STREET SMART
MORRIS PLAINS

STREETSMART

Presented by:

TransOptions

Laura Cerutti
Project Manager
TransOptions
(973) 267-7600
lcerutti@transoptions.org

TransOptions is one of eight Transportation Management Associations (TMAs) in New Jersey. The TMAs are tasked with implementing strategies and programs that address traffic congestion, economic development, air quality, and livability issues.

Each TMA is responsible for a designated service area, with TransOptions being responsible for the northwestern quadrant of the state. This area encompasses all of Morris, Warren and Sussex counties, as well as suburban Essex, Passaic and Union counties.

Acknowledgments

TransOptions would like to thank the following for a successful Street Smart pedestrian safety campaign in Morris Plains:

The Morris Plains Police Department
The Borough of Morris Plains
Morris Plains School District
Local Business Community
Local media and news outlets
North Jersey Transportation Planning Authority (NJTPA)
Rutgers Center for Advanced Infrastructure and Transportation
New Jersey Division of Highway Traffic Safety (NJDHTS)

A special thanks to the residents and businesses of Morris Plains, New Jersey for their participation in Street Smart Morris Plains

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Executive Summary

The Borough of Morris Plains participated in the Street Smart NJ pedestrian safety campaign in October 2018. The Morris Plains Police Department requested the program after recent crashes involving pedestrian occurred in the community. The Morris Plains Police Department partnered with TransOptions, a local nonprofit that implements the Street Smart NJ pedestrian safety campaign in municipalities throughout northwestern New Jersey. During the month-long effort, the Morris Plains Police Department and TransOptions worked to increase awareness of the importance of safe walking and driving in the borough with the goal of changing behaviors. This was accomplished through enforcement, education, and grassroots outreach throughout the community. The campaign was evaluated through intersection observations and surveys conducted by Rutgers Center for Advanced Infrastructure and Transportation (CAIT) under a contract with the North Jersey Transportation Planning Authority (NJTPA). TransOptions conducted a speed study using a mounted speed radar device and midblock crossing counts between the train station and a popular bagel store directly across Speedwell Avenue. The campaign had the following results:

- There was an 8.3 percent increase in compliant speeds of drivers traveling in the area of study
- There was a significant difference observed between the pre- and post-campaign survey results in relation to pedestrian safety, distracted driving, drowsy driving and speeding/aggressive driving.
- Almost all respondents (96.5 percent) indicated knowledge that a ticket could be given for not stopping for pedestrians, indicating that efforts to promote public education about this law since its passage have been successful *(Rutgers CAIT)*.
- Almost all respondents specified knowledge that it is illegal to drive while using a hand-held mobile device (98.2 percent) *(Rutgers CAIT)*.
- Very few pre-campaign survey participants (92.4 percent) indicated they had not seen or heard messaging that mentioned "Street Smart," however that number dropped to 62.9 percent in the post-campaign survey. This indicates that more people became aware of Street Smart during the campaign, however public knowledge of the campaign name may be still limited *(Rutgers CAIT)*.
- There was a significant increase in recognition after the campaign of Street Smart's five core safety messages (Use Crosswalks, Wait for the Walk, Stop for Pedestrians, Obey Speed Limits, and Heads Up, Phones Down), and for "Any Street Smart sign" *(Rutgers CAIT)*.
- 24.6 percent state that they were aware of local efforts to enforce the law to stop for pedestrians in the crosswalk, whereas only 13.7 percent of all respondents indicated having seen or heard about efforts to enforce pedestrian safety laws for crossing against the signal or outside the crosswalk.
- More than half of participants in the pre-campaign survey reported that police impose driver-related pedestrian safety laws (e.g. speeding, stopping for pedestrians in the crosswalk) "very strictly" or "somewhat strictly" (54.2 percent). There was no significant difference in the post-campaign surveys. Most respondents indicated they thought pedestrian-safety laws were enforced "not very strictly" or "not at all" (77.2 percent). Following the campaign there was a slight improvement seen. *(Rutgers CAIT)*.
- The results for the Borough of Morris Plains demonstrate significant improvements in rates of non-compliance for drivers but no statistically significant change in pedestrian behaviors *(Rutgers CAIT)*.
- There were statistically significant reductions in red light signal running and turning vehicles failing to stop for pedestrians.
- While there were positive improvements as a result of the campaign a number of things remained unchanged. There was no significant difference observed in both the pre- and post-campaign survey for all the aspects of participant observations of other people including; pedestrians crossing against the signal, mid-block or crossing while using cellphone and drivers using cellphones while driving, drivers not stopping for pedestrians in the crosswalk and drivers speeding in areas with pedestrians *(Rutgers CAIT)*. There was also no significant improvement in self-reported behaviors of pedestrians crossing against the signal or mid-block while using cellphone and drivers using cellphones while driving, drivers not stopping for pedestrians in crosswalks and drivers speeding in areas with lots of pedestrian *(Rutgers CAIT)*.

Street Smart Overview

The Street Smart NJ campaign is a statewide public education, awareness and behavioral change campaign that was developed by the North Jersey Transportation Planning Authority (NJTPA) and piloted in 2013. The NJTPA, along with the Federal Highway Administration (FHWA), the New Jersey Department of Transportation (NJDOT), NJ Transit, NJDHTS, and the Transportation Management Associations (TMAs) worked with numerous community partners to develop and pilot the Street Smart NJ program. The campaign is funded through U.S. Department of Transportation resources and the Highway Traffic Safety (HTS) Federal Highway Safety Grant 2018 administered by the New Jersey Division of Highway Traffic Safety (NJDHTS) as well as in-kind contributions.

The program was developed in response to New Jersey being designated as a pedestrian focus state in 2011due to the state's pedestrian fatality rate exceeding the national average. The program had reached approximately 90 communities in New Jersey as of the end of 2018. The campaign is implemented throughout New Jersey by several organizations, including the state's eight Transportation Management Associations (TMAs), including TransOptions, in partnership with the NTJPA.

Street Smart NJ has three main goals:

- Change pedestrian and motorist behaviors to reduce the incidence of pedestrian injuries and fatalities in New Jersey.
- Educate motorists and pedestrians both about their roles and responsibilities for safely sharing the road.
- Increase enforcement of pedestrian safety laws and roadway users' awareness of that effort.

Morris Plains, New Jersey

Morris Plains is located in Morris County, covering approximately 2.594 square miles with a population of 5,532 according to the 2010 U.S. Census. Morris Plains has a walkable downtown area along US-202/Speedwell Avenue that is lined with small businesses, restaurants, an active train station that provides commuter access to New York City and an elementary school. Morris Plains is also home to Honeywell World Headquarters, which attracts drivers into the community and increases roadway congestion during rush hour.

TransOptions used the NJDHTS Crash Analysis Tool hosted through Rutgers University's Center for Advanced Infrastructure and Transportation (CAIT) to examine crash data in Morris Plains. According to the Crash Analysis Tool, there were nine crashes that involved pedestrians from January 1, 2012 to December 31, 2017, including one fatal crash. Morris Plains police contacted TransOptions in the summer of 2018 in response to recent pedestrian crashes that occurred in the borough and expressed interest in conducting a pedestrian safety program in the community. TransOptions and Morris Plains police decided to conduct a Street Smart pedestrian safety campaign in October 2018.

Campaign Results

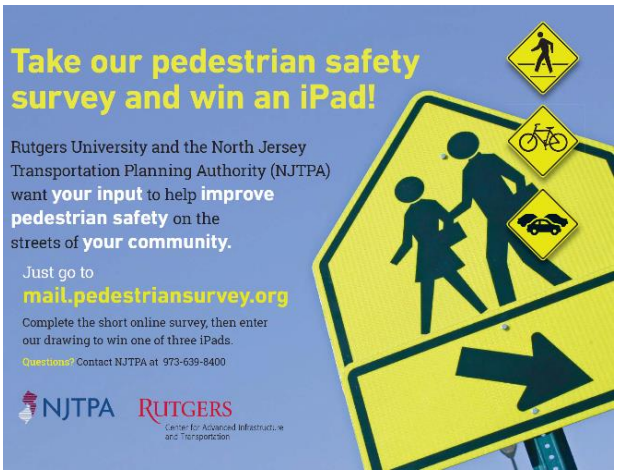
Campaign evaluation was conducted by Rutgers CAIT for the Morris Plains' Street Smart campaign. This included intersection observations and community surveys. Rutgers CAIT collected and analyzed the Morris Plains data.

The following sections include segments directly from Rutgers CAIT's report of the survey data and intersection observations from Morris Plains. Morris Plains was also one of seven municipalities included in a larger study conducted by Rutgers CAIT and the NJTPA. This report only contains information about the Morris Plains results. The full Rutgers CAIT reports, which include information about the other six municipalities, can be found in the Appendix.

COMMUNITY SURVEY

Morris Plains Survey Recruitment

The survey contributors were recruited both before and after the Street Smart campaign, which began on October 4, 2018 and continued for roughly a month.



Flyers advertising participation in the survey were mailed to residences in the zip code 07950 on September 12 pre-campaign and November 12 post-campaign. In addition, flyers were handed out in person to passers-by on the following dates: September 22, September 27, September 30, October 2, November 10, November 1, November 12, November 17, and November 18. Rutgers CAIT was also out in the community on September 22, September 27, September 30, November 10, November 11, November 17, and November 18 to recruit survey participants. Lastly, community leaders in Morris Plains helped advertise the survey via social media.

Method of Recruitment	Pre-Campaign	Post-Campaign	Total
Flyer	3	17	20
Mail	54	38	92
Social	306	255	561
Tablet	10	11	21
Total	373	321	694

Table 1 Survey Distribution Method

Table 1: In total, 694 participants responded to the surveys, including 373 pre-campaign and 321 post-campaign survey participants. In addition, 345 (92.7 percent) pre-survey respondents resided in Morris Plains, and 284 (88.5 percent) post-campaign participants were residents. Survey responses by recruitment method are summarized below. *[Analysis from Rutgers CAIT]*

Demographics

Demographic data depicts equivalent sample composition for the pre- and post-campaign surveys, which supports the theory that variations obtain in pre- and post-campaign responses were attributable to the campaign.

With respect to gender, out of entire sample there were 32.9 percent male participants and 65.4 female participants. Meanwhile, based on the US Census Bureau, Morris Plains' population is estimated to be 48.8 percent female as of 2018, signifying that this group was overrepresented in the survey response. Based on the NHTSA Traffic Safety Facts, males are far more likely to be injured or killed in pedestrian-related crashes than females (males comprise over two thirds of pedestrian fatalities). Upcoming studies may benefit from additional efforts to collect a representative sample by gender.

The racial breakdown of survey participants was 85.9 percent white, 3.5 percent Asian or Pacific Islander, 3.2 percent Hispanic or Latino, and 1.2 percent black or African American. For comparison, U.S. Census data for 2018 shows Morris Plains population is 91.9 percent white, 9.1 percent Hispanic or Latino, 4.7 percent Asian, and 2.2 percent black or African American. The survey sample indicates that the minority populations were underrepresented in the survey. Future surveys should employ precise efforts to recruit participants that construct a representative sample of the demographics in each campaign location. When looking at participants' level of education, 76.7 percent reported having a bachelor's degree or higher, which is higher than Morris Plains' overall population (60.1 percent). *[Analysis from Rutgers CAIT]*

Mode Share

Table 2: Based on the survey results, the majority (97.9 percent) of participants use cars as their primary transportation mode on a weekly basis. More than half (53.7%) stated that they walk, 13.8 percent said they use public transportation and 8.6 percent use bicycles, 1.2 percent prefer a motorcycle or moped and specified that they use personal transportation or other mode of transportation.

	Pre - Frequency	Pre- Percent of Respondents	Pre- Percent of Total Responses	Post-Frequency	Post- Percent of Respondents	Post- Percent of Total Responses
Bicycle	28	8.6	4.89%	17	6.1	3.33%
Bus	4	1.2	0.70%	9	3.2	1.76%
By Car	319	97.9	55.67%	276	98.9	54.12%
Commuter Boat, Ferry	2	0.6	0.35%	1	0.4	0.20%
Commuter Rail	27	8.3	4.71%	22	7.9	4.31%
Motorcycle, Moped	4	1.2	0.70%	4	1.4	0.78%
Personal Transportation Device (Mobility Scooter, Skateboard, Rollerblades, etc.)	1	0.3	0.17%	1	0.4	0.20%
Subway	12	3.7	2.09%	8	2.9	1.57%
Walk	175	53.7	30.54%	171	61.3	33.53%
Other	1	0.3	0.17%	1	0.4	0.20%
Total	573	N/A	100.0%	510	N/A	100.0%

Table 2 Transportation Modes use by Survey Participants

The post-campaign responses were consistent, with travel by car being the most popular mode (98.9 percent), followed by walking (61.3 percent) and public transportation (14.4 percent). *[Analysis from Rutgers CAIT]*

Pedestrian Safety Observations of Others

Table 3: The pre- and post-campaign surveys asked participants to share their observations about other drivers and pedestrians, including whether people cross against the signal, outside of a crosswalk or while using a cell phone and whether drivers stop for people crossing, speed in areas with a lot of pedestrians or drive while using a cell phone. The results show no significant difference between the pre- and post-campaign surveys. *[Analysis from Rutgers CAIT]*

In the past week how often have you seen...	Pre (n)	Post (n)	Total (n)	Delta Mean Rank	Mann-Whitney U	Z	p	Effect Size
Q1 a: Pedestrians cross against the signal	365	314	679	-10.71	55497.5	-0.742	0.458	0.028
Q1 b: Pedestrians cross mid-block (without crosswalk)	364	314	678	-0.01	57115.0	-0.014	0.989	0.0003
Q1 c: Pedestrians cross while using cell phone	363	310	673	8.27	54883.0	-0.570	0.569	0.022
Q1 d: Drivers not stop for pedestrians in crosswalk	362	311	673	0.02	54154.0	-0.877	0.380	0.034
Q1 e: Drivers speed with lots of pedestrians	359	309	668	0.05	51979.5	-1.451	0.147	0.056
Q1 f: Drivers run red lights or stop signs	359	309	668	-11.97	53478.0	-0.830	0.406	0.032
Q1 g: Drivers using cell phone	356	308	664	0.1	54807.5	-0.007	0.994	0.0003
***Significant change between pre- and post-campaign response**								

Table 3 Observed Behaviors of Other People

Pedestrian Safety Behaviors (Self-Reported Behaviors)

Table 4: Survey participants were also asked about their own behaviors before and after the campaign. Participants were asked whether they cross against the signal or outside of a crosswalk, or if they cross the street while using a cellphone. They were also asked whether they use a cell phone while driving, if they stop for pedestrians in crosswalks and if they speed in areas with lots of pedestrian. Additionally, looking in terms of the effect size based on the Cohen's classification of effective size, all the aspects have small effective size.

The effect size for the survey sample can be calculated by dividing absolute Standardized test statistic, Z, by the square root of the total sample size, n, as follows:

$$\text{Effect Size} = \frac{Z}{\sqrt{n}}$$

According to the Cohen's classification of effect size, the 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." *[Analysis from Rutgers CAIT]*

In the past week how often have you... (emphasis original)	Pre (n)	Post (n)	Total (n)	Delta Mean Rank	Mann-Whitney U	Z	p	Effect Size
Q2 a: Crossed against the signal	329	290	619	-5.18	46907.0	-0.398	0.691	0.016
Q2 b: Crossed mid-block (without crosswalk)	331	290	621	-1.35	47786.0	-0.102	0.919	0.004
Q2 c: Crossed while using cell phone	329	283	612	-2.40	46189.0	-0.206	0.837	0.008
Q2 d: Not stopped for pedestrians while turning (as a driver)	346	295	641	11.65	49180.0	-1.122	0.262	0.044
Q2 e: Sped while driving in area with lots of pedestrians	342	292	634	4.56	49214.0	-0.330	0.741	0.013
Q2 f: Run red lights or stop signs while driving	339	291	630	-7.6	48134.5	-1.043	0.297	0.042
Q2 g: Driven while using a cell phone	339	291	630	-20.07	46181.0	-1.652	0.099	0.066

Table 4 Self-Reported Behaviors

Pedestrian Safety Knowledge

Table 5: Survey participants were also asked about their knowledge of pedestrian traffic signals. Most of the respondents (91.1 percent) indicated that it is proper to start crossing the street when the walk signal is enabled and nearly all respondents (99.7 percent) indicated that they should not start walking when the orange don't walk sign is enabled. However, there was some confusion about the pedestrian count-down clock. People should only complete crossing when the count-down clock is displayed, they should not start crossing, according to federal safety guidelines. The survey showed two images, one of a count-down clock stopped at 8 seconds and another stopped at 23 seconds. About a third of respondents (32.9 percent) said they could cross when 23 seconds remain on the count-down clock and 12.1 percent said they could cross when 8 seconds remain, however they are not permitted to begin crossing once the clock is displayed. This demonstrates a lack of understanding about how pedestrian count-down signals work and may explain at least some observed behavior of pedestrians crossing against the signal in the companion observational study. Additional public education on count-down signals could help address this issue. *[Analysis from Rutgers CAIT]*

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	632	91.1%
Eight-second count-down clock	84	12.1%
Twenty-three second count-down clock	228	32.9%
Don't walk signal	692	99.7%
Total	694	100.0%

Table 5 Crossing Signal Knowledge

Table 6: The surveys also asked participants about their knowledge of pedestrian safety law enforcement. Overwhelmingly respondents (95.2 percent) were correct in noting that pedestrians could receive a ticket for violating pedestrian-related traffic laws. A majority (89.9 percent) also indicated knowledge that they could get a ticket specifically for crossing against the signal. More than a third of respondents said they could receive a ticket for crossing while using a cell phone, but New Jersey does not have a law to regulate this specific behavior at this time. Almost all respondents said a driver could be issued a ticket for not stopping for pedestrians, which indicates that efforts to promote public education about this law since its

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?	592	95.2%
Crossing the street illegally (against signal or mid-block)	554	89.8%
Using a hand-held cell phone while crossing	223	36.2%
Not stopping for pedestrians in crosswalk	598	96.5%
Using a hand-held cell phone while driving	609	98.2%
Total	620	100.0%

Table 6 Knowledge of NJ Pedestrian Safety Laws

passage have been successful. In addition, almost all respondents specified knowledge that it is illegal to drive while using a hand-held mobile device.

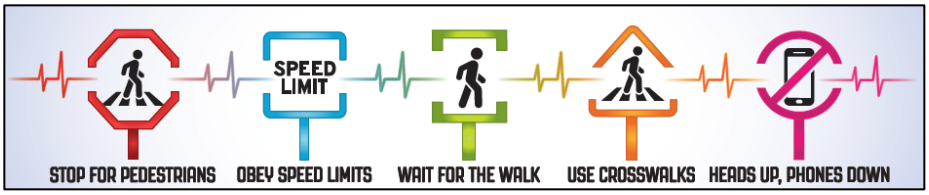
Overall, the responses show that almost all respondents are knowledgeable of pedestrian-related traffic laws. Thus, observed noncompliance may be due to a conscious choice to disregard the law or a lack of understanding of how to appropriately apply knowledge of the law to a specific intersection context. *[Analysis from Rutgers CAIT]*

Campaign Exposure

Table 7: A majority of respondents said they had read, seen or heard safety messaging in the last 30 days. The largest number of participants, 45 percent, said they had been exposed to distracted driving messaging, followed by 38 percent for driving under the influence of alcohol messaging and nearly 37 percent for speeding/aggressive driving messaging. Following the campaign there was a significant increase in the number of survey participants who said they had been exposed to messaging about pedestrian safety, distracted driving, drowsy driving and speeding/aggressive driving. There was no significant difference detected between pre- and post-campaign in relation to messaging about bicycle safety, seat belt use, driving under influence of alcohol and drugs.

Q: In the last 30 days, have you read, seen or heard any messages addressing the following… (check all that apply)							
	Total (n)	Total (%)	Pre (n)	Pre (%)	Post (n)	Post (%)	p
Speeding/aggressive driving	230	36.6%	112	33.1%	118	40.7%	0.050*
Driving under the influence of alcohol	238	37.9%	120	35.5%	118	40.7%	0.182
Driving under the influence of a drug	110	17.5%	53	15.7%	57	19.7%	0.192
Drowsy driving	28	4.5%	8	2.4%	20	6.9%	0.006*
Seat belt use	184	29.3%	93	27.5%	91	31.4%	0.290
Distracted driving	283	45.1%	130	38.5%	153	52.8%	0.000*
Pedestrian safety	205	32.6%	74	21.9%	131	45.2%	0.000*
Bicycle safety	84	13.4%	42	12.4%	42	14.5%	0.451
None of the above	164	26.1%	103	30.5%	61	21.0%	0.007*
*Significant change between pre- and post-campaign response							

Table 4 Safety Messaging by Topic



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
"Use Crosswalks"	192	30.5%	47	13.9%	145	50.0%	0.000*
"Wait for the Walk"	113	18.0%	20	5.8%	93	32.3%	0.000*
"Stop for Pedestrians"	161	25.6%	42	12.4%	119	41.3%	0.000*
"Obey Speed Limits"	97	15.5%	30	8.8%	67	23.4%	0.000*
"Heads Up Phones Down"	154	24.8%	49	14.5%	105	36.8%	0.000*
Any Street Smart sign	281	40.5%	94	25.2%	187	58.3%	0.000*
*Significant change between pre- and post-campaign response							

Table 8 Campaign Message Recognition

Table 8: The pre-campaign survey found that the majority of participants (92.4 percent) had not seen or heard messaging that mentions "Street Smart." That number decreased to 62.9 percent in the post-campaign survey, which shows the campaign helped raise awareness, but this indicates that public knowledge of the campaign is still limited.It is worth noting that when survey participants were shown images of Street Smart signs they had a higher recognition rate following the campaign. *[Analysis from Rutgers CAIT]*

Enforcement Awareness

Table 9: A majority of respondents said they had not read, seen, or heard

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
Crossing against signal or outside crosswalk	81	13.7%	37	11.9%	44	15.7%	0.184
Not stopping for pedestrians in crosswalk	145	24.6%	70	22.6%	75	26.8%	0.237
Other	21	3.6%	11	3.5%	10	3.6%	0.988

Table 9 Enforcement Awareness

about police efforts to enforce pedestrian safety laws in the neighborhood. There was only a very small increase in the number of people who said they were aware of enforcement efforts in surveys following the campaign. Only 24.6 percent of all survey respondents said that they were aware of local efforts to enforce the law to stop for pedestrians in the crosswalk, and only 13.7 percent indicated having seen or heard about efforts to enforce pedestrian safety laws for crossing against the signal or outside of the crosswalk.

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)	%
Very strictly	92	16.8
Somewhat strictly	205	37.4
Not very strictly	175	31.9
Not at all	76	13.9
Total	548	100.0

Table 10 Enforcement Awareness of Driving-related pedestrian 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)	%
Very strictly	29	5.7
Somewhat strictly	88	17.2
Not very strictly	230	44.8
Not at all	166	32.4
Total	513	100.0

Table 11 Enforcement Awareness of Walking-related pedestrian laws

Table 10 and 11: This awareness was reinforced by responses that asked how strictly participants think police in their area enforce pedestrian-related safety laws. Most respondents indicated they thought pedestrian-safety laws were enforced "Not very strictly" or "Not at all" (77.2 percent). There was only a slight improvement in the post-campaign responses.

Just over half of survey participants reported that police enforce driver-related pedestrian safety laws (e.g. speeding, stopping for pedestrians in the crosswalk) "Very strictly" or "Somewhat strictly" in the pre-campaign survey. There was no significant difference in the post-campaign survey. *[Analysis from Rutgers CAIT]*

INTERSECTION OBSERVATIONS

The intersection of Speedwell Avenue and Littleton Road is located approximately a quarter-mile from the Morris Plains 9/11 Memorial Park and the Borough 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 as well as several stores.

NJ-124/Speedwell Avenue runs from north to south. It is a two-way street with one lane in each direction. On the south side of the intersection the northbound lane splits into two to create a left turn only lane. On the north side of the intersection, the southbound lane splits into two with a left turn only lane.

Littleton Road runs from east to west and has one lane in each direction. Coming from east to west the westbound direction splits into two lanes at the intersection for right turns. Turning on red is not permitted from this direction.

Franklin Road runs east to west. It has one lane in each direction. At the traffic signal no lane splitting occurs. Right turns on red are allowed at this intersection.

Method for Data Collection

The primary objective of the observational study is to determine if the campaign is effective in mitigating non-compliant behaviors of drivers and pedestrians, resulting in improved safety for pedestrians at the study locations. Given the fact that crashes are not frequent events, it is better to observe the occurrence of risky non-compliant behaviors by motorists and pedestrians that can serve as proxy measures for safety. Safety improves when there is a reduction in non-compliant behaviors. Therefore, the data collection efforts include conducting observations at the study locations to document the behaviors of drivers and pedestrians both before and after the campaign. Before conducting observations, Rutgers CAIT identified which data would be collected, how it would be collected in the field, and how the raw data should be processed to provide a useful dataset for analysis purposes. *[Analysis from Rutgers CAIT]*

Data Required to Assess Pedestrian and Driver Behavior

To conduct the observational evaluation, for each proxy measure, two types of data were collected: 1) counts of the occurrences of non-compliant behavior, and 2) counts of a measure of exposure or the number of opportunities that pedestrians or drivers have a chance 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 and is used to compare the pre- and post-campaign datasets to identify if there is a statistically significant change in driver and pedestrian behavior. NJTPA selected four proxy measures to gauge the impact of its Street Smart NJ campaign messaging:

- ***Proxy 1: Mid-block Crossing and Crossing Against the Signal:*** a pedestrian crosses 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 total number of pedestrians crossing the street.

- ***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 total number of left or right turning vehicles when pedestrians are present so that turning vehicles have an opportunity to properly stop for pedestrians.

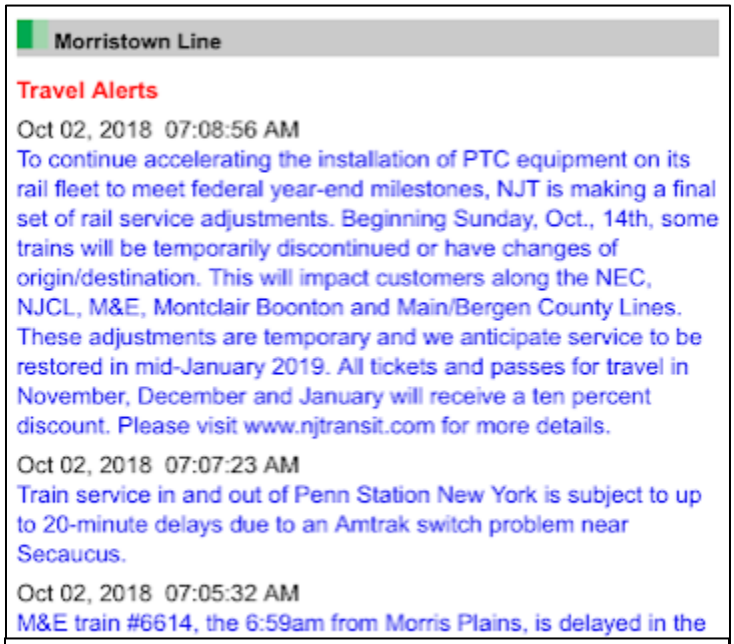
- ***Proxy 3: Failure to Stop Before Right Turn at Red Signal or Stop Sign:*** a right turning vehicle fails to make a complete stop and stay stopped for pedestrians before making a right turn on red. The measure of exposure is the total number of right turning vehicles that approach the stop bar on 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 turning vehicle fails to make a complete stop for pedestrians before making a right turn at STOP sign. The measure of exposure is the total number of right turning vehicles that approach the stop sign.

- ***Proxy 4: Red Light Signal and Stop Sign Running:*** a vehicle passing an intersection when the traffic signal is red. The measure of exposure is the total number of vehicles that enter the intersection. For unsignalized intersections, this proxy is a vehicle passing the intersection fails to make a complete stop at stop sign. The measure of exposure is the total number of vehicles that enter the intersection.

[Analysis from Rutgers CAIT]

Data Collection Schedule

To evaluate the safety proxy behaviors of community members before and after the Street Smart NJ campaign, each measure must be observed and recorded at pre-determined study locations. In order to ensure high-quality data collection occurs in each Street Smart NJ community, several activities must be coordinated including pre-campaign data collection, the campaign duration, and post-campaign data collection. Pre-campaign observations were collected as close as possible to the launch of the campaign, within a window of approximately two weeks before the campaign. Similarly, the post-observations were collected as close as possible to the campaign conclusion, within a window of approximately two weeks after the campaign. To the extent possible, data was collected at the same location, during the same days of the week, at the same time of day and with similar weather conditions. This is done to minimize the source of bias and number of external, non-campaign factors that can influence the behavior of drivers and pedestrians. Pedestrian and motor vehicle traffic volumes are also crucial external factors that play a central role in the analysis. These volumes are heavily influenced by the above factors, although there are additional influences, such as economic trends and random chance that also contribute significantly to these total counts. As a result, vehicle and pedestrian volumes were controlled for in the analysis by collecting vehicle and pedestrian counts during the observation and calculating the proxy behaviors based on an exposure rate:



Note: On the morning of October 2, during the pre-campaign intersection observations the 6:59 a.m. train from Morris Plains experienced mechanical issues. This train is at peak morning rush hour and may have caused commuters to change their behaviors and use of the intersection.

i.e., observed proxy behaviors as a percentage of the overall vehicle and pedestrian volumes. Data were collected only on weekdays as shown in Table 12. *[Analysis from Rutgers CAIT]*

Community and Intersection	Pre-Campaign	Post-Campaign
Morris Plains – Speedwell Avenue and Franklin Place	Tuesday, October 2nd, 2018 7 am to 11 am	Monday, November 12th, 2018; 7 am to 11 am

Table 12 Observation Data Collection Dates

Data Collection Method

As previously stated, in this project, four non-compliant behaviors and four measures of exposure were observed for multiple intersection approaches at each study site. To ensure accurate counts, student workers were employed to take video recordings of each intersection approach to capture the occurrence of proxy safety variables and quantify overall pedestrian exposure risk. The video data enabled the extraction of behaviors of interest and maintains the information in a manner that can be used for further analysis. It should be noted that the students who were collecting data in the field were also collected conventional traffic

counts of the proxy safety behaviors by hand in 15-minute aggregations. Conventional traffic count data was used to supplement and double-check observations logged from the video observations.

Summary of Raw Data

The raw data in this project includes the counts of the number of compliant and non-compliant behaviors observed at each site and for each proxy behavior. These counts were directly logged from the video recordings and are summarized in Table 14.

Community	Proxy	Pre-Campaign			Post-Campaign		
		Compliant	Non-Compliant	Rate of Non-Compliance	Compliant	Non-Compliant	Rate of Non-Compliance
Morris Plains	Proxy 1	85	28	0.248	81	33	0.289
	Proxy 2	17	10	0.370	27	13	0.325
	Proxy 3	29	30	0.508	13	5	0.278
	Proxy 4	6727	303	0.043	5020	94	0.018

(***Proxy 1: Proper Pedestrian Crossings, Proxy 2: Turning Vehicles Stop for Pedestrians, Proxy 3: Turning Vehicles Stop for Pedestrians before Right Turn at Red Signal or Stop Sign, Proxy 4: Vehicles Stop at Red Signal or Stop Sign)***

Table 13 Raw Data Behavior Compliance

Data Analysis and Results

The data gathered during the pre- and post-campaign observations were compared to identify the effectiveness of Street Smart NJ campaign in changing the behaviors of drivers and pedestrians. It is assumed that each individual driver or pedestrian who travels 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 fact, each driver or pedestrian that has an opportunity to be involved in risky, non-compliant behavior will either decide to comply with traffic regulations or not.

The results at Speedwell Avenue and Franklin Place in the City of Morris Plains demonstrate significant improvements in rates of non-compliance for drivers but no statistically significant change in pedestrian behaviors. This data is important to note because the total number of pedestrians observed during the pre- and post-campaign periods were 113 and 114 respectively. It should stand to reason that if the campaign is successful in reaching out to pedestrians then a reduction in non-compliance should be observed during the post-campaign evaluation. The way in which the information is delivered to the pedestrians at this intersection may need to be altered as the data shows that pedestrian behavior remained the same.

There were statistically significant reductions in red light signal running and turning vehicles failing to stop for pedestrians. These proxies were reduced by 58.1 and 45.3 percent, respectively. It should be noted that the pre-campaign and post-campaign observations were done on different days. The pre-campaign observation was a Tuesday, while the post-campaign observation was a Monday. These results indicate that the campaign was effective at reducing risky driving behaviors, which resulted in increased safety for both pedestrians and drivers. *[Analysis from Rutgers CAIT]*

Community	Proxy	Pre-Campaign		Post-Campaign		Change			
		Sample	Rate ($p^{\wedge 1}$)	Sample	Rate ($p^{\wedge 2}$)	%	Rate Difference ($p^{\wedge 2}$-$p^{\wedge 1}$)	95% Confidence Interval	P-Value
Morris Plains	1	113	0.248	114	0.289	+16.5	+0.041	(-0.073, 0.155)	0.76*
	2	27	0.370	40	0.325	-13.8	-0.045	(-0.270, 0.174)	0.35*
	3	59	0.508	18	0.278	-45.3	-0.231	***(-0.427, -0.031)***	***0.04†***
	4	7030	0.043	5114	0.018	-58.1	-0.025	***(-0.031, -0.019)***	***0.00†***

Table 14 Data Analysis of Behavioral Data

*Statistically insignificant increase/reduction in rate of non-compliance
† ***Statistically significant increase/reduction in rate of non-compliance***

Midblock Crossing Counts (Conducted by TransOptions)

The Morris Plains Police Department expressed concern that people were crossing midblock, outside of crosswalks, throughout the day between the train station area and a popular bagel store across the street. TransOptions placed cameras to monitor midblock crossing in this area while Rutgers conducted its intersection study.

According to New Jersey law 39:4-32 (shown below), pedestrians must give drivers adequate time to stop when crossing and shall give drivers the right-of-way at any point on a roadway other than within a marked crosswalk or within an unmarked crosswalk at an intersection. Using information from the law, TransOptions considered pedestrians who crossed midblock with no approaching vehicles as compliant. Pedestrians who crossed midblock dangerously were counted as non-compliant. A noncompliant midblock crossing was determined to be if a pedestrian crossed when an oncoming vehicle was approaching or if they crossed between vehicles stopped in the roadway at a red light.

****not statistically significant***

	Pre-Campaign Observation October 2nd, 2018			Post-Campaign Observation November 12th, 2018;		
	Compliant	**Non-Compliant**	**% Non-Compliant**	**Compliant**	**Non-Compliant**	**% Non-Compliant**
Pedestrians Crossing mid-block	0	25	**100%**	2	21	**91%**

Table 15 Mid-block Crossing Data

In the pre-campaign observation, a total of 25 pedestrians crossed midblock from the train station area towards the bagel store in violation of the law. In the post-campaign observation, a total of 23 pedestrians crossed midblock in the same area and only two of those people crossed in compliance with the law. There was no significant difference in midblock crossing behaviors at this location. It is recommended that Morris Plains consider additional enforcement, install signage or explore the feasibility of installing barriers at this location to prevent dangerous midblock crossings.

2013 New Jersey Revised Statutes
Title 39: MOTOR VEHICLES AND TRAFFIC REGULATION
Section 39:4-32 - Crossing roadway; signal.

d.) No pedestrian shall leave a curb or other place of safety and walk or run into the path of a vehicle which is so close that it is impossible for the driver to yield or stop.

f.) Every pedestrian upon a roadway at any point other than within a marked crosswalk or within an unmarked crosswalk at an intersection shall yield the right-of-way to all vehicles upon the roadway.

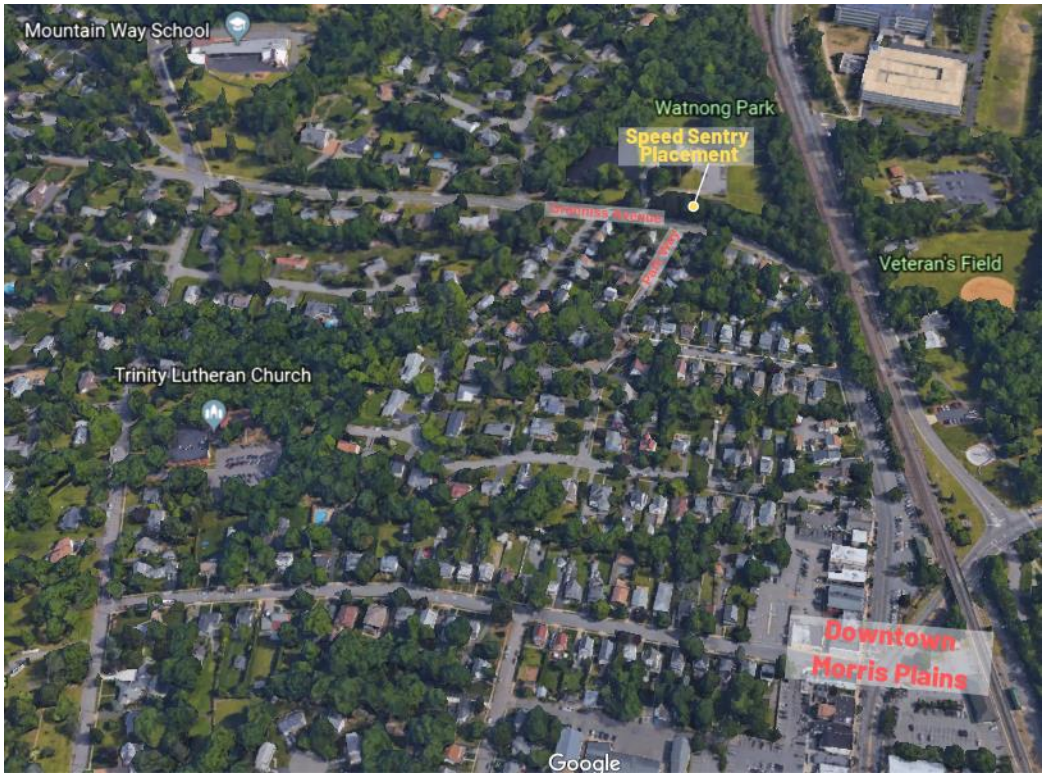
Speed Radar Study (Conducted by TransOptions)

While the Street Smart campaign was active in Morris Plains, TransOptions placed its Speed Sentry radar device on Granniss Avenue near the intersection of Park Way. This location was selected based on the police department's recommendation of targeting speeding behaviors as drivers approached Mountain Way School, located approximately 1,500 feet from the Speed Sentry's placement. The Speed Sentry collected data on the speeds of drivers as they came around a sharp curve and headed towards the school.

The sign was mounted on a 25MPH speed limit sign from October 15, 2018 to November 2, 2018. The digital display was turned off for the first week of the speed study in order to capture the natural behaviors of drivers who likely did not notice the device or did not believe it was operating. While the digital display was off, a baseline of uninfluenced speed behaviors was established with compliant speeds at (16.3 percent), low risk speeds at (50.4 percent), medium risk speeds at (29.1 percent), and high risk speeds at (4.2 percent)

Date/Time Range	Speed Limit	Mode	Compliant = 25 MPH	Low Risk >25MPH; ≤30 MPH	Medium Risk >30 MPH; ≤35 MPH	High Risk >35 MPH	Total Vehicles
10/14/2018 *Baseline*	**25**	**Display Off**	1,990 (16.3%)	6,198 (50.4%)	3,582 (29.1%)	519 (4.2%)	**12289**
10/21/2018	**25**	**Display Off; Speed Display**	2,635 (19.1%)	6,884 (49.7%)	3,820 (27.6%)	510 (3.7%)	**13849**
10/28/2018	**25**	**Speed Display**	2,590 (24.6%)	5,472 (51.9%)	2,244 (21.3%)	235 (2.2%)	**10541**
		% Change	**8.3 % increase**	**1.5% increase**	**7.8% decrease**	**2% decrease**	
		Total # Vehicles	**7,215 (19.7%)**	**18,554 (50.6%)**	**9,646 (26.3%)**	**1,264 (3.4%)**	**36679**

The digital display was switched on for the remainder of the study. Compliant speeds increased 8.3 percent, low risk speeds remained relatively the same throughout the study, medium risk speeds decreased by 7.8 percent, and high risk speeds decreased by 2 percent.



The data from Morris Plains' speed study shows a shift from dangerous medium and high risk speeds to compliant and low risk speeds. This is especially important because on average, a pedestrian has a 90 percent chance of surviving a crash if struck by a person driving at 20 MPH, a 50 percent chance of surviving if struck by a person driving at 30 MPH, and a 10 percent chance of surviving a crash if struck by a person driving at 40 MPH.

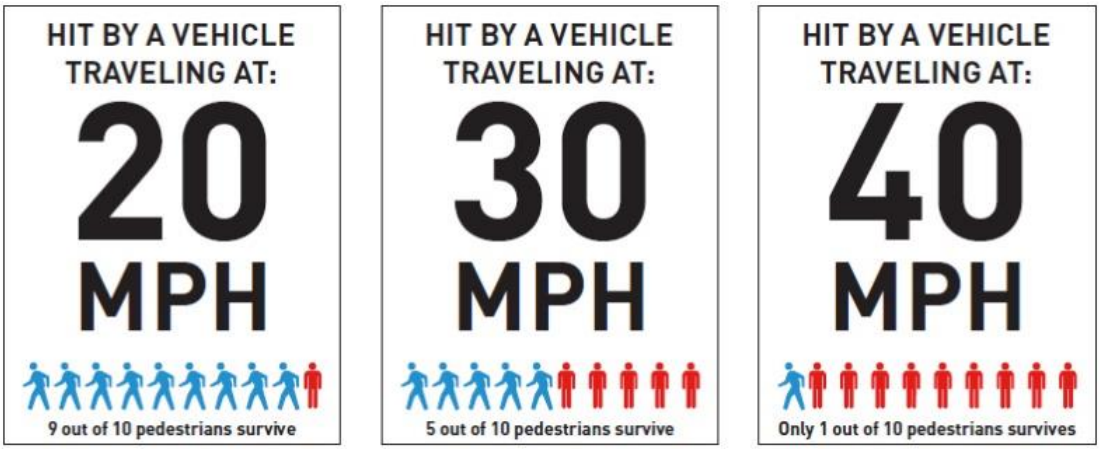


Photo from Vision Zero Network

Enforcement, Education, and Outreach

During the month-long campaign, TransOptions, the Morris Plains Police Department, and community organizations worked in the community to change behaviors and raise awareness of safe walking and driving in the Borough of Morris Plains.

Enforcement

The Morris Plains Police Department did not receive any grant funding for its enforcement efforts. The police initiated the campaign in partnership with TransOptions in response to recent crashes.

The Morris Plains Police Department focused its enforcement efforts at the intersection of Speedwell Avenue and Franklin Place near the Morris Plains Train Station. This area was selected as a focus point because there is a high rate of midblock crossings between the train station and the businesses located directly across the street, including a popular bagel store that attracts commuters during the morning rush hour. The intersection itself is wide and busy with five-legs converging at once including Speedwell/US 202 both north and south, the Speedwell Avenue extension, Franklin Place, and the train station parking lot. It is a challenging intersection for drivers and pedestrians to navigate.

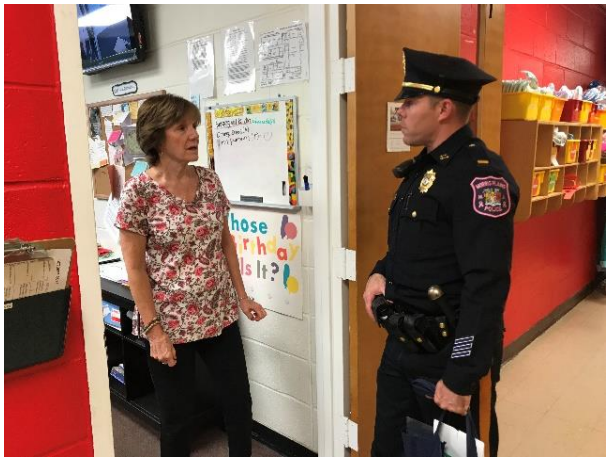
The Morris Plains Police Department dedicated 40 hours of enforcement efforts and distributed a total of 92 campaign-related warnings including 27 warnings for crossing against the traffic signal and 10 for driver cellphone use.

On October 25, 2018, the Morris Plains Police Department conducted a spotter program surrounding the intersection of Speedwell Avenue and Franklin Place near the entrance of the train station's parking. Police officers were strategically placed near the crosswalks, the traffic lights, and in the areas where people are inclined to cross midblock from the businesses to the train station. Officers engaged with both drivers and pedestrians who were observed crossing dangerously or using cellphones. Police officers directed drivers who were violating the law to pull into the train station parking lot.

Media was invited to cover the event. WMBC-TV, the Daily Record and TAPinto Morristown covered the event and interviewed the police department and TransOptions.

Education & Outreach

Both TransOptions and the Morris Plains Police Department participated in outreach activities in the community during the month-long campaign. Activities included:



- Engagement with local businesses and organizations in the target area: TransOptions and the Morris Plains Police Department walked along Speedwell Avenue to engage the local businesses and community organizations. Businesses were given Street Smart safety tip cards and posters to display. TransOptions and the police officers explained the importance of pedestrian safety in Morris Plains and the businesses community's role in helping promote safe behaviors.
- Street signs with campaign messages were strategically placed around the community to inform pedestrians and drivers of the campaign and raise awareness.
- A digital variable messaging sign with driving safety messages was strategically placed in a heavily traveled location, right before drivers pass under the train bridge before entering downtown.

- Coffee with a Cop at the Morris Plains Famers Market: TransOptions attended the Morris Plains Police Department's Coffee with a Cop program at the Morris Plains Farmers' Market. Pedestrian safety information and reflective items were distributed at the event.
- Morris Plains Halloween Parade: The Morris Plains Police Department invited TransOptions to participate in their town-wide Halloween Parade. This is a highly attended event where police officers walk with children from one park to another park through the borough. TransOptions set up a table at the second park to greet trick-or-treaters as they took refreshments. TransOptions distributed flashlight finger rings to trick-or-treaters and a Halloween safety card to parents attending the event to increase visibility and safe walking on Halloween night.

- Two safe walking education programs were conducted with senior groups in Morris Plains.
- TransOptions presented its Traffic Safety Town program to 4th grade students at Borough School.
- Safe walking and Street Smart was promoted at the Morris Plains Health Fair.

Recommendations

It is recommended that Morris Plains continue to participate in activities related to preventing crashes involving pedestrians in the borough. The following activities should be considered:

- Continue use of high-visibility enforcement and education from the Morris Plains Police Department
- Continue including pedestrian safety messaging and education in borough activities such as the farmers' market
- Conduct a walkability audit with TransOptions in order to identify impediments to safe walking
- Continue scheduling regular education programs in partnership with TransOptions
- Engage groups in the borough on safe walking and driving
- Inform residents of potentially dangerous crossings and stretches of roadways in the borough to raise awareness of the need to drive and walk with caution
- Monitor behaviors and interact with pedestrians crossing at crosswalks or midblock to the train station
- Consider the feasibility of installing some type of barrier (planters, decorative fencing) along Speedwell Avenue across from the bagel store to prevent dangerous midblock crossing
- Explore funding opportunities for infrastructure improvements.

RUTGERS

Center for Advanced Infrastructure and Transportation

Rowan University

North Jersey Transportation Planning Authority (NJTPA)

Behavioral Pedestrian Safety Survey: Final Report

Authors
Dr. Mohammad Jalayer, Rowan University
Dr. Patrick Szary, Rutgers CAIT
Mr. Thomas Hillman, Rutgers CAIT
Mr. Christopher Wyce

ABSTRACT

This report provides the results of the behavioral survey to gauge the level of effects of the pedestrian safety campaign before and after the North Jersey Transportation Planning Authority (NJTPA) pedestrian safety education and enforcement campaign (*Street Smart NJ*) in seven communities across the state of New Jersey. The survey determines 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 to determine which campaign activities are most effective. The behaviors using a variety of survey recruitment strategies– including in-person flyer distribution, direct mail advertising, social media advertising, and intercept surveys using tablet devices – were compared and measured in seven communities (Asbury Park, Garfield, Morris Plains, Newark, Princeton, Rutherford……) in 2018-2019.

EXECUTIVE SUMMARY

Pedestrian safety at intersections, where motor vehicles and pedestrians cross paths, is a serious matter of concern for traffic and road safety engineers and professionals. The severity of pedestrian-involved crashes is high since a pedestrian is not protected by any automobile safety features (such as the mass and frame of their vehicle, airbags, and seatbelts) as motorists are in crash events. According to the National Highway Traffic Safety Administration (NHTSA), in 2015 there were more than 5,376 pedestrian deaths and over 70,000 pedestrian injuries resulting from traffic crashes. It is estimated that the total cost of pedestrian fatalities and injuries in the year 2000 was $20.8 billion; in today's dollars, this would be equivalent to $30.75 billion. Due to the severity of pedestrian-related crashes, these crashes merit special attention and additional analysis.

Over the past few years, a considerable number of studies have been performed to identify the factors that contribute to pedestrian crashes and develop effective safety countermeasures. Several other studies focused on pedestrian behaviors and countermeasures to change pedestrian risky behaviors. Although several engineering countermeasures (e.g., traffic sign, traffic signal controls, pavement markings, and roadway geometry) can be employed to enhance pedestrian safety, the behavior of pedestrians and drivers can play an important role in crash risk. Education programs and public outreach efforts provide an opportunity for motorists and pedestrians to address observed or documented behaviors such as speeding, stopping, and crossing. A goal in New Jersey is to mitigate the rate of violations associated with pedestrian and driver behavior to enhance pedestrian safety at intersections.

To improve pedestrian safety, the NJTPA conducted a four-week pedestrian safety education and enforcement campaign called *Street Smart NJ* in eight communities during 2018 and 2019.

The goal of the program is to enhance the pedestrian safety by increasing awareness of pedestrian safety risks and improve compliance with pedestrian and motorist laws. In order to evaluate the effectiveness of the campaign program with respect to behavioral changes, a web-based survey was designed and distributed through the communities using the following recruitment strategies:

1. In-person flyer distribution
2. Direct mail advertising
3. Social media advertising
4. Intercept surveys using tablet devices

Behavioral data were collected to measure the effect of the campaign in seven geographically, and demographically diverse communities in northern, central, and southern New Jersey. It should be noted that the impact of the campaign was assessed by analyzing the results of survey in each community and the entire communities as a whole. The study communities include:

- The City of Newark: Raymond Boulevard and Mulberry Street
- The City of Princeton: Nassau Avenue and Washington Road
- The City of Morris Plains: Franklin PI and Speed Avenue
- The City of Garfield: Midland Avenue and Winkle Avenue
- The City of Asbury Park: Memorial drive and Springwood Avenue
- The Township of Rutherford: Park Avenue and Glen Road

INTRODUCTION

Pedestrian safety at intersections, where motor vehicles and pedestