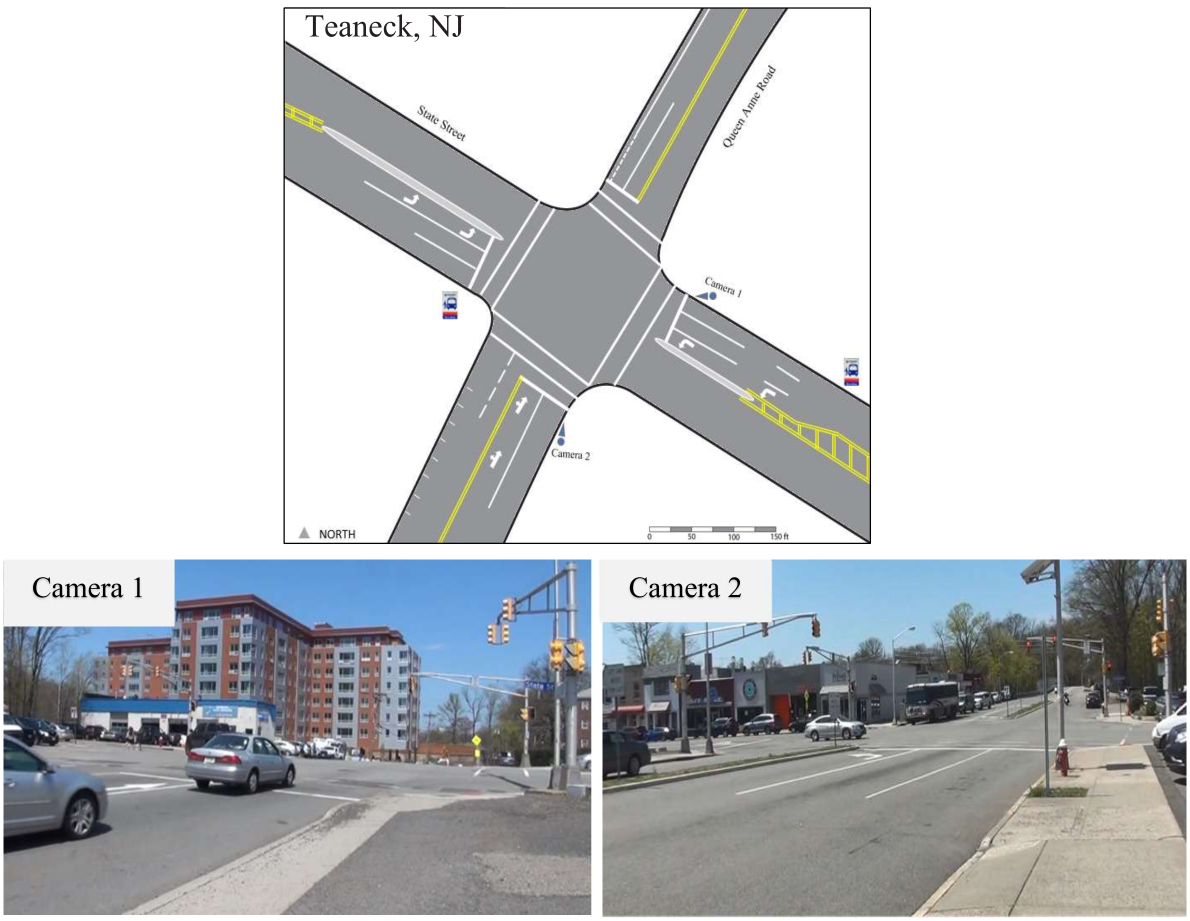

Figure 9. Intersection of Queen Anne Road and State Street and Camera Views in Teaneck, NJ

3.2.3.2 Monmouth County, City of Asbury Park–Memorial Drive and Springwood Avenue. The City of Asbury Park has a population of 15,408 and a land area of 1.42 square miles (U.S Census Bureau, 2019B). The intersection of Memorial Drive and Springwood Avenue is situated near the Asbury Park Train Station, and there are train tracks parallel to Memorial Drive. The intersection is approximately one mile west of the shoreline and a block away from Wesley Lake. The intersection is located approximately a half-mile from Asbury Park Middle School in the southern part of the township and has several residential apartments and a shopping center near it. A traffic signal controls the intersection, and crosswalks are present at three intersection approaches. The cameras were positioned on the southwest and northeast corners of the intersection in order to record all pedestrian and vehicle movements (Figure 11).

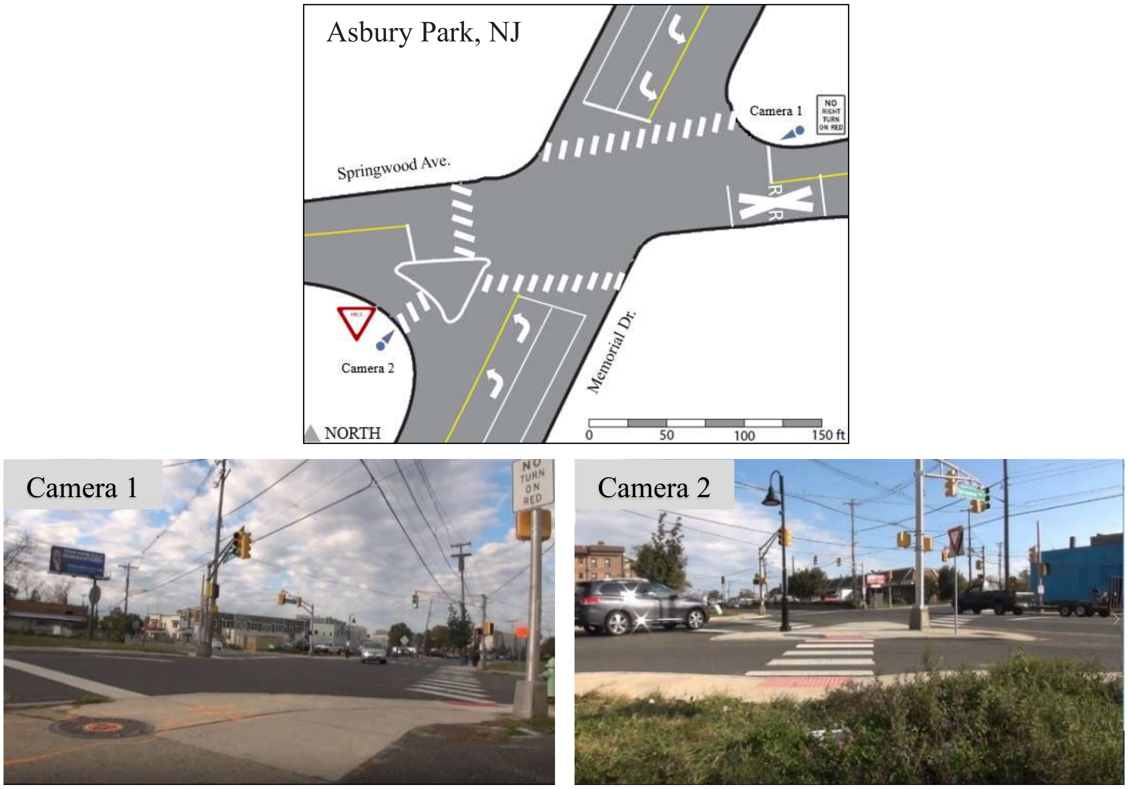

Figure 10. Intersection of Memorial Drive and Springwood Avenue and Camera Views in Asbury Park, NJ

3.2.3.3 Bergen County, City of Garfield – Midland Avenue and Van Winkle Avenue. The City of Garfield is 2.10 square miles with a population of 31,802 (U.S Census Bureau, 2019C). The T-intersection of Midland Avenue and Van Winkle Avenue is located a mile from Garfield High School in the southern part of the city. A rail track runs parallel to Midland Avenue to the west and intersects Van Winkle Avenue. The intersection has only residential apartments on its east side, and there is a pharmacy, shopping center, and residential apartments to the west. The intersection is a half-mile east of the Passaic River. The cameras were installed on the west and north corners of the intersection in order to record all pedestrian and vehicle movements (Figure 12).

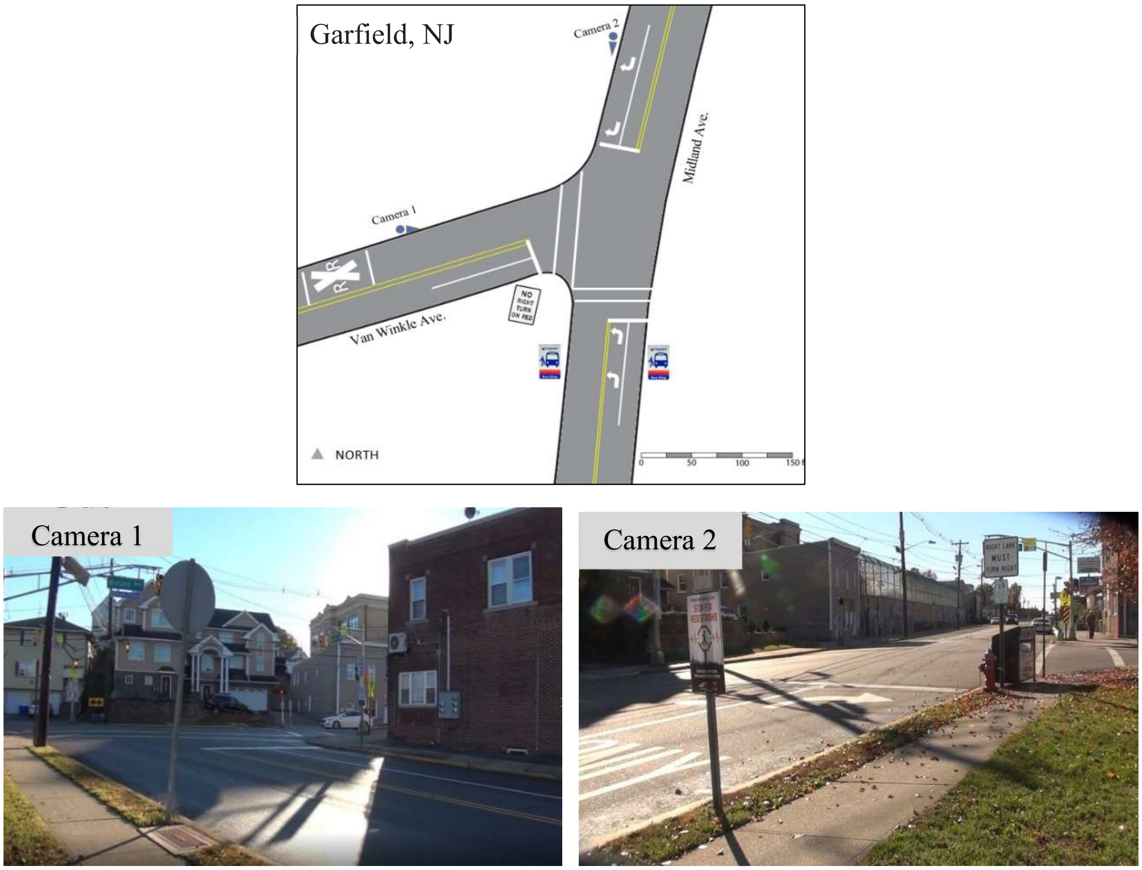

Figure 11. Intersection of Midland Avenue and Van Winkle Avenue and Camera Views in Garfield, NJ

3.2.3.4 Essex County, City of Newark – Raymond Boulevard and Mulberry Street. The City of Newark is New Jersey's largest city, with 282,015 residents spread across 24.19 square miles (U.S Census Bureau, 2019D). The intersection of Raymond Boulevard and Mulberry Street is located 0.3 miles from Military Park in the geographic central part of the city. The Passaic River is to the east of the intersection. The U.S. Social Security Administration, PSE&G, One Newark Center and the Seton Hall Law School are all located at this intersection The intersection is located 0.4 miles from the Newark Penn Station. As a result, this intersection experiences a high volume of pedestrians. Cameras were positioned on two corners of the intersection to record the movements of pedestrians and drivers (Figure 13).

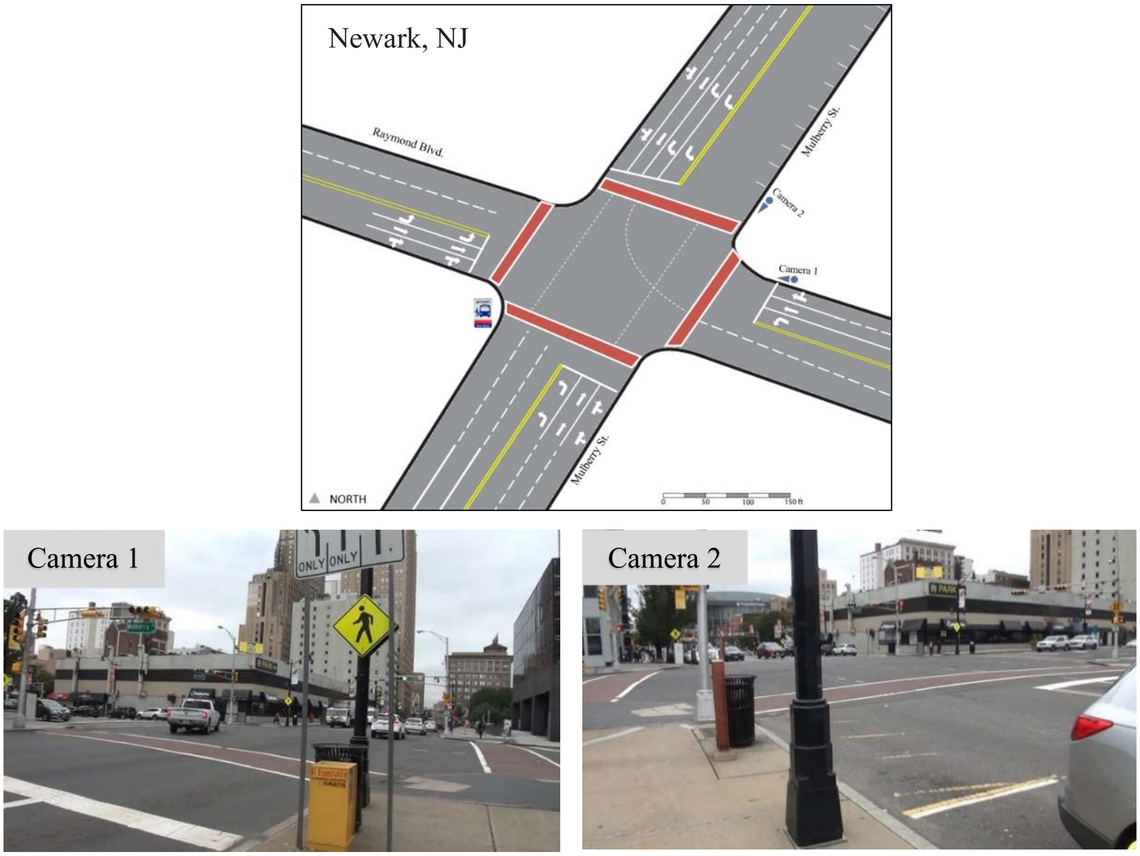

Figure 12. Intersection of Raymond Boulevard and Mulberry Street and Camera Views in Newark, NJ

3.2.3.5 Morris County, – Borough of Morris Plains – Speedwell Avenue and Franklin Road. The Borough of Morris Plains is 2.56 square miles with a population of 6,255 (U.S Census Bureau, 2019E). The intersection of Speedwell Avenue and Littleton Road is located approximately a quarter mile from the Morris Plains 9/11 Memorial Park and Alfred Vail Elementary School is a half-mile south. Two blocks to the west is the Morris Plains library. Running to the north, Speedwell Avenue turns into Granniss

Avenue. The Morris Plains train station is at the intersection, which generates increased pedestrian and traffic volume during early morning hours. The cameras were positioned on the northeast and southeast corners of the intersection in order to record all pedestrian and vehicle movements (Figure 14).

Figure 13. Intersection of Speedwell Avenue and Franklin Road and Camera Views in Morris Plains, NJ

3.2.3.6 Mercer County, Municipality of Princeton – Washington Road/ Vandeventer Ave and Nassau Street. The Municipality of Princeton is 1.84 square miles and has 31,187 residents (U.S Census Bureau, 2019F). The intersection of Washington

Road/Vandeventer Avenue and Nassau Street is located at the heart of Princeton's central business district and next to the Princeton Garden Theatre and the Princeton United Methodist Church. It is approximately 0.2 miles from Palmer Square, a popular plaza with a collection of shops, restaurants, offices, and residential spaces. The intersection connects Princeton University to the plaza on Nassau Street and surrounding neighborhoods on Vandeventer Avenue, which increases the pedestrian volume during the university's working hours. Figure 15 shows the locations of cameras on the southwest and northeast corners of the intersection in order to capture all movements.

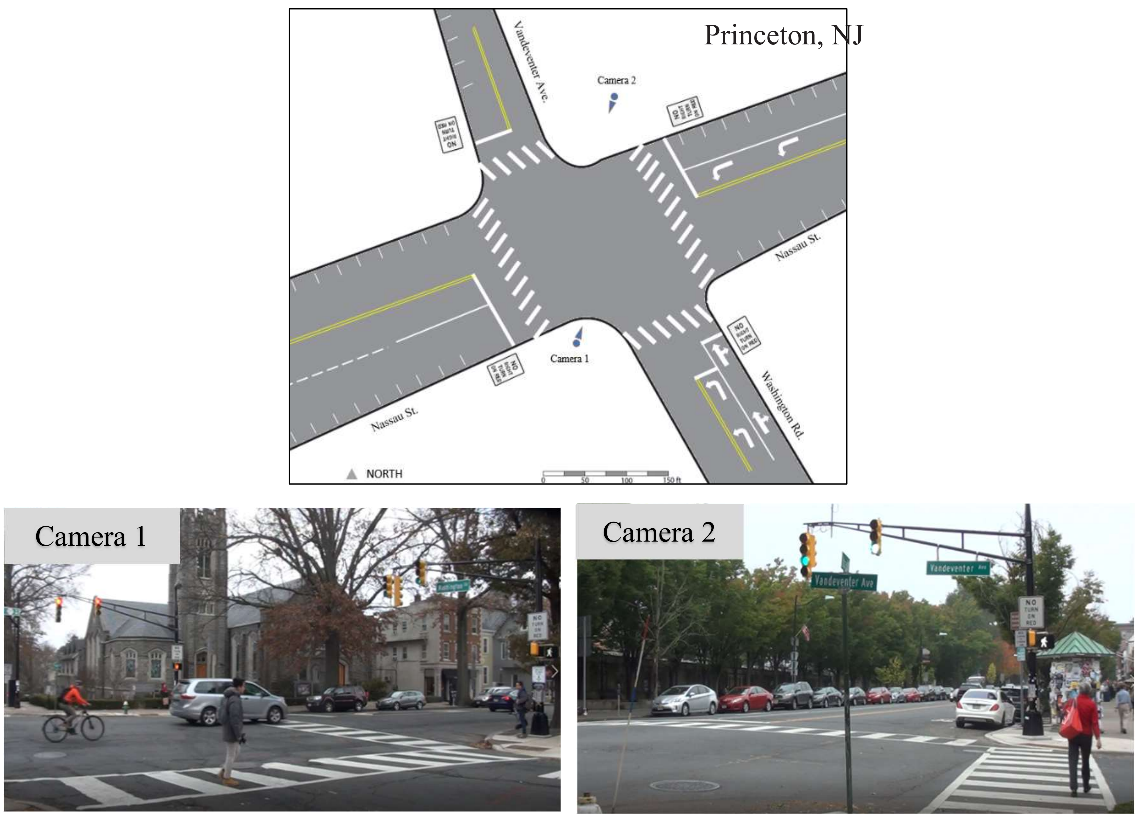

Figure 14. Intersection of Nassau Street and Vandeventer Avenue and Camera Views in Princeton, NJ

3.2.3.7 Bergen County, Borough of Rutherford – Glen Road onto Park Avenue. The Borough of Rutherford is 2.81 square miles and has 18,303 residents. (U.S Census Bureau, 2019G). The intersection of Glen Road and Park Avenue is located next to a Dunkin Donuts, the Park Avenue Pet Center, Goffin's Hallmark Shop, and many other locally owned businesses. Continuing to the north is a rotary connecting Erie Avenue and Park Avenue. When traveling south on Park Avenue, there are various parks for people to enjoy. The locations of cameras on the southwest corners of the T-intersection is shown in Figure 16.

Figure 15. Intersection of Glen Road onto Park Avenue and Camera Views in Rutherford, NJ

3.2.3.8 Middlesex County, Township of Woodbridge – Main Street and Eleanor Place. The township of Woodbridge is 23.2 square miles and has 100,145 residents (U.S Census Bureau, 2019H). The 3-way T-intersection of Main Street and Eleanor Place is located near the Woodbridge Municipal Court, which is in the epicenter of the commercial area of Woodbridge. It is 0.2 miles away from the Woodbridge railway station. The intersection has no traffic signal and is controlled by a stop sign on Eleanor Place. Figure 17 illustrates the location of cameras on the south and east corners of the intersection.

Figure 16. Intersection of Main Street and Eleanor Place and Camera Views in Woodbridge, NJ

3.2.4 Statistical analysis. To determine the effectiveness of the Street Smart NJ campaign in changing behavior, the behaviors of pedestrians and drivers before and after the campaign (pre- and post-campaign) were compared. The assumption is that each individual who drives or walks through the intersection makes a decision to obey or disobey traffic regulations, with some probability that is independent of the behavior of other drivers and pedestrians. Given this assumption, each driver or pedestrian that has an opportunity to be involved in unsafe, non-compliant behavior will either decide to comply with traffic regulations or not, following a Bernoulli (binary) process.

In this project, when a driver or pedestrian does not comply with a specific traffic regulation captured in the proxy variables, it is considered a Bernoulli success, whereas a Bernoulli failure occurs when a safe, compliant behavior is observed. In this situation, the success rate specifies how often people engage in unsafe behaviors. In a total population of drivers and pedestrians, the number of successes follows a binomial distribution and the proportion of successes out of the total population of motorists and pedestrians follows an approximately normal distribution, which was used for hypothesis testing and quantifying the magnitude of the effect. As discussed earlier, by counting non-compliant and compliant behavior events, it is possible to measure the proportion of non-compliance for drivers or pedestrians. More specifically, for each proxy, two different rates of non-compliance, including the rate of non-compliant behavior in the pre-campaign data and rate of non-compliant behavior in the post-campaign data, were calculated.

To test whether a change in the rate of non-compliant behavior is significant, statistical calculations verify whether or not it is possible to reject the null hypothesis that the behavior did not change. The fundamental equation to conduct the test is as follows:

$$\mathrm{Z} = \frac{\hat{\rho}_2 - \hat{\rho}_1}{\sqrt{\hat{\rho}(1-\hat{\rho})(\frac{1}{n_1} + \frac{1}{n_2}})$$

$$\hat{\rho} = \frac{\mathrm{X}_1 - \mathrm{X}_2}{n_1 - n_2}$$

$$\hat{\rho}_1 = \frac{\mathrm{X}_1}{n_1}$$

$$\hat{\rho}_2 = \frac{\mathrm{X}_2}{n_2}$$

where, X_1 is the number of non-compliant events in pre-campaign data; X_2 is the number of non-compliant events in post-campaign data; n_1 is a measure of exposure to pre-campaign data; n_2 is a measure of exposure to post-campaign data; $\hat{\rho}_1$ is probability that a person did not comply with the regulations in pre-campaign data; $\hat{\rho}_2$ is probability that a person did not comply with the rules in post-campaign data; and $\hat{\rho}$ is a pooled sample proportion or combined average of probabilities.

The estimate of the change in the rate of non-compliance is the difference $(\hat{\rho}_2 - \hat{\rho}_1)$. A negative value indicates a decrease in the proportion of the drivers and pedestrians engaging in unsafe behaviors, representing an improvement in traffic safety. The null hypothesis indicates that the rate of non-compliance in the pre-campaign is equal to or less than the post-campaign (H0: $\hat{\rho}_1 \leq \hat{\rho}_2$) and the alternative hypothesis indicates that the rate of non-compliance in the pre-campaign is greater than the post-campaign (H1: $\hat{\rho}_1 > \hat{\rho}_2$). It should be noted that the researchers most often use significance values of 0.01, 0.05, or 0.10, corresponding to 99 percent, 95 percent, and 90 percent confidence level, respectively. In this study, we considered a significant level of 95 percent.

3.3 Results and Observations

Considering the statistical methods described in previous sections, the significance in the change of each proxy at each location was measured. Table 3 presents a summary of the results with the observed change in the rate of non-compliant behaviors, $\hat{\rho}_1 - \hat{\rho}_2$, and the *P*-value associated with this change. For a change to be statistically significant at the 95 percent level ($\alpha = 0.05$), the *P*-value must be less than 0.05.

It is worth mentioning that more than three hours of video data was collected at each site, allowing the sample sizes to be large enough to prove that the changes in behavior appear to be systematic, rather than simple random variations, especially at the urban intersections. Appendix A represents the hourly distribution non-compliance behavior for each study location. Furthermore, to be sure of the magnitude of the changes in behavior, it is best to look at the upper and lower bounds of confidence intervals, because the true change may be more or less than the observed change, due to random variation. As the study team evaluated the change in rates rather than a simple normally distributed variable, confidence intervals were more accurate than the analysis of hypothesis testing.

The results of this study demonstrate that there was an overall decrease in dangerous behaviors following the campaigns and many of these reductions were statistically significant (Table 3). Negative values are favorable results, as they show reductions in unsafe behaviors, which is the goal of the Street Smart NJ campaign.

Positive values indicate increases in unsafe behaviors following the campaign. Additionally, some of the increases can be associated with other influential factors, such as weather conditions and day of the week.

Table 3

Change in Counts and Rates of Non-Compliant Behaviors from the Pre- to Post-Campaign

Community	Proxy	Pre-Campaign			Post-Campaign			Change					
		Non-Compliant	Sample n_1	Rate (p^1)	Non-Compliant	Sample n_2	Rate (p^2)	%	Rate Difference (p^2-p^1)	Lower 95.0% CI	Upper 95.0% CI	P-Value	Signification Test
Teaneck	1	112	472	0.237	86	253	0.340	43.3%	0.103	0.034	0.173	0.998	Insignificant Increase
	2	57	167	0.341	32	152	0.211	-38.3%	-0.131	-0.225	-0.032	0.005	Significant Reduction
	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	47	5343	0.009	26	4931	0.005	-40.1%	-0.004	-0.007	0.000	0.017	Significant Reduction
Asbury Park	1	126	142	0.887	65	161	0.404	-54.5%	-0.484	-0.568	-0.384	0.000	Significant Reduction
	2	26	58	0.448	13	51	0.255	-43.1%	-0.193	-0.355	-0.013	0.018	Significant Reduction
	3	18	54	0.333	5	50	0.100	-70.0%	-0.233	-0.378	-0.075	0.002	Significant Reduction
	4	11	3336	0.003	7	2909	0.002	-27.0%	-0.001	-0.004	0.002	0.256	Insignificant Reduction
Garfield	1	44	106	0.415	33	91	0.363	-12.6%	-0.052	-0.184	0.083	0.226	Insignificant Reduction
	2	13	41	0.317	13	37	0.351	10.8%	0.034	-0.168	0.236	0.626	Insignificant Increase
	3	129	160	0.806	71	241	0.295	-63.5%	-0.512	-0.588	-0.421	0.000	Significant Reduction
	4	59	3393	0.017	20	3646	0.005	-68.5%	-0.012	-0.017	-0.007	0.000	Significant Reduction
Newark	1	629	2083	0.302	239	1762	0.136	-55.1%	-0.166	-0.191	-0.141	0.000	Significant Reduction
	2	398	844	0.472	222	826	0.269	-43.0%	-0.203	-0.247	-0.157	0.000	Significant Reduction
	3	97	376	0.258	48	372	0.129	-50.0%	-0.129	-0.184	-0.073	0.000	Significant Reduction
	4	61	6066	0.010	28	6147	0.005	-54.7%	-0.006	-0.009	-0.002	0.000	Significant Reduction

Community	Proxy	Pre-Campaign			Post-Campaign			Change					
		Non-Compliant	Sample n_1	Rate (p^1)	Non-Compliant	Sample n_2	Rate (p^2)	%	Rate Difference (p^2-p^1)	Lower 95.0% CI	Upper 95.0% CI	P-Value	Signification Test
Morris Plains	1	50	134	0.373	31	111	0.279	-25.2%	-0.094	-0.207	0.025	0.060	Insignificant Reduction
	2	10	27	0.370	15	42	0.357	-3.6%	-0.013	-0.240	0.203	0.456	Insignificant Reduction
	3	29	58	0.500	5	18	0.278	-44.4%	-0.222	-0.419	0.040	0.049	Significant Reduction
	4	303	7030	0.043	94	5577	0.017	-60.9%	-0.026	-0.032	-0.020	0.000	Significant Reduction
Princeton	1	410	1758	0.233	312	965	0.323	38.6%	0.090	0.055	0.126	1.000	Insignificant Increase
	2	51	287	0.178	17	179	0.095	-46.6%	-0.083	-0.142	-0.017	0.007	Significant Reduction
	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	129	2670	0.048	54	2692	0.020	-58.5%	-0.028	-0.038	-0.019	0.000	Significant Reduction
Rutherford	1	56	364	0.154	66	466	0.142	-7.9%	-0.012	-0.062	0.036	0.311	Insignificant Reduction
	2	24	112	0.214	23	153	0.150	-29.8%	-0.064	-0.161	0.029	0.089	Insignificant Reduction
	3	159	184	0.864	154	207	0.744	-13.9%	-0.120	-0.196	-0.041	0.001	Significant Reduction
	4	159	184	0.864	154	207	0.744	-13.9%	-0.120	-0.196	-0.041	0.001	Significant Reduction
Woodbridge	1	57	138	0.413	61	150	0.407	-1.5%	-0.006	-0.119	0.106	0.456	Insignificant Reduction
	2	63	126	0.500	24	108	0.222	-55.6%	-0.278	-0.387	-0.155	0.000	Significant Reduction
	3	22	83	0.265	7	98	0.071	-73.1%	-0.194	-0.304	-0.086	0.000	Significant Reduction
	4	63	147	0.429	42	143	0.294	-31.5%	-0.135	-0.241	-0.024	0.008	Significant Reduction

Note: Proxy 1: Unsafe Crossing and Crossing against the Signal, Proxy 2: Turning Vehicle Fails to Stop for Pedestrian, Proxy 3: Failure to Stop before Right Turn at Red Signal or Stop Sign, and Proxy 4: Running Red Light Signal or Stop Sign; "No Turn on Red" signs are placed at the intersection, so Proxy 3 was not measured for Princeton and Teaneck

In terms of intersection geometry, 4-leg intersections exhibited more consistent improvements across all four measures: total percent changes were -22 percent for Proxy 1, -40 percent for Proxy 2, -53 percent for Proxy 3, and -51 percent for Proxy 4 (Table 4). The changes for the 5-leg intersection (Morris Plains) were -25 percent for Proxy 1, -3 percent for Proxy 2, -44 percent for Proxy 3, and -61 percent for Proxy 4. The corresponding total for the 3-leg intersections was -12 percent for Proxy 1, -44 percent for Proxy 2, -65 percent for Proxy 3, and -28 percent for Proxy 4. There was a reduction in all aspects of the behaviors (Table 4).

Table 4

Change in Counts and Rates of Non-Compliant Behaviors from the Pre- to Post-Campaign

Groups	Proxy	Pre-Campaign			Post-Campaign			Change			
		Sample n_1	Non-Compliant	Rate $\hat{p}_1$	Sample n_2	Non-Compliant	Rate $\hat{p}_2$	%	$\hat{p}_2 - \hat{p}_1$	P-Value	Significance Test
All Intersection	1	5,197	1,484	29%	3,959	893	23%	-21.0%	-0.060	0.000	Significant
	2	1,662	642	39%	1,548	359	23%	-40.0%	-0.154	0.000	Significant
	3	890	454	51%	933	189	20%	-60.3%	-0.308	0.000	Significant
	4	28,169	832	3%	26,252	425	2%	-45.2%	-0.013	0.000	Significant
5-Leg Intersection	1	134	50	37%	111	31	28%	-25.2%	-0.094	0.060	Insignificant
	2	27	10	37%	42	15	36%	-3.6%	-0.013	0.456	Insignificant
	3	58	29	50%	18	5	28%	-44.4%	-0.222	0.049	Significant
	4	7,030	303	4%	5,577	94	2%	-60.9%	-0.026	0.000	Significant
4-Leg Intersection	1	4,455	1,277	29%	3,141	702	22%	-22.0%	-0.063	0.000	Significant
	2	1,356	532	39%	1,208	284	24%	-40.1%	-0.157	0.000	Significant
	3	430	115	27%	422	53	13%	-53.0%	-0.142	0.000	Significant
	4	17,415	248	1%	16,679	115	1%	-51.6%	-0.007	0.000	Significant
3-Leg Intersection	1	608	157	26%	707	160	23%	-12.4%	-0.032	0.089	Insignificant
	2	279	100	36%	298	60	20%	-43.8%	-0.157	0.000	Significant
	3	402	310	77%	493	131	27%	-65.5%	-0.505	0.000	Significant
	4	3,724	281	8%	3,996	216	5%	-28.0%	-0.021	0.000	Significant

Note: Proxy 1: Unsafe Crossing and Crossing against the Signal, Proxy 2: Turning Vehicle Fails to Stop for Pedestrian, Proxy 3: Failure to Stop before Right Turn at Red Signal or Stop Sign, and Proxy 4: Running Red Light Signal or Stop Sign

The insignificant reductions associated with Proxy 1 and Proxy 2 at 5-leg intersections could be a result of the confusion that 5-leg intersections, compared to 4-leg intersections, can create for people traveling through them. But it is not clear exactly why the behaviors vary at different intersection designs. However, it should be noted that in this study, there is only one 5-leg intersection in the Morris Plains, which is controlled by a traffic signal. It is possible that a combination of factors such as weather conditions and a holiday contribute in different ways to the effectiveness of the Street Smart NJ campaign in changing pedestrian and driver behaviors.

All of the 4-leg intersections in the study (i.e., Teaneck, Asbury Park, Newark, and Princeton) are controlled by a traffic signal. The 3-leg intersection in Garfield is controlled by a traffic signal, and the 3-leg intersections in Rutherford and Woodbridge are controlled by a stop sign. Overall, the aggregated results from all communities show that the majority of pedestrian and driver unsafe behaviors were improved following the Street Smart NJ campaign (Table 4). Overall, there were statistically significant improvements for all four proxies at 4-leg intersections and for Proxies 2, 3, and 4 at 3-leg intersections. There were also significant reductions in Proxy 3 and Proxy 4 at 5-leg intersections.

Table 5

Statistically Significant Change in Rate of Non-Compliant Behaviors Based on Intersection Traffic Control

Traffic Control	Proxy 1	Significant Test	Proxy 2	Significant Test	Proxy 3	Significant Test	Proxy 4	Significance Test
Signalized	-21.5%	Significant	-37.8%	Significant	-55.0%	Significant	-59.7%	Significant
Unsignalized	-8.4%	Insignificant	-50.7%	Significant	-22.1%	Significant	-16.5%	Significant

Intersections that are controlled with a traffic light have significant reductions in non-compliant behaviors. Unsafe crossing and crossing against the signal at the intersection with traffic lights significantly decreased by 21.5 percent in comparison with unsafe crossing at an intersection with a stop sign, which had an insignificant decrease of 8.4 percent (Table 5). However, Proxy 2 behavior (turning vehicle fails to stop for pedestrians) significantly decreased by 37.8 percent in signalized intersections, and there was a significant reduction of 50.7 percent in intersections with a stop sign. Proxy 3 behaviors (failure to stop before right turn at red signal or stop sign) showed significant reductions of 55 percent and 22.1 percent at intersections controlled by a traffic light and with a stop sign, respectively. Proxy 4 (running a red light or stop sign) showed significant decreases of 59.7 percent at traffic signals and 16.5 percent at stop signs. Overall, signalized intersections showed greater reductions in unsafe behaviors when compared to unsignalized intersections.

Table 6

Change in Rates of Non-Compliant Behaviors from the Pre- to Post-Campaign for All Intersections

Road Users	Change of Non-Compliant Behavior	Significance Test
Pedestrian	-21 %	Significant
Driver	-41 %	Significant

Table 6 shows the significant reductions in non-compliant behavior among both pedestrians and drivers following the campaign; however, the improvement in driver behavior was twice as larger as pedestrian behavior. The weather could have played a role in these results. For example, people walking are less likely to wait for a signal before crossing in cold or inclement weather. The changing of seasons could have played a role in this result. To be specific, pedestrians in cold weather may be more likely to rush, causing an increase in the probability of unsafe behavior. On the other hand, in adverse weather conditions, drivers tend to be more careful, which results in increased driver caution and safety compliance. In addition, pedestrians take more risks in crossing the unsignalized intersections that carry low traffic volumes.

Table 6 lists the changes in rates of non-compliant behaviors from the pre- to post-campaign for all study intersections. According to this table, statistically significant reductions in non-compliant behaviors in respect to driver and pedstrains were observed following the campaign. To be specific, a 41 percent reduction in non-compliant behaviour of drivers and a 21 percent reduction in non-complant behaviour of pedestrians were recorded.

Chapter 4

Evaluating the Effectiveness of the Street Smart New Jersey Campaign: Behavioral Pedestrian Safety Analysis

4.1 Introduction

This chapter evaluates behavioral change and public awareness through the results of a web-based survey distributed through seven geographically and demographically diverse communities in northern, central, and southern New Jersey campaign communities (i.e., Asbury Park, Garfield, Morris Plains, Newark, Princeton, Rutherford, and Woodbridge) in 2018 and 2019. The impact of the campaign was assessed by analyzing the results of surveys in each community and all the communities as a whole. The survey measures the success of the campaign in changing behaviors among both pedestrians and drivers, how the campaign has shaped public awareness and attitudes about pedestrian safety, and which campaign activities are most effective. By using messages such as "Obey Speed Limit," "Stop for Pedestrians," "Use Crosswalk," "Heads Up, Phones Down," and "Wait for the Walk," the campaign uses public outreach to educate motorists and pedestrians on the importance of obeying traffic rules. The safety campaign promotes educational materials (Figure 18) through paid advertising, earned media, signage, and social media.

Figure 17. Messages used in the Street Smart NJ campaign (NJTPA, 2019)

In-person flyer distribution, direct mail advertisements, social media advertisements, and intercept surveys using tablet devices were used to gather responses in the study communities. Overall, 2,558 survey responses were collected in the target communities.

4.2 Method and Data

4.2.1 Site selection. The process for selecting sites for the Street Smart NJ campaign and the behavioral study was to recognize sites that could benefit from an improvement in driver and pedestrian behavior and may illustrate the changes that have been followed by the campaign. Considering crash data from the past was one of the major criteria for site selection as locations with a high number of previous crashes are likely to continue to have the highest number of future pedestrian crashes in the absence of intervention. Additionally, locations with high crash incidence are also likely indicators of non-compliant behaviors that could be improved through the community's participation in the Street Smart NJ campaign. Notably, coordination with local communities is also a factor in community selection, since the success of Street Smart depends on engaged local participation. Diverse size of communities and geographical coverage of the region would be incorporated for the site selection.

It is likely that locations with high pedestrian and traffic flow are likely to be selected, to provide sufficient survey data for comparison. In this study, seven geographically and demographically diverse communities in northern, central, and southern New Jersey were selected for further analysis. These campaign communities include Asbury Park, Garfield, Morris Plains, Newark, Princeton, Rutherford, and Woodbridge.

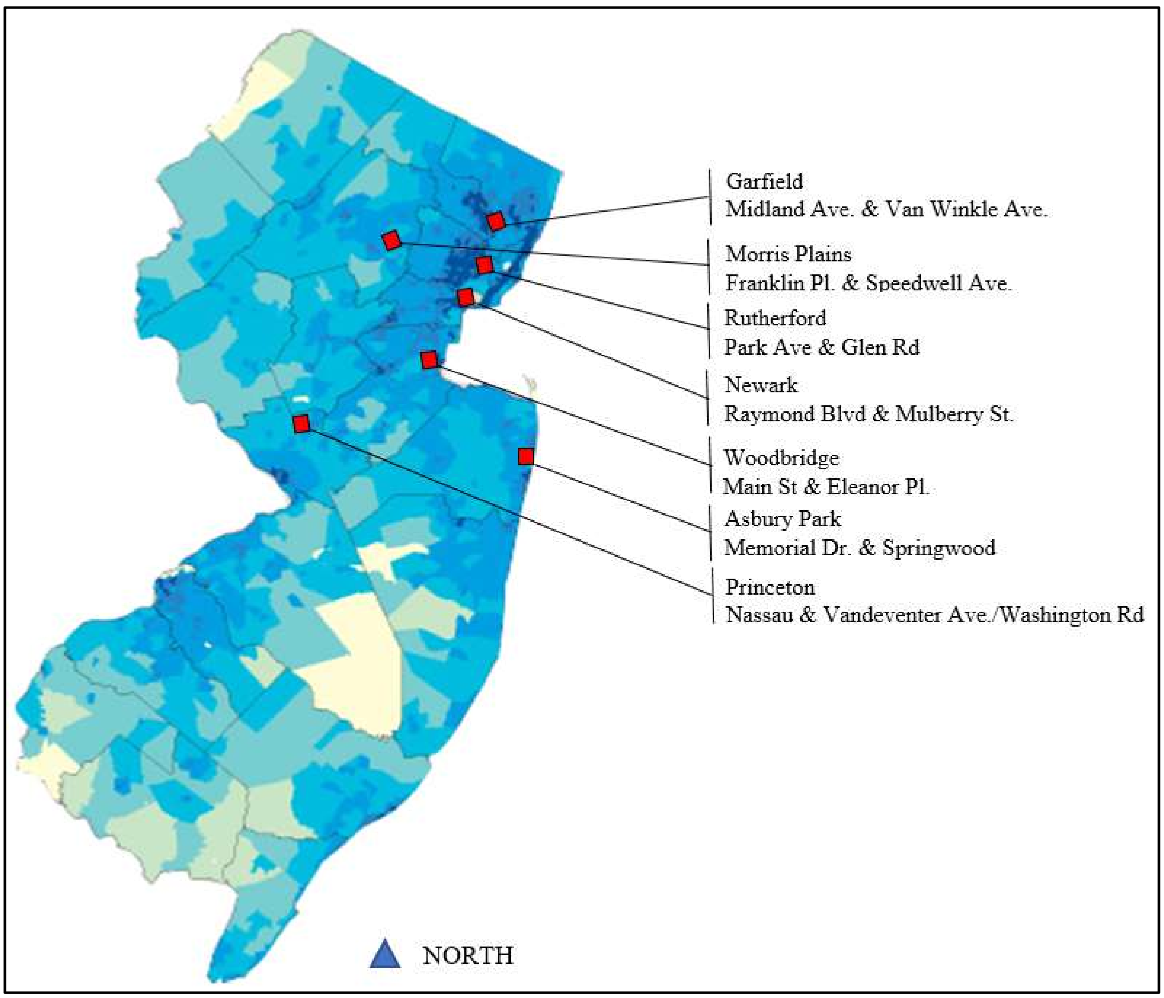

Figure 18. A Map of Behavioral Study Locations

4.2.2 Survey design. In this study, a web-based survey was designed to determine the effectiveness of the campaign messaging and activities using a cross-sectional design, which captured changes that occurred immediately after the campaigns were conducted. Independent samples were collected for the pre- and post-campaign surveys. Survey participants were recruited during a period of two to six weeks before and after the Street Smart campaigns via the following methods: in-person flyer distribution, direct-mail advertising, social media advertising, and intercept surveys using tablet devices. This variety of recruitment methods was used to ensure that a sufficient sample size was collected for each community and to reduce sampling bias based on the recruitment method. Figure 20 shows a sample of the flyer used in direct mail advertising method.

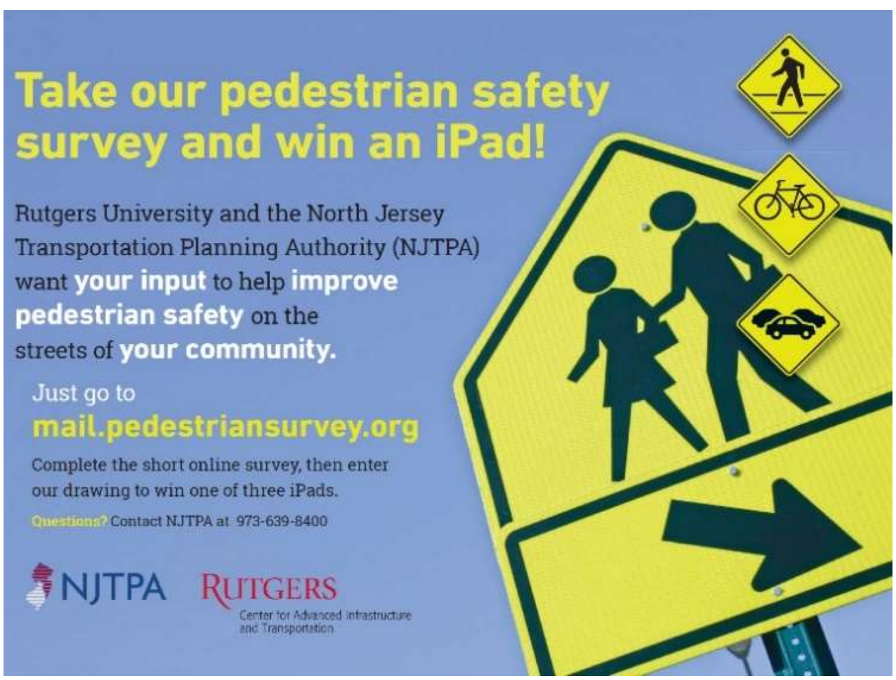

Figure 19. Sample of flyer used in direct mail advertising method

The survey contains different sections, including screening and demographics questions, as well as questions about awareness of campaign messages, pedestrian safety laws and behaviors, and enforcement. Incorporating screening questions in the survey helps ensure the right participants are selected. Demographic questions (e.g., gender, age, race, education, profession or employment status) help determine what factors may influence a respondent's answers, interests, and opinions. Survey participants were asked whether they were exposed to the campaign messages related to pedestrian and motorist safety, such as pedestrian crossing and speed limits. They were also asked about their knowledge of pedestrian safety laws and behaviors, such as using a hand-held cell phone while walking or driving, traffic lights and pedestrian signals, and turning maneuvers at intersections. Participants were asked about enforcement of motorist and pedestrian safety laws in New Jersey, such as issuing tickets or warnings for failing to stop for someone crossing or for not using a crosswalk. It should be noted that the survey participants were recruited both before and after the Street Smart NJ campaigns, which lasted for approximately one month. The readers are referred to survey link "social.pedestriansurvey.org" for further information. We note that safeguards were incorporated in the survey to ensure results are from persons 18 years of age and older who live in or frequent the campaign location(s) and that the survey results will remain strictly confidential. The survey used for the evaluation is attached in Appendix B.

A sample is a set of respondents selected in such a way that they represent the total population as much as possible. Two important measures of the accuracy and reliability of sample-based survey data are margin of error and confidence level. Margin of error is the positive and negative deviation deemed acceptable for survey results in a given sample. In this context, the margin of error is the difference between the opinions of the respondents and the opinion of the entire population. For example, a survey is carried out with a 5 percent margin of error and 90 percent of the survey respondents select a given category of answer. Using this 5 percent margin of error enables the prediction that between 85 percent (90 percent-5 percent) and 95 percent (90 percent+5 percent) of the entire population share a preference for that category. Confidence level shows how often the percentage of the population that selects one category actually lies within the boundaries of the margin of error. For instance, using the above margin of error example with a 95 percent confidence interval would predict that 95 percent of the time, between 85 percent and 95 percent of the population shares a preference for that answer category.

As a part of this study's necessary accuracy and reliability thresholds for the sample, the researcher can calculate how many people need to take the survey for it to be representative of the larger population. It should be noted that many research studies use a 95 percent confidence interval and a margin of error of between 5 percent and 10 percent. Table 7. provides a better understanding of the required sample size, based on different study populations at a 95 percent confidence level and margins of error between 5 percent and 1 percent.

Table 7

Example of Required Sample Size for Different Confidence Intervals and Margins of Errors

Population Size	Confidence Level= 95%			Confidence Level= 99%		
	Margin of Error			Margin of Error		
	5%	2.5%	1%	5%	2.5%	1%
100	80	94	99	87	96	99
500	217	377	475	285	421	485
1,000	278	606	906	399	727	943
10,000	370	1,332	4,899	622	2,098	6,239
100,000	383	1,513	8,762	659	2,585	14,227
500,000	384	1,532	9,423	663	2,640	16,055
1,000,000	384	1,534	9,512	633	2,647	16,317

4.2.3 Statistical analysis.

4.2.3.1 Mann-Whitney U test*.* The Mann-Whitney U test, which is non-parametric, was used to confirm if two independent sample means are equal or not. The test does not make any assumptions related to the distribution of scores. Initially, the test was proposed for equal sample sizes, but its application was later extended for unequal sample sizes.

It should be noted that when the ranks of the two samples (pre-campaign and post-campaign) are collected from the identical population distribution and the null hypothesis is true, it can be expected to have the equal mean rank for the results of both samples. However, if the sample result is affected by the independent variable, then it can be expected to impact their rank order and even cause the mean ranks to be different for the two samples. The calculation procedure for the Mann-Whitney test is as follows:

$$U_1 = R_1 - \frac{n_1 (n_1 + 1)}{2}$$

$$U_2 = R_2 - \frac{n_2(n_2+1)}{2}$$

Where U_1 and U_2 are Mann-Whitney for pre-campaign and post-campaign, respectively, n_1 is the number of respondents for pre-campaign, n_2 is the number of respondents for post-campaign, and R_1 and R_2 are rank sums for pre-campaign and post-campaign, respectively. If the U value is equal to or less than the critical value, the two samples are statistically significant.

As a part of this study, Statistical Package for the Social Sciences (SPSS) software was used to perform the Mann-Whitney U test. SPSS provides various outcomes, such as mean ranks for each group and three other statistics tests, Mann-Whitney U, Wilcoxon W, and Z-score Z. Wherein, U is the Mann-Whitney U statistic, and W is the Wilcoxon, i.e., the lowest sum of the rank and is used to calculate the p-value. SPSS uses an approximation to the standard normal distribution to give the Z statistic and p-value.

As we have a large sample size (i.e., both n_1 and n_2 are greater than 20), then the U distribution tends to a normal distribution. Additionally, the Mann-Whitney U test can assist in analyzing ranked and ordinal data without being influenced by outliers. (Salkind, N. J., 2010)

4.2.3.2 Effect size. The effect size for the survey sample is calculated by dividing the absolute standardized test statistic, *z*, by the square root of the total sample size, *n*, as follows:

$$\text{Effect Size} = \frac{z}{\sqrt{n}} \qquad (2)$$

Cohen's classification of effect size is used to determine whether the changes are statistically significant. According to Cohen's classification, an effect size between 0.1 and

0.3 is considered to have a small effect, between 0.3 and 0.5 is considered to have a moderate effect, and 0.5 and above is considered to have a large effect.

4.2.3.3 P-Value. In order to analyze the survey results, it is first required to determine the significance level, which varies between 0 and 1. It should be noted that researchers most often use significance values of 0.01, 0.05, or 0.10, corresponding to 99 percent, 95 percent, and 90 percent confidence level, respectively. In this study, we considered a significant level to be 95 percent.

4.3 Results and Discussion

Overall, 2,558 respondents participated in the survey. It should be noted that 317 out of those 2,558 respondents did not live in or frequent any of the campaign communities, so the study team removed those before the aggregated output was produced. Therefore, 2,241 survey respondents lived in or frequented one of the campaign communities, including 1,132 in pre-campaign and 1,109 in post-campaign. With respect to the recruitment methods, approximately 50 percent of total respondents were recruited through social media advertisements, followed by intercept surveys using tablet devices (20.3 percent), and direct mail (19.9 percent), as shown in Table 8. The detailed results are described in the following sections.

Table 8

Survey Responses by Recruitment Method

Method of Recruitment	**Pre-Campaign (n)**	**Percentage of Pre-Campaign**	**Post-Campaign (n)**	**Percentage of Post-Campaign**	**Total (n)**	**Total Percentage**
Flyer	80	7.1%	158	14.2%	238	10.6%
Mail	169	14.9%	278	25.1%	447	19.9%
Social	654	57.8%	448	40.4%	1102	49.2%
Tablet	229	20.2%	225	20.3%	454	20.3%
Total	1132	100.0%	1109	100.0%	2241	100.0%

4.3.1 Demographics. Based on the aggregated results, 59.5 percent of the participants were female, 38.4 percent were male, and 2.1 percent preferred not to say. Comparatively, according to the US Census Bureau of 2018, the seven study communities had 50.2 percent female populations on average, resulting in that female respondents were overrepresented in the overall survey (U.S. Census Bureau, 2018). However, in pedestrian-related crashes, males are more likely to be killed or injured than females (males comprise over two-thirds of pedestrian fatalities). According to the results, for the upcoming studies, extra effort and arrangement may be required to collect a demonstrative sample by gender.

In terms of race and ethnicity of participants, 68.7 percent were white, 8.6 percent were Hispanic or Latino, 7.7 percent were Black or African American, and 6.8 percent were Asian. Comparatively, based on the US Census Bureau of 2018, considering the average of the seven study communities, 50.2 percent of the observed population is White, 22.1 percent are Hispanic or Latino, 17.7 are Black or African American and 9.8 percent are Asian (U.S. Census Bureau, 2018). This specifies that White participants were overrepresented in the survey and Hispanic or Latino, Asian and Black or African American respondents were underrepresented in this study. Similarly, future survey studies should employ precise efforts to recruit participants who produce a representative sample of the demographics in each campaign location. Regarding the education of the participants, highly educated participants (bachelor's degree or higher) were also overrepresented (67.8 percent) compared to the mean of the seven community's population (40.9 percent) (U.S. Census Bureau, 2018).

4.3.2 Mode Share. According to the overall survey analysis, the majority of the participants use a car as a daily mode of transport. Of the 1,132 pre-campaign respondents, 88.9 percent prefer to use a car, 63.6 percent like to walk, 33.7 percent use public transportation, 16.7 percent use a bicycle, 3.6 percent use a motorcycle or moped, personal transportation device or another mode of transportation. Of the 1,109 post-campaign respondents, most of the survey participants (86.6 percent) prefer to use a car, 67.3 percent stated they prefer to walk, 46.5 percent use public transportation, 12.3 percent use a bicycle, 4.3 percent use motorcycle, moped, personal transportation device or other modes of transportation (Table 9).

Table 9

Survey Response for Transportation Mode

	Pre - Frequency	Pre- Percent of Respondents	Post- Frequency	Post- Percent of Respondents
Bicycle	167	16.7%	125	12.3%
Bus	121	12.1%	165	16.3%
By Car	892	88.9%	877	86.6%
Commuter Boat, Ferry	11	1.1%	10	1.0%
Commuter Rail	125	12.5%	183	18.1%
Motorcycle, Moped	16	1.6%	17	1.7%
Personal Transportation Device (Mobility Scooter, Skateboard, Rollerblades, etc.)	7	0.7%	10	1.0%
Subway	80	8.0%	112	11.1%
Walk	638	63.6%	682	67.3%
Other	13	1.3%	16	1.6%
Total	2070	N/A	2197	N/A

4.3.3 Pedestrian Safety Observations. The results of pedestrian safety observation of the other people showed improvements in pedestrians' and drivers' non-compliant behaviors, including pedestrians crossing against the signal, pedestrians crossing mid-block without a crosswalk, pedestrians crossing while using a cell phone, drivers not stopping for pedestrians in a crosswalk, drivers speeding near high volumes of pedestrians, drivers running red lights or stop signs, and drivers using a cell phone while driving (Table 10). To be specific, statistically significant improvements in drivers' behaviors (i.e., drivers not stopping for pedestrians in the crosswalk, and drivers speeding near high volumes of pedestrians) were observed following the Street Smart NJ pedestrian campaign. Figures 21 and 22 provide a detailed comparison of responses for the pedestrian safety observation questions.

Table 10

Results of Pedestrian Safety Observation

In the past week how often have you seen..	Pre (n)	Post (n)	Total (n)	Delta Mean Rank	Mann-Whitney U	Z	p-value	Effect Size
Q1 a: Pedestrians cross against the signal	1109	1090	2199	-4.29	602048.0	-0.17	0.869	0.004
Q1 b: Pedestrians cross mid-block (without crosswalk)	1106	1089	2195	-25.03	588480.5	-0.96	0.337	0.020
Q1 c: Pedestrians cross while using cell phone	1102	1083	2185	2.42	595409.0	-0.09	0.926	0.002
Q1 d: Drivers not stop for pedestrians in crosswalk	1100	1082	2182	-67.6	558225.5	-2.58	0.010*	0.055
Q1 e: Drivers speed with lots of pedestrians	1093	1076	2169	-51.54	543820.0	-3.13	0.002*	0.067
Q1 f : Drivers run red lights or stop signs	1093	1079	2172	-35.21	570554.5	-1.36	0.175	0.029
Q1 g: Drivers using cell phone	1085	1075	2160	-48.77	556850.0	-1.88	0.060	0.040

*Significant change between pre- and post-campaign response
Pre (n): Pre-campaign respondents, and Post (n): Post-campaign respondents

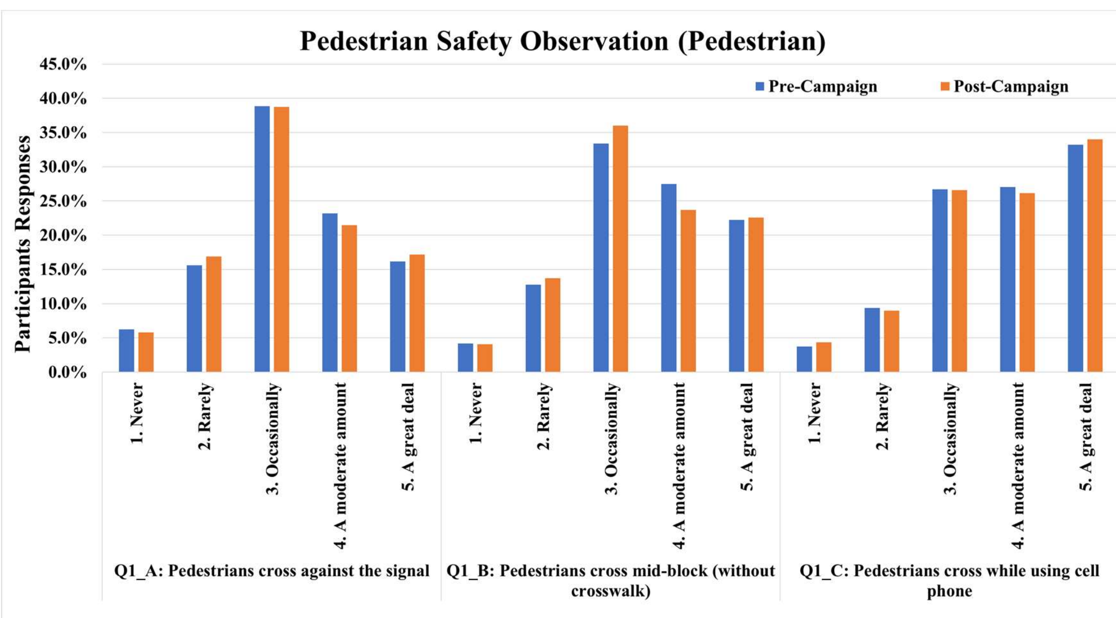

Figure 20. Pre- and post-campaign response comparison for Pedestrian Safety Observation (Pedestrian)

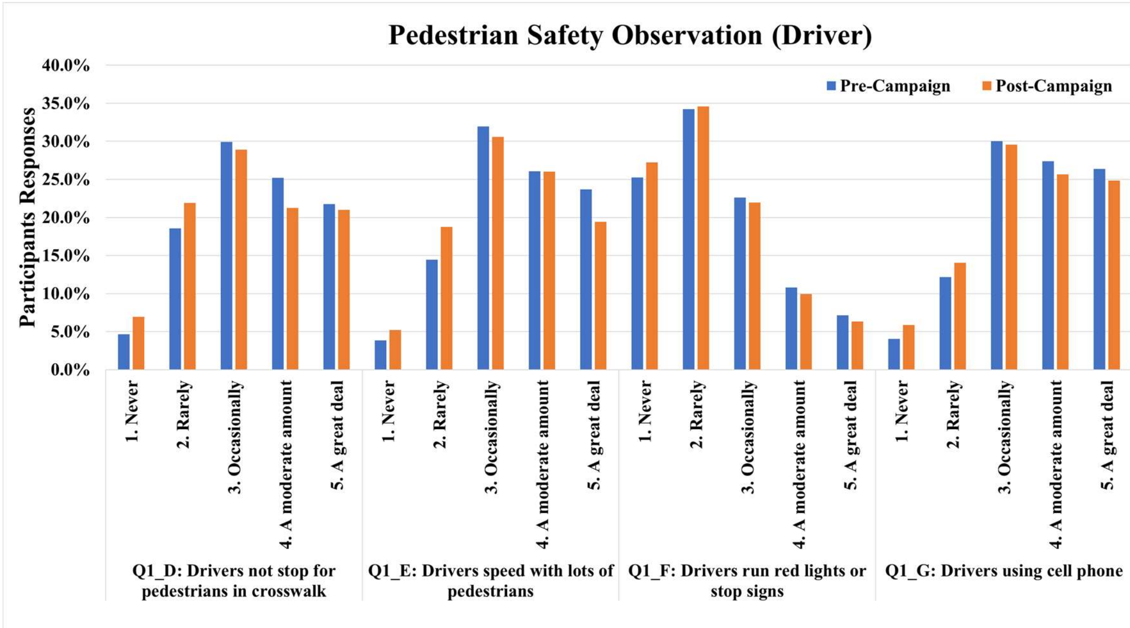

Figure 21. Pre- and post-campaign response comparison for Pedestrian Safety Observation (Driver)

4.3.4 Pedestrian Safety Behaviors. Similar to the pedestrian safety observations, based on the aggregated survey results, improvements in both pedestrians' and drivers' non-compliant self-reported behaviors were observed following the Street Smart NJ safety campaign. The safety improvements included pedestrian crossing against the signal, pedestrians crossing mid-block without a crosswalk, pedestrians crossing while using a cell phone, drivers not stopping for pedestrians while turning, drivers speeding while driving in areas with high volumes of pedestrians, drivers running red lights or stop signs, and drivers using a cell phone while driving. We note that a statistically significant change was reported in self-reported personal behavior for pedestrians crossing mid-block without a crosswalk. Figures 23 and 24 provide a detailed comparison of responses for the pedestrian safety observation questions.

Table 11

Results of Pedestrian Safety Self-Behavior Participants

In the past week how often have you...	**Pre (n)**	**Post (n)**	**Total (n)**	**Delta Mean Rank**	**Mann-Whitney U**	**Z**	**p-value**	**Effect Size**
Q2 a: Crossed against the signal	1024	1030	2054	-45.36	504069.0	-1.83	0.068	0.040
Q2 b: Crossed mid-block (without crosswalk)	1032	1028	2060	-65.04	496952.0	-2.61	0.009*	0.058
Q2 c: Crossed while using cell phone	1029	1021	2050	-20.70	514700.0	-0.89	0.376	0.020
Q2 d: Not stopped for pedestrians while turning (as a driver)	992	973	1965	-16.18	474661.5	-0.82	0.414	0.018
Q2 e: Speed while driving in area with lots of pedestrians	981	964	1945	-40.01	453384.5	-1.65	0.099	0.037
Q2 f: Run red lights or stop signs while driving	972	961	1933	-14.26	460159.0	-0.98	0.325	0.022
Q2 g: Driven while using a cell phone	970	959	1929	-20.78	455096.0	-0.94	0.348	0.021

*Significant change between pre- and post-campaign response
Pre (n): Pre-campaign respondents, and Post (n): Post-campaign respondents

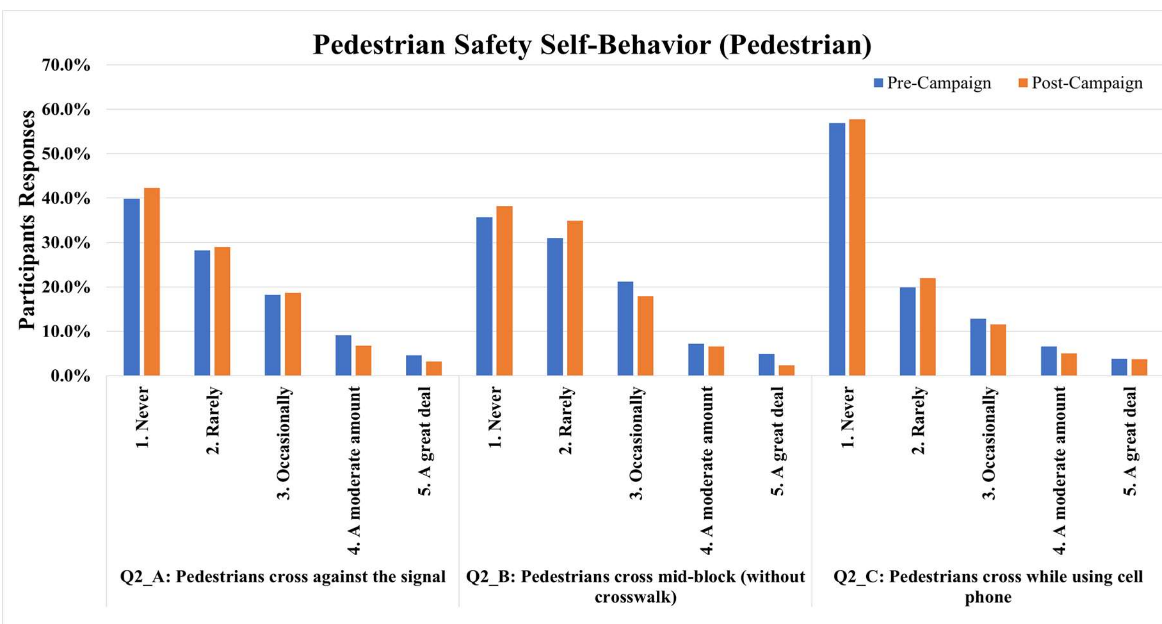

Figure 22. Pre- and post-campaign response comparison for Pedestrian Safety Self-Behavior (Pedestrian)

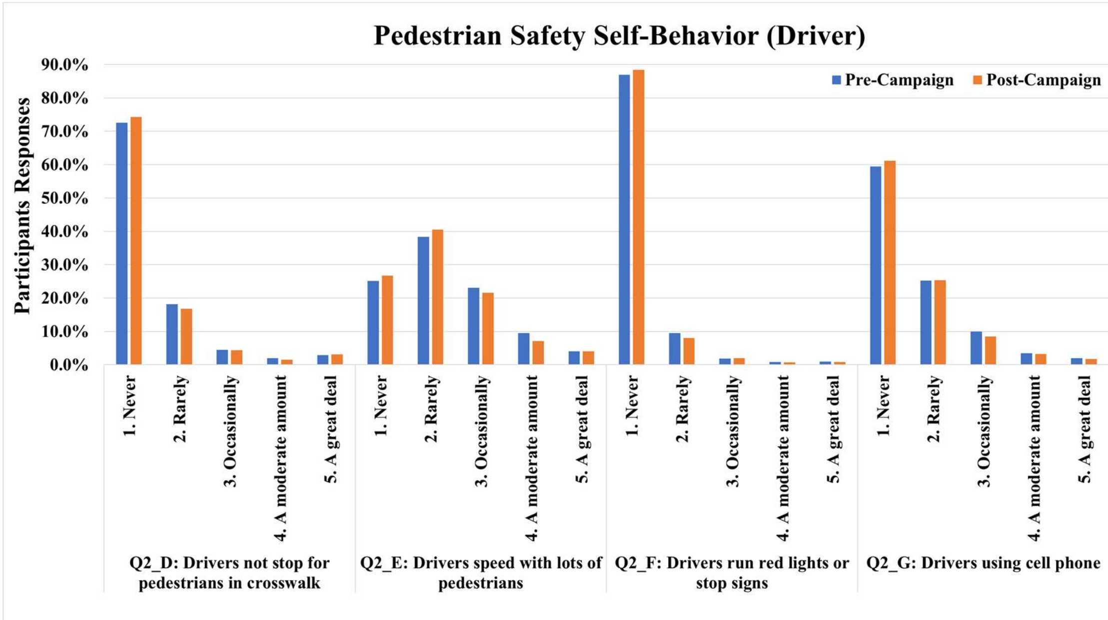

Figure 23. Pre- and post-campaign response comparison for Pedestrian Safety Self-Behavior (Driver)

4.3.5 Pedestrian Safety Knowledge. Pertaining to the knowledge of pedestrian traffic signals, most of the respondents (98.9 percent) indicated that it is acceptable to start crossing the street when the “Walk” signal is enabled, and 99 percent indicated they should not start walking when the “Don’t Walk” sign is enabled. However, there was confusion about whether or not to start crossing when the pedestrian signal count-down clock was enabled. Participants were shown two pictures of countdown clocks, one with 23 seconds remaining and one with 8 seconds remaining. Although pedestrians are not supposed to begin crossing during a count-down clock of any length, 18 percent indicated they believed one should begin to cross in the short count-down condition, and 38.8 percent indicated one should begin to cross during the longer count-down clock. The results demonstrate a lack of public understanding and awareness of how count-down clocks should function. In the future, Street Smart may want to focus on education regarding the proper use of the pedestrian signals.

Table 12

Results of Knowledge of Pedestrian Traffic Signals

Q: At intersections with a traffic light and pedestrian signal, when should you begin to cross the street?		
	Total Frequency	**Total Percentage of Respondents**
Walk signal	2084	98.9%
Eight-second count-down clock	380	18.0%
Twenty-three second count-down clock	818	38.8%
Don't walk signal	22	1.0%
Total	2107	100.0%

In terms of the pedestrian safety law enforcement, overall, 90.6 percent indicated that pedestrians could receive a ticket for violating pedestrian traffic laws, while 81.9 percent of the survey respondents indicated knowledge that a ticket could be received for crossing against the signal and 37.8 percent of the participants believed one could receive a ticket for crossing while using a cell phone, although no state law exists to regulate this specific behavior. In addition, 96.8 percent of respondents indicated that it is illegal to drive while using a hand-held cell phone and 93 percent of survey participants showed knowledge that a ticket could be issued for drivers not stopping for pedestrians. This indicates that efforts need to be targeted to spread public education about this law.

Table 13

Results of Knowledge of Pedestrian Safety Law Enforcements

Q: To the best of your knowledge, can you receive a ticket in New Jersey for…?		
	Total Frequency	**Total Percentage of Respondents**
Violating pedestrian traffic laws?	1863	90.6%
Crossing the street illegally (against signal or mid-block)	1683	81.9%
Using a hand-held cell phone while crossing	777	37.8%
Not stopping for pedestrians in crosswalk	1913	93.0%
Using a hand-held cell phone while driving	1990	96.8%
Total	2056	100.0%

It should be noted that the results demonstrated that almost all survey respondents have knowledge of pedestrian safety traffic laws. Thus, observed noncompliance may be due to a conscious choice to disregard the law or lack of knowledge about how to appropriately apply knowledge of the law to a specific intersection context.

4.3.6 Campaign Exposure. Most survey participants indicated they had read, seen or heard some type of safety messaging in the last 30 days (Table 14). 31.6 percent of respondents indicated exposure to pedestrian safety campaign messaging in both the pre- and post-campaign. To be specific, a statistically significant improvement in pedestrian safety was observed following the Street Smart NJ pedestrian campaign.

Table 14

Results of Exposure to Highway Safety Campaign Messaging

Q: In the last 30 days, have you read, seen or heard any messages addressing the following…?							
	Total (n)	**Total**	**Pre (n)**	**Pre**	**Post (n)**	**Post**	**p-value**
Speeding/aggressive driving	736	35.3%	356	34.3%	380	36.4%	0.308
Driving under the influence of alcohol	765	36.7%	346	33.3%	419	40.1%	0.001*
Driving under the influence of a drug	360	17.3%	158	15.2%	202	19.3%	0.002*
Drowsy driving	131	6.3%	51	4.9%	80	7.7%	0.010*
Seat belt use	615	29.5%	287	27.6%	328	31.4%	0.058
Distracted driving	804	38.6%	364	35.0%	440	42.1%	0.001*
Pedestrian safety	659	31.6%	269	25.9%	390	37.4%	0.000*
Bicycle safety	304	14.6%	145	14.0%	159	15.2%	0.410
None of the above	589	28.3%	333	32.1%	256	24.5%	0.000*

*Significant change between pre- and post-campaign response
Pre (n): Pre-campaign respondents, and Post (n): Post-campaign respondents

Moreover, based on the aggregated analysis of all the study communities, survey respondents indicated that they have seen or heard much more about the Street Smart program following the pedestrian safety campaign. Prior to the campaign, 85.6 percent of survey participants said they had not seen or heard about Street Smart. That number dropped to 68.4 percent following the campaign. This decrease was statistically significant (p=0.00); however, the results show there is still a lack of public knowledge of Street Smart NJ. In addition, survey participants were also shown pictures of specific Street Smart NJ campaign signs and asked if they had seen them. According to the aggregated survey result, there were statistically significant increases in recognition for all messages, including “Wait for the Walk,” “Obey Speed Limits,” “Heads Up, Phones Down,” “Any Street Smart sign,” “Stop for Pedestrians,” and “Use Crosswalks” in the post-campaign survey. These results indicated the effectiveness of the Street Smart NJ campaign in enhancing public awareness on both pedestrian and driver safety.

Table 15

Results of Exposure to Street Smart NJ Campaign Messages

Q: In the last 30 days, have you read, seen or heard any messages similar to the following…?							
	Total (n)	**Total**	**Pre (n)**	**Pre**	**Post (n)**	**Post**	**p-value**
"Use Crosswalks"	699	33.5%	218	21.0%	481	46.0%	0.000*
"Wait for the Walk"	388	18.7%	100	9.6%	288	27.8%	0.000*
"Stop for Pedestrians"	558	26.8%	168	16.2%	390	37.3%	0.000*
"Obey Speed Limits"	364	17.5%	116	11.2%	248	23.8%	0.000*
"Heads Up, Phones Down"	597	28.8%	201	19.5%	396	38.0%	0.000*
Any Street Smart sign	1013	45.2%	362	32.0%	651	53.7%	0.000*

*Significant change between pre- and post-campaign response
Pre (n): Pre-campaign respondents, and Post (n): Post-campaign respondents

4.3.7 Enforcement Awareness. With respect to awareness of enforcement efforts, while most of the survey respondents indicated that they had not read, seen, or heard about police efforts to enforce pedestrian safety laws in the neighborhood, there were small but insignificant improvements in police efforts to enforce pedestrian safety following the campaign (Table 16). Based on the results, 25.9 percent stated that they were aware of local efforts to enforce the law to stop for pedestrians in the crosswalk and 15.5 percent of all respondents stated that they have seen or heard about efforts to enforce pedestrian safety laws for crossing against the signal or outside the crosswalk.

Table 16

Results of Exposure to Police Efforts to Enforce Pedestrian Safety Law Results of Exposure to Police Efforts to Enforce Pedestrian Safety Law

Q: Have you recently read, seen or heard about the following police efforts to enforce pedestrian safety?							
	Total (n)	**Total**	**Pre(n)**	**Pre**	**Post(n)**	**Post**	**p-value**
Crossing against signal or outside crosswalk	304	15.5%	140	14.6%	164	16.4%	0.280
Not stopping for pedestrians in crosswalk	507	25.9%	229	23.9%	278	27.7%	0.051
Other	68	3.5%	32	3.3%	36	3.6%	0.757

*Significant change between pre- and post-campaign response
Pre (n): Pre-campaign respondents, and Post (n): Post-campaign respondents

Additionally, the awareness was reinforced by responses to the question, which asked how strictly respondents notice police in their area impose pedestrian-related safety laws. Most survey respondents indicated they believed pedestrian-safety laws were enforced “not very strictly” or “not at all” (80.5 percent). However, there was a significant improvement following the campaign (p= 0.007). In addition, less than half of respondents reported that police enforce driver-related pedestrian safety laws (e.g., speeding, stopping for pedestrians in the crosswalk) “very strictly” or “somewhat strictly” (47.4 percent). There was not a significant improvement in these responses following the campaign (p= 0.095). Table 17 and 18 shows the results of self-reported opinion about the police efforts to enforce driver and safety laws respectively.

Table 17

Results of Self-Reported Opinion about the Police Efforts to Enforce Pedestrian Safety Laws

Q: How strictly do you think police in your area enforce pedestrian-related safety laws, such as crossing against the signal or mid-block?		
	Total (n)	**Percentage**
Very strictly	81	4.5%
Somewhat strictly	269	15.0%
Not very strictly	706	39.4%
Not at all	738	41.1%
Total	1794	100.0%

Table 18

Results of Self-Reported Opinion about the Police Efforts to Enforce Drivers Safety Laws

Q: How strictly do you think police in your area enforce driver-related pedestrian safety laws, such as speeding or stopping for pedestrians in the crosswalk?		
	Total (n)	**Percentage**
Very strictly	259	13.8%
Somewhat strictly	629	33.6%
Not very strictly	638	34.1%
Not at all	345	18.4%
Total	1871	100.0%

Chapter 5

Summary of Results and Future Work

This study provides observational and behavioral evaluation of the Street-Smart NJ pedestrian safety intervention campaign. In order to examine the effectiveness of the campaign, pre- and post-campaign data collection were conducted at the study locations. To assess the changes in behaviors of pedestrians and drivers followed by the campaign, a web-based survey was designed and distributed among the study communities, along with monitoring several intersections. Overall results from both studies confirmed that the Street Smart NJ program methodology demonstrated success in reducing risky behaviors among drivers and pedestrians. The results presented in this study support the principle that education and enforcement programs, such as Street Smart NJ, can be useful in supporting engineering safety improvements.

5.1 Summary of Results

5.1.1 Observational study. Analysis of aggregated observations from all eight locations shows statistically significant reductions in risky behaviors as follows:

- In terms of the pedestrians crossing against the signal or outside the crosswalk, there was a 21 percent reduction observed followed by the campaign.
- For the turning vehicle, a 40 percent reduction in turning vehicle failing to stop for a pedestrian and a 60.3 percent reduction in drivers failing to stop before turning right on red or at a stop sign was reported.
- Drivers running a red light or a stop sign was reduced by 45.2 percent at the

study locations.

- Aggregated observations from all locations show 41 percent and 21 percent reductions in non-compliant behaviours of drivers and pedestrians, respectively.

- Busy urban intersections (e.g., Newark) showed more consistent improvements in safety behavior as a result of education and enforcement, compared to suburban locations (e.g., Garfield) with lower traffic volume. This is a promising result, because busy urban intersections have higher crash rates and the areas where the greatest safety benefits can be realized through education and enforcement activities

5.1.2 Behavioral study. Based on the 2,558 survey responses collected through four different recruitment methods, including in-person flyer distribution, direct mail, social media advertisements, and intercept surveys using tablet devices, the following findings were reached.

- There were improvements in pedestrians' and drivers' non-compliant behaviors, including pedestrians crossing against the signal, pedestrians crossing mid-block without a crosswalk, pedestrians crossing while using a cell phone, drivers not stopping for pedestrians in a crosswalk, drivers speeding near high volumes of pedestrians, drivers running red lights or stop signs, and drivers using a cell phone while driving
- Most of the respondents (99.0 percent) have knowledge of pedestrian safety laws and regulations, with some confusion related to pedestrian count-down signals and the use of a cell phone while crossing.

- 53.7 percent of survey respondents indicated that they had increased knowledge of Street Smart NJ following the campaigns in their communities.
- A statistically significant increase in recognition of all Street Smart NJ messages — Stop for Pedestrians, Obey Speed Limits, Wait for the Walk, Use Crosswalks and Heads Up, Phones Down — following the campaigns.
- The majority of respondents (90 percent) indicated that pedestrians could receive a ticket for violating pedestrian traffic laws, and 81.9 percent of the survey respondents indicated knowledge that a ticket could be received for crossing against the signal. In aspects to drivers, 93 percent of survey participants showed knowledge that a ticket could be issued for drivers not stopping for pedestrians, and 96.8 percent of respondents indicated that it is illegal to drive while using a hand-held cell phone.

5.2 Future Work

In terms of the behavioral analysis conducted by surveys, extra efforts could be made to better match the demographic representation of the responding sample to that of the area. Additional qualification questions in the survey, along with a large sample to support it, could have resulted in the potential for more subgroup analysis. For example, questions were asked to determine if respondents walked or drove to their destinations every week; however, did they primarily walk or drive to their destinations? When responding to the survey, were they responding from the point-of-view of a driver or that of a pedestrian? This point of view determination could also be used in other areas, such as the location or specific town a respondent was thinking about when considering driver and pedestrian behavior, what intersection types, etc. If questions were added to gather this level of detail, it may have led to some patterns emerging that would inform the focus of future campaign activities.

Regarding the observational analysis performed using video data, implementation of modern image-processing techniques with advanced deep learning and machine learning algorisms is recommended. Additionally, collecting more video data, at least for continuous 48-72 hours, to obtain a better understanding of pedestrians and driver activates at the study locations is also suggested. In terms of the analysis, evaluating the surrogate safety measures (SSM) as indicators of crashes and incidents are useful tools in safety evaluations and could help practitioners and professions to have a better picture of the problem.

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Appendix A

Hourly Observed Non-Compliance for Each Study Location

1) Hourly Observed Non-Compliance for Township of Teaneck

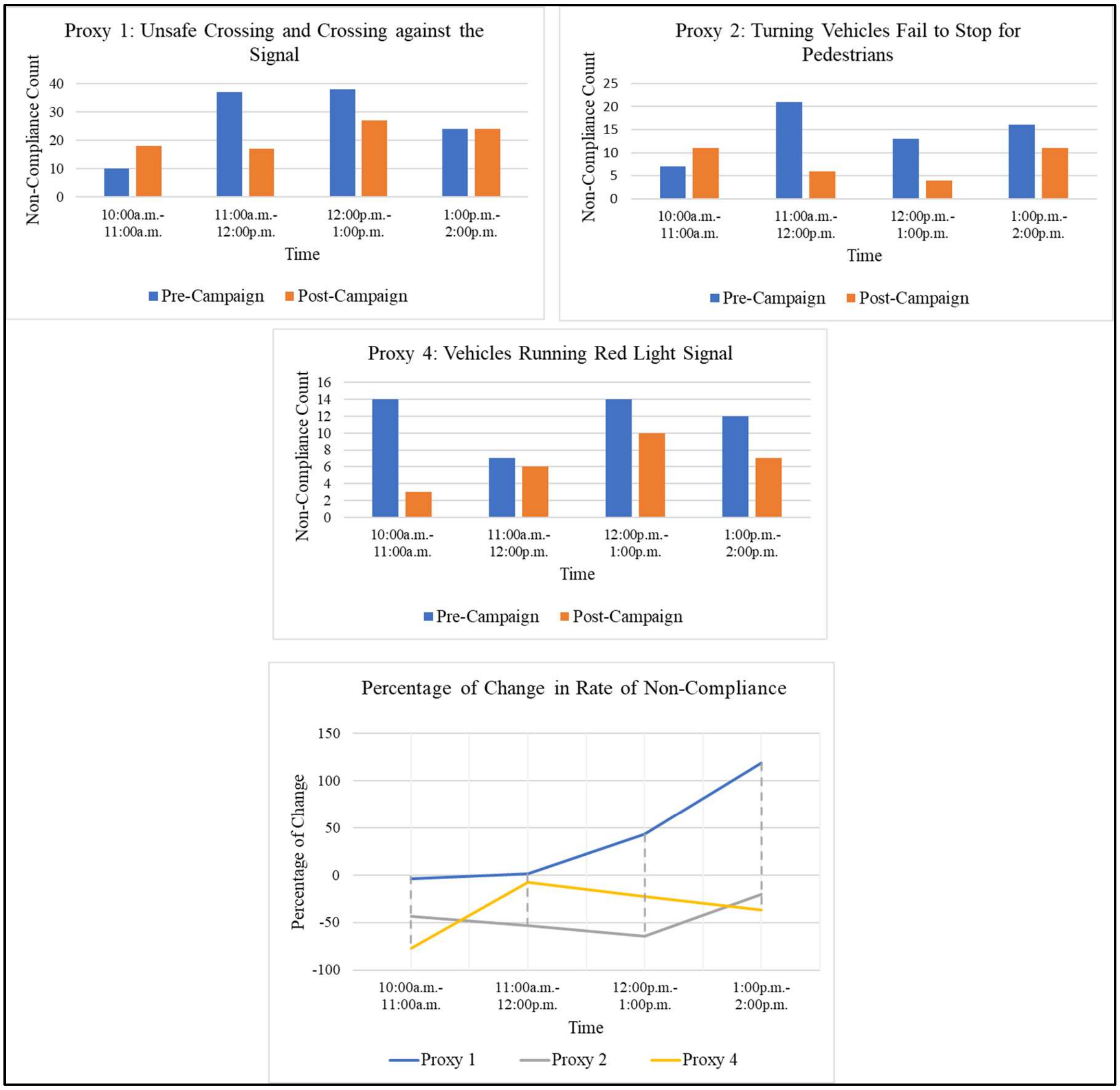


Figure A1. Hourly Observed Non-Compliance for the Township of Teaneck

2) Hourly Observed Non-Compliance for City of Asbury Park

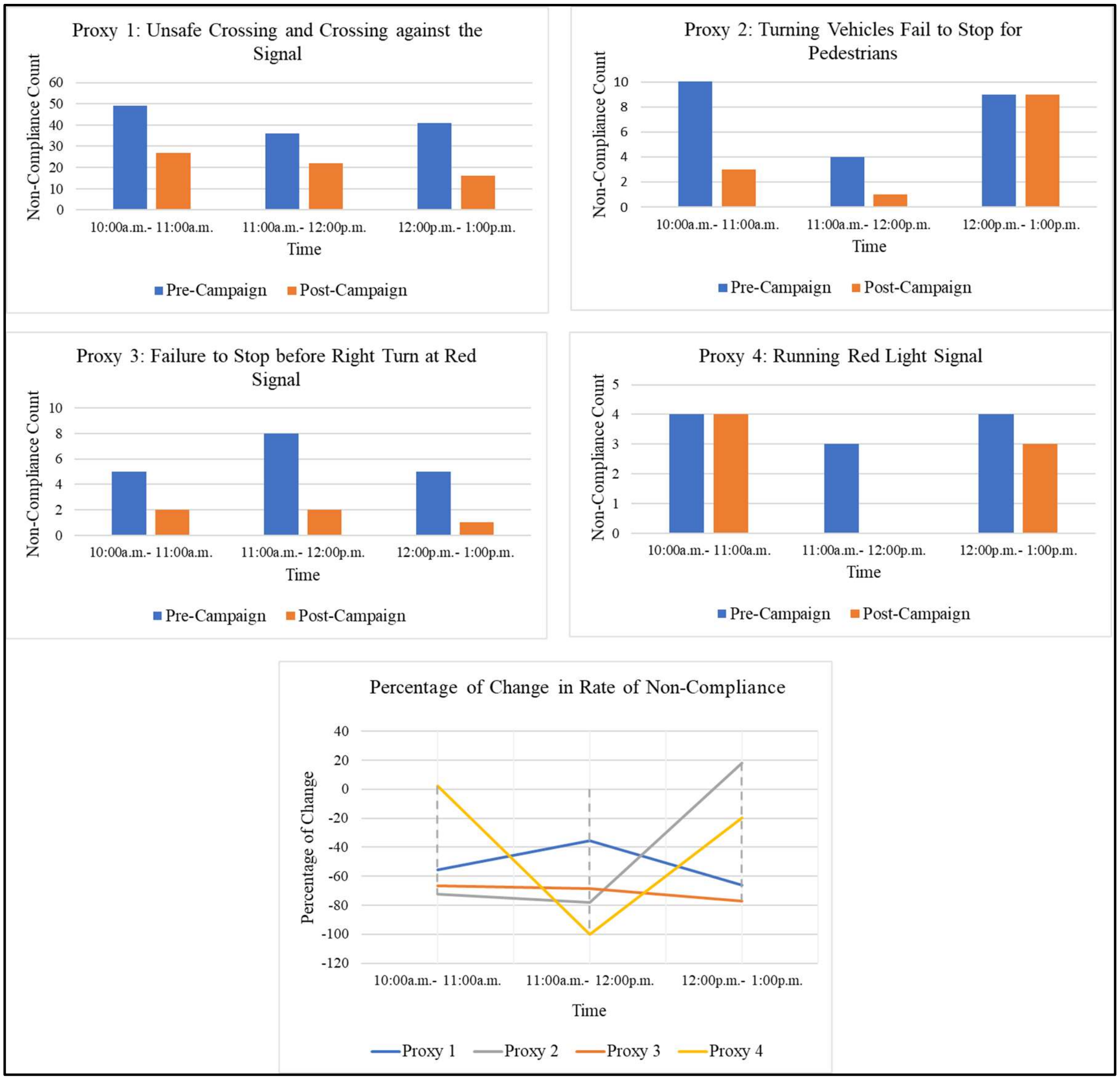


Figure A2. Hourly Observed Non-Compliance for the City of Asbury Park

3) Hourly Observed Non-Compliance for City of Garfield

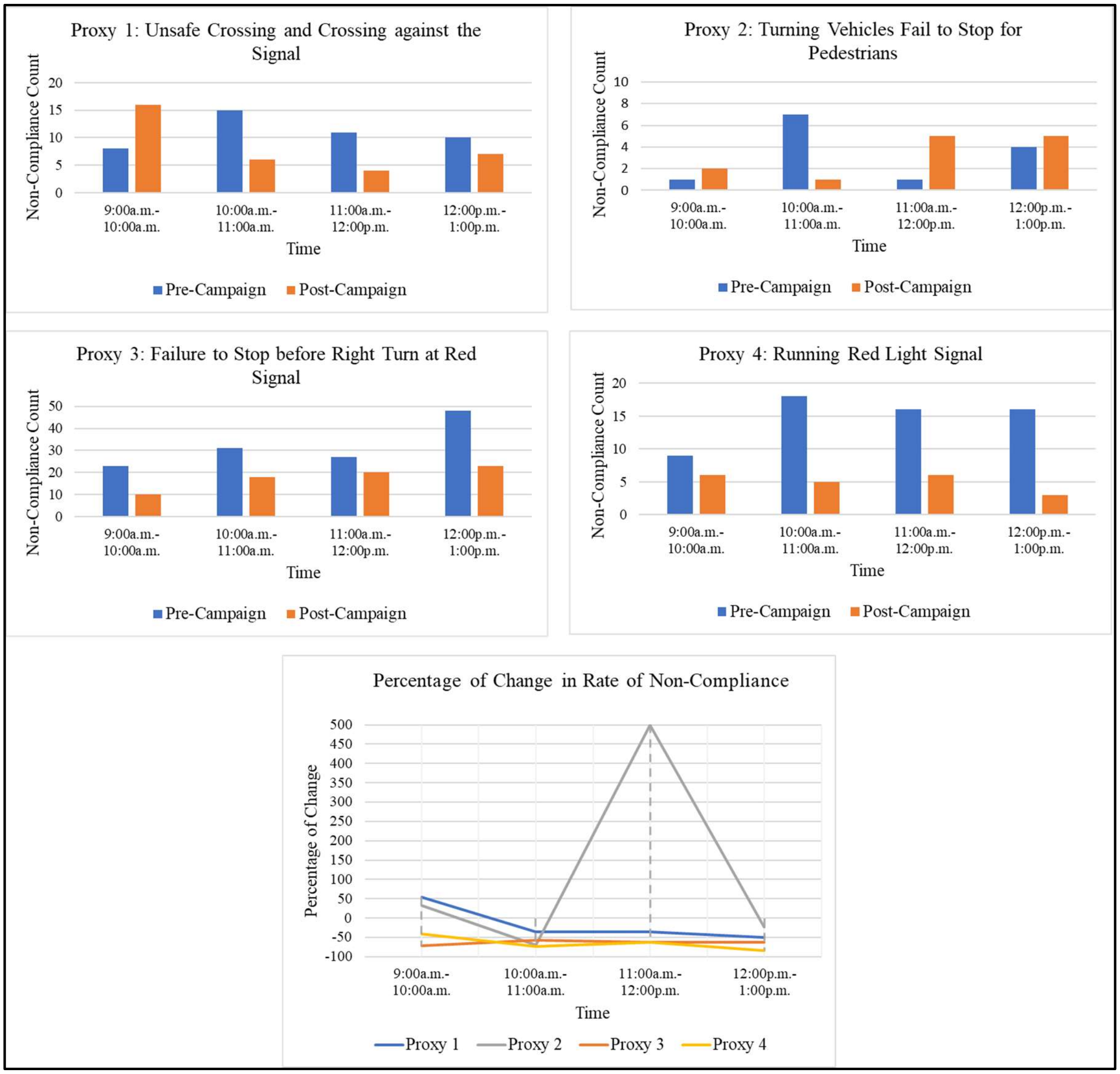


Figure A3. Hourly Observed Non-Compliance for the City of Garfield

4) Hourly Observed Non-Compliance for City of Newark

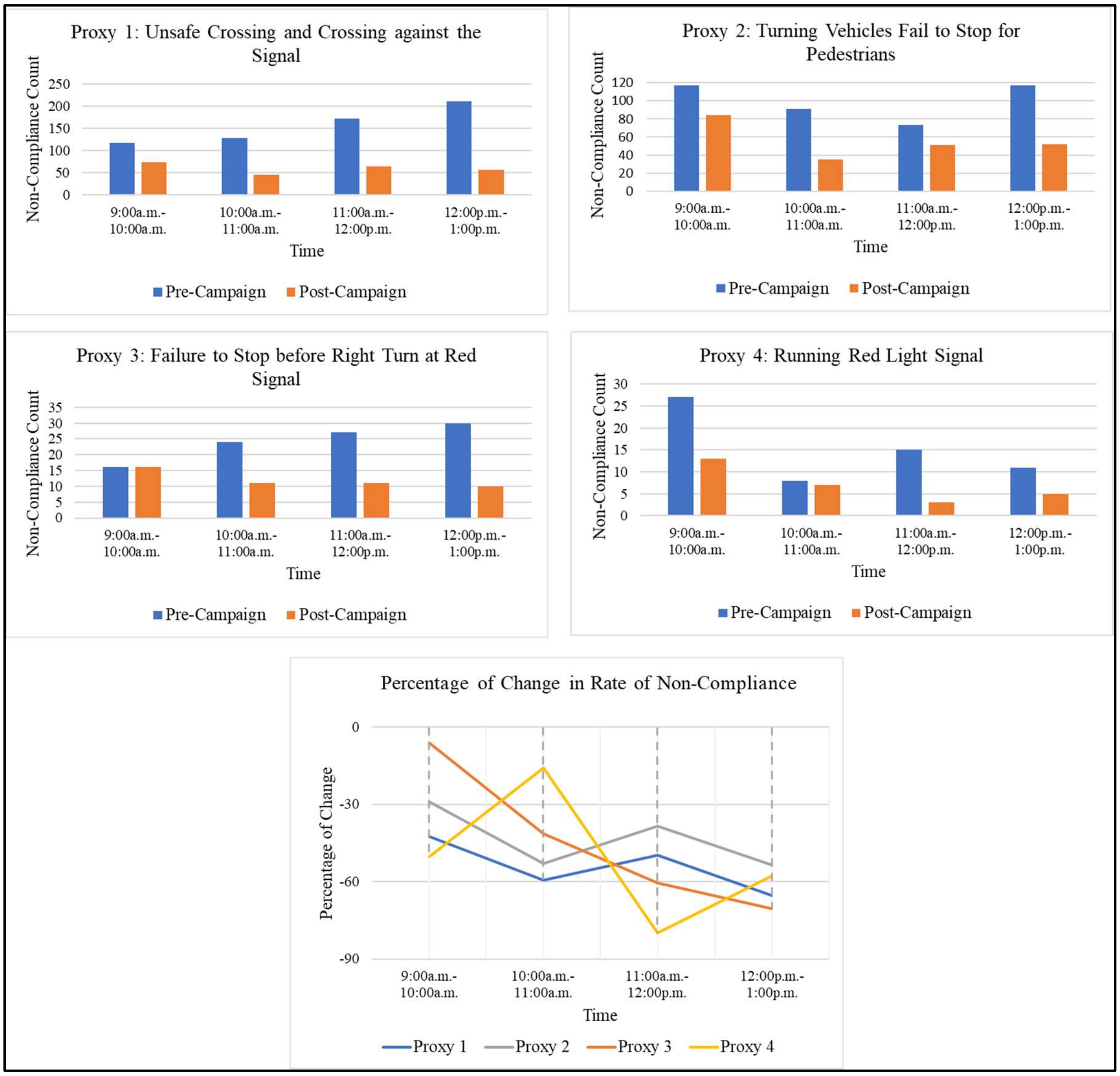


Figure A4. Hourly Observed Non-Compliance for the City of Newark

5) Hourly Observed Non-Compliance for Borough of Morris Plain

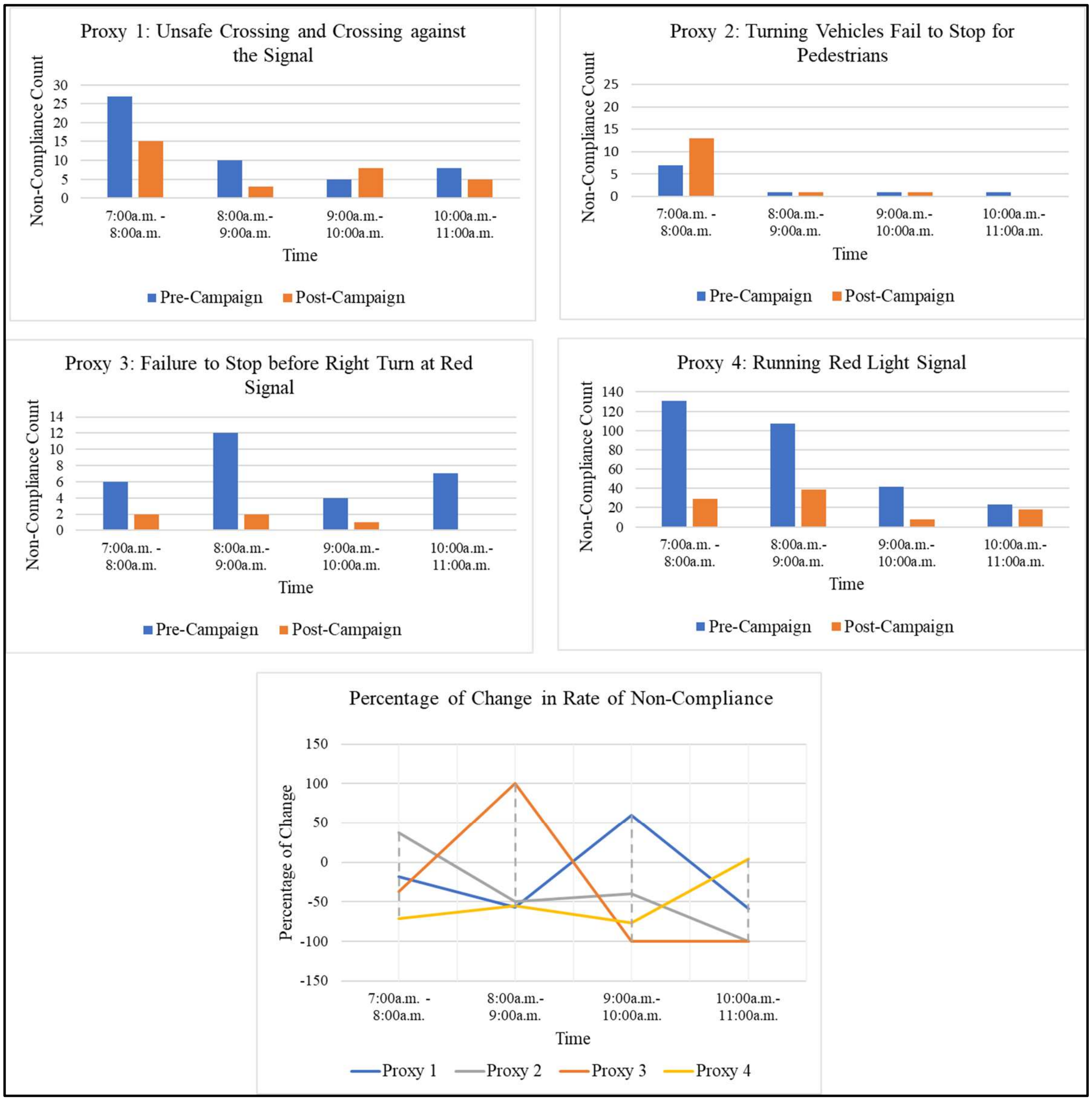


Figure A5. Hourly Observed Non-Compliance for the Borough of Morris Plain

6) Hourly Observed Non-Compliance for Municipality of Princeton

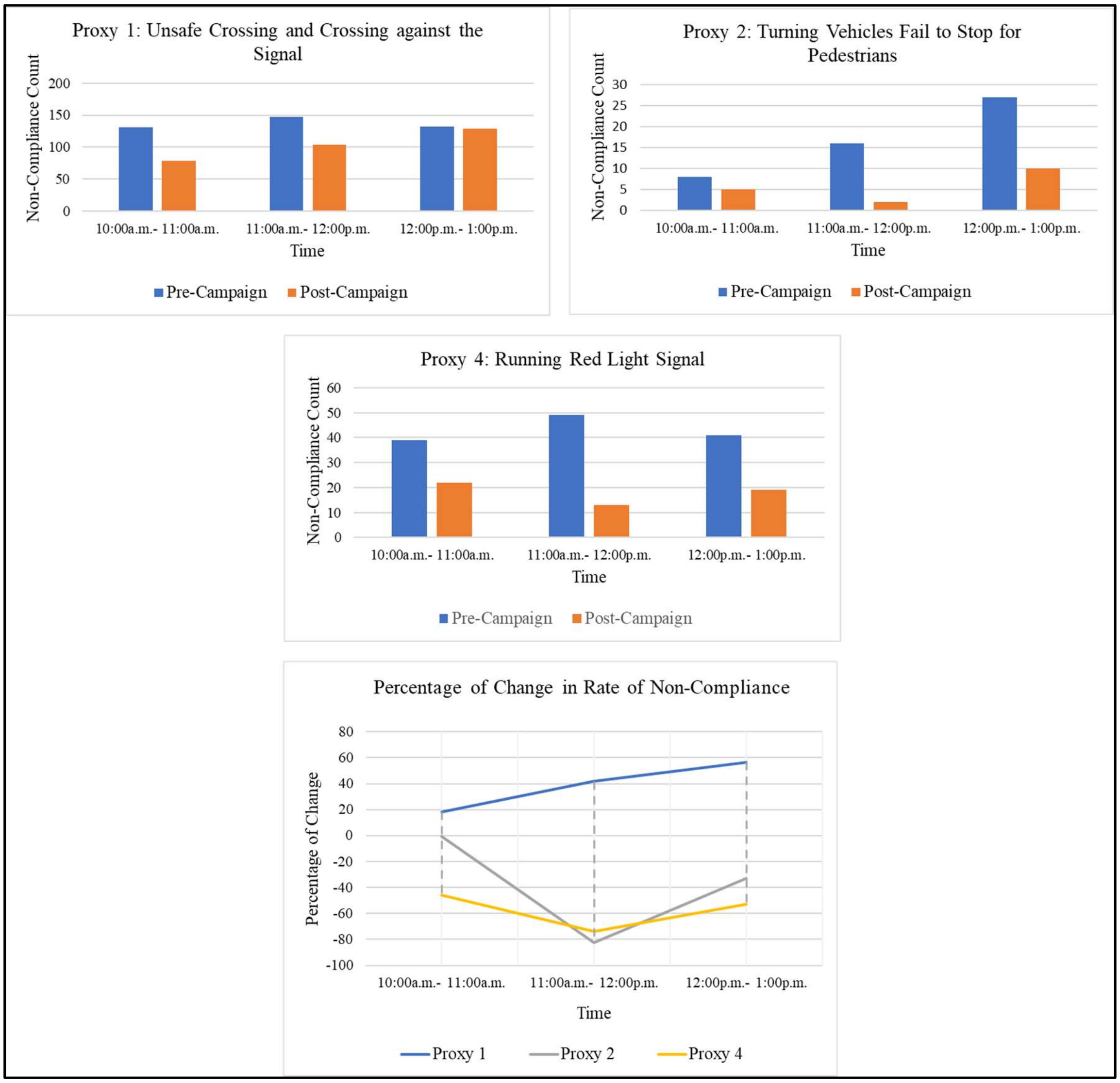


Figure A6. Hourly Observed Non-Compliance for the Municipality of Princeton

7) Hourly Observed Non-Compliance for Borough of Rutherford

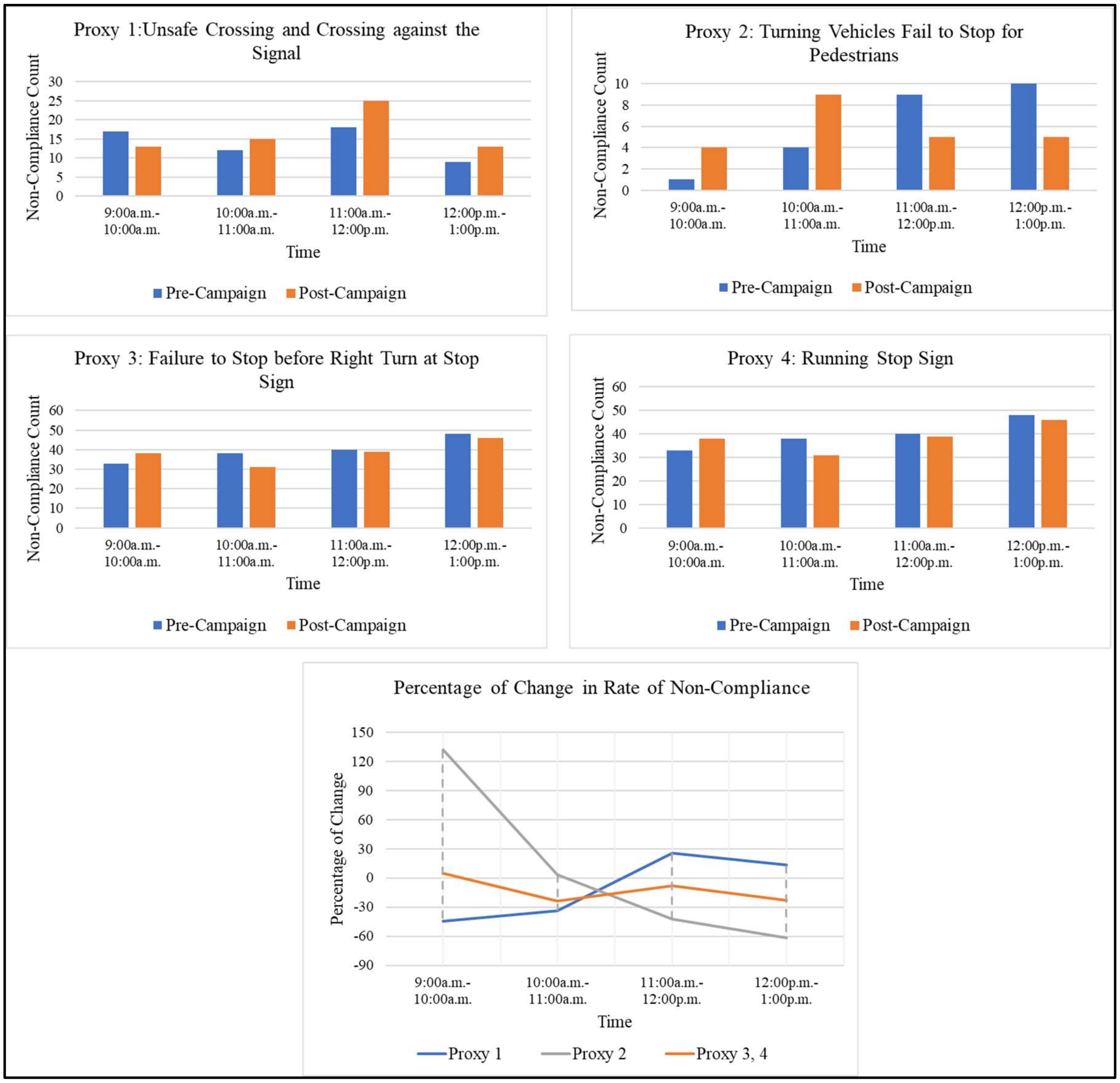


Figure A7. Hourly Observed Non-Compliance for the Borough of Rutherford

8) Hourly Observed Non-Compliance for Township of Woodbridge

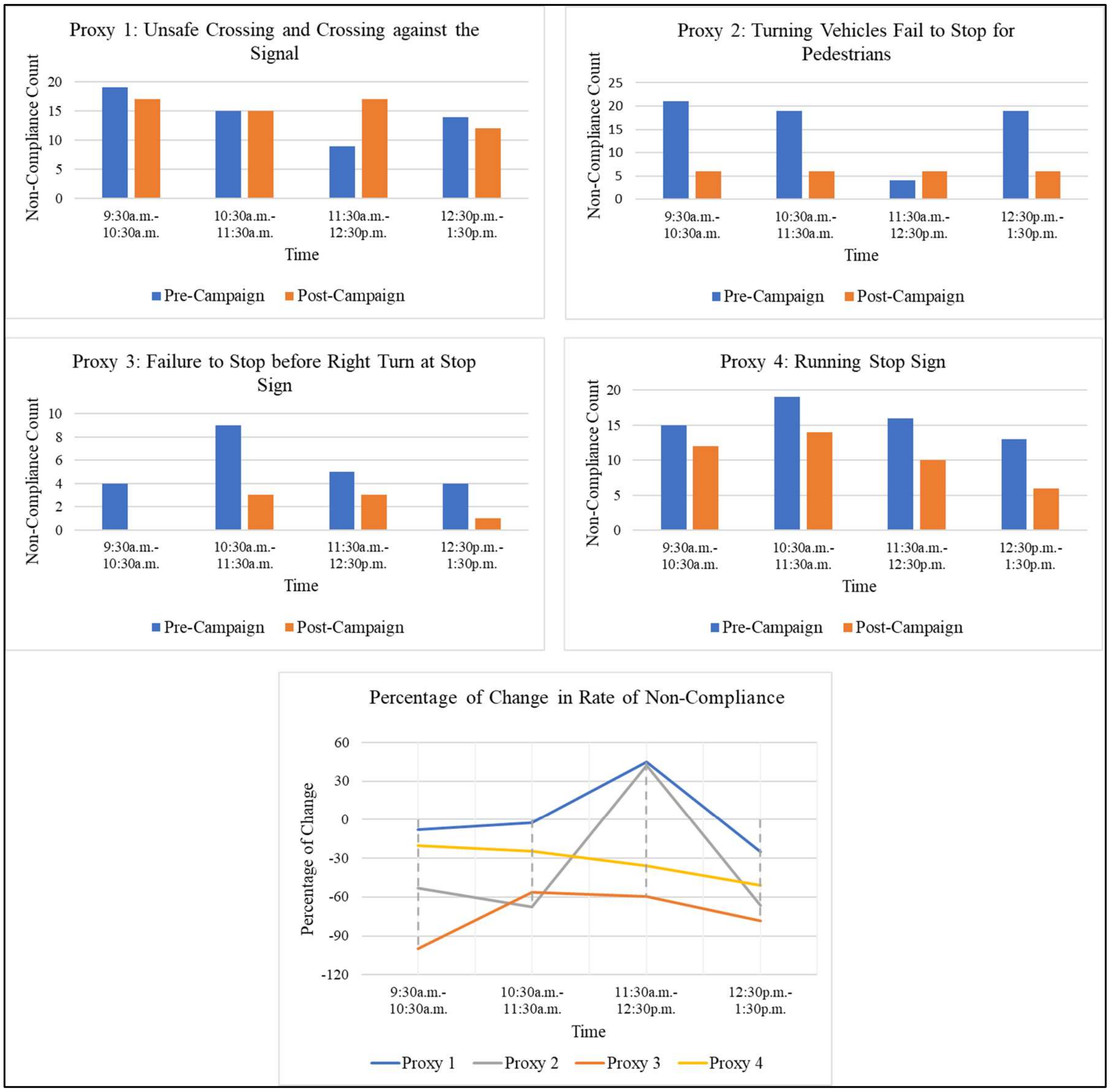


Figure A8. Hourly Observed Non-Compliance for the Township of Woodbridge

Appendix B

Survey Questionnaire

Screener

S1. Are you 18 years of age or older?

a) Yes
b) No
→ **If No,** TERMINATE

S1.1 In what state do you live?

a) I live in New Jersey
→ **If Yes,** S2

b) I do not live in New Jersey
→ **If No,** S1.2

S1.2 In what state do you work, go to school, or primarily frequent during the day?

a) I work, go to school, or primarily frequent New Jersey
→ **If Yes,** S2

b) I do not work, go to school, or primarily frequent New Jersey
→ **If No,** TERMINATE

S2. Where do you live?

a) Asbury Park
b) Boonton
c) Cherry Hill
d) Fort Lee
e) Garfield
f) Morris Plains
g) Newark
h) Princeton

i) Rutherford
j) None of the above [**exclusive; cannot select this response *and* any of the above]**
If none of the above, Proceed to S2.1

S2.1 Please enter your home zip code or the name of the city you live in below:

a) Zip Code
b) City – drop down list of NJ municipalities, with Other/not NJ option
→ Regardless of the answer, Proceed to S3

S3. Do you work, go to school, or regularly frequent (e.g., for shopping, social events, errands, or recreation) any of the following locations? *Please select all that apply*

a) Asbury Park
b) Boonton
c) Cherry Hill
d) Fort Lee
e) Garfield
f) Morris Plains
g) Newark
h) Princeton
i) None of the above [exclusive; cannot select this response and any of the above]

If none of the above, Proceed to S3.1

If any of above, Proceed to S4

S3.1 Please enter the zip code or the name of the city you work/go to school/regularly frequent below:

a) Zip Code
b) City drop down list of NJ municipalities, with Other/not NJ option

→ If S2, 2.1, 3, or 3.1 within study area, Proceed to S4
c) If outside study area, terminate.

1. In the past week, how often **have you seen…**

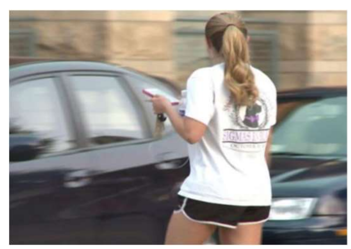
People who crossed the street in an unsafe manner against the "walk" signal?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

People who crossed the street in an unsafe manner outside of a crosswalk?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

People using a hand-held cell phone while walking or crossing the street?



a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

Drivers not stopping for pedestrians in the crosswalk when traveling or making a left or right turn?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

Drivers speeding in areas with a lot of people walking?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

Drivers running red lights or stop signs?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

Drivers using a hand-held cell phone while driving?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

2. In the past week, **have you…**

Crossed the street against the "walk" signal?

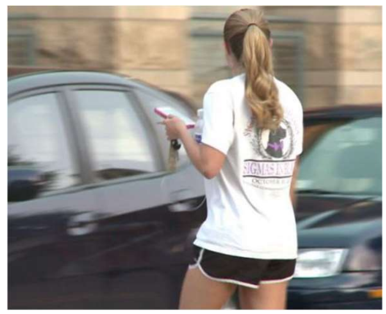
a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't walk

Crossed the street in an unsafe manner outside of a crosswalk?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't walk.

Used a hand-held cell phone while walking or crossing the street?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't walk



Not stopped for pedestrians in crosswalks when traveling or making a left or right turn?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't drive

Driven over the speed limit on a local street?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't drive

Run a red light or stop sign?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't drive

Used a hand-held cell phone while driving?

a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal
f) Not Applicable – Didn't drive

3. At intersections with a traffic light and pedestrian signal, when should **you begin to cross** the street? *(check all that apply)*

4. In the last 30 days, have you read, seen or heard any messages addressing the following… *(check all that apply)*

a) Speeding/aggressive driving
b) Driving under the influence of alcohol
c) Driving under the influence of a drug
d) Drowsy driving
e) Seat belt use
f) Distracted driving
g) Pedestrian safety
h) Bicycle safety
i) None of the "above"

5. Have you read, seen or heard any message or signage that mentions "Street Smart"?

a) Yes
b) No

6. In the last 30 days, have you read, seen or heard any messages similar to the following…

a

- Yes
- No

b

- Yes
- No

c

- Yes
- No

d

- Yes
- No

e

- Yes
- No

If select any of ped/speeding options in Q5 or any of the images in Q6 ask:

7. Where have you seen or heard these messages *(check all that apply)*

a) Radio
b) Streaming radio
c) Television
d) News
e) On posters or signs you have seen while driving
f) On posters or signs you have seen while walking
g) On posters or signs at transit stations and on or in buses
h) On tent cards
i) Tip cards or fact sheets distributed by your places of employment or schools
j) Tip cards or fact sheets distributed by law enforcement officers, family, friends, community organizations, volunteers on the street or businesses
k) Social media sites (e.g., Facebook, Twitter, and Instagram)
l) Internet advertising
m) Other (Please specify: ________)

8. In the past month, have you seen or received information about pedestrian safety from any of the following sources *(check all that apply)*

a) Emails from your employer or school
b) Emails from friends, family, community organizations or businesses
c) Newsletters distributed by your employer or school
d) Newsletters distributed by community organizations or places of worship
e) Local newspapers
f) Social media sites
g) Other (Please specify: ________)

9. To the best of your knowledge, **can you receive a ticket in New Jersey** for…

a) Violating pedestrian traffic laws?
Yes No
b) street in an unsafe manner outside of a crosswalk or against the "walk" signal Yes No
c) Using a hand-held cell phone while crossing the street
Yes No
d) Not stopping for pedestrians in a crosswalk
Yes No
e) Using a hand-held mobile device while driving
Yes No

10. Have you recently read, seen or heard about the following police efforts to enforce pedestrian safety laws? (*Check all that apply)*

a) Police issuing tickets or warnings for people who crossed the street in an unsafe manner
b) Police issuing tickets or warnings for "Not stopping for pedestrians in crosswalks"
c) Other (Please specify ___)
d) Never

11. How strictly do you think police in your area enforce **pedestrian-related safety laws**, such as jaywalking or crossing against the traffic light?

a) Very strictly
b) Somewhat strictly
c) Not very strictly
d) Not at all
e) Don't know/rather not say

12. How strictly do you think police in your area enforce **driver-related pedestrian safety laws**, such as speeding or stopping for pedestrians in crosswalks?

a) Very strictly
b) Somewhat strictly
c) Not very strictly
d) Not at all
e) Don't know/rather not say

13. How would you rate the following in terms of how serious a problem is in your community?

Distracted driving (e.g., texting or talking on the phone while driving)

a) Not at all a problem
b) Minor problem
c) Moderate problem
d) Serious problem

Distracted pedestrian (e.g., texting or talking on the phone while walking)

a) Not at all a problem
b) Minor problem
c) Moderate problem
d) Serious problem

Pedestrians disobeying traffic rules (e.g., crossing in the middle of a street or against the light)

a) Not at all a problem
b) Minor problem
c) Moderate problem
d) Serious problem

Drivers not stopping for pedestrian at crosswalks

a) Not at all a problem
b) Minor problem
c) Moderate problem
d) Serious problem

Speeding

a) Not at all a problem
b) Minor problem
c) Moderate problem
d) Serious problem

Bicyclists not following traffic laws

a) Not at all a problem
b) Minor problem
c) Moderate problem
d) Serious problem

14. Please evaluate the degree to which you agree or disagree with the following statements:

Most people I know obey pedestrian-related safety laws, such as crossing the street in the crosswalk.

a) Strongly disagree
b) Disagree
c) Neither agree or disagree
d) Agree
e) Strongly agree

15. Most people I know obey driving-related safety laws, such as stopping for pedestrians and obeying speed limits

a) Strongly disagree
b) Disagree
c) Neither agree or disagree
d) Agree
e) Strongly agree

16. What mode(s) of transportation do you use on a weekly basis? *(check all that apply)*

a) Bicycle
b) Bus
c) By car
d) Commuter boat, ferry
e) Commuter rail
f) Motorcycle or Moped
g) Personal Transportation Device (Mobility Scooter, Skateboard, Rollerblades, etc.)
h) Subway
i) Walk
j) Other (Please specify: _________)

Demographics

For classification purposes, please tell us a few things about yourself. Your responses will be kept strictly confidential and this information will not be connected to you personally.

D1. What is your gender?

a) Male
b) Female
c) Rather not say

D2. What is your age?

a) 18-24
b) 25-34
c) 35-44
d) 45-54
e) 55-64
f) 65-74
g) 75 years and over
h) Don't know/rather not say

D3. What is your race? (*check all that apply)*

a) White
b) Hispanic or Latino
c) Black or African American
d) Native American or American Indian
e) Asian/Pacific Islander
f) Other, (Please specify_______)
g) Rather not say

D4. Do you speak any languages besides English at home?

a) No
b) Yes

→ If Yes-> (Please specify_______)

D5. What is the highest level of education you have completed?

a) Less than a high school diploma/equivalent
b) Some high school or high school graduate
c) Some college
d) Associates' degree
e) Bachelor's degree
f) Advanced degree

D6. Are you enrolled in any type of education institution like university, college, community college or technical training program?

a) Yes, full time
b) Yes, part time
c) No

If selected a NJ location for home address during pre-screen, ask D7. Else skip to D8.

D7. How long have you lived in New Jersey (in total)?

a) Less than one year
b) 1-5 years
c) 5 or more years

If qualified for survey based on working/frequenting Street Smart locations but do NOT live in NJ based on Pre-Screen responses, ask D8.1, D 8.2, and D 8.3. Else, skip to D9.

D8.1 Have you ever lived in New Jersey in the past?

a) Yes -> D 11.2
b) No -> Skip to D12

D8.2 How long did you live in New Jersey?

a) Less than 1 year
b) 1-5 years
c) 5 or more years

D8.3. What is the ZIP Code where you lived in New Jersey?

____

D9. Where do you work at your primary job?

a) Zip Code
b) Municipality, State

For a chance to win 1 of 3 iPads enter your contact information. All information is kept strictly confidential and will not be shared with any third parties. Only winners are contacted. If you do not wish to enter the contest, do not enter any information below. When you are finished, please click on the "Submit" button below to submit your responses.

a) Name
b) Email
c) Phone
d) Address

We thank you for your time spent taking this survey. Your response has been recorded.

Survey is completed ____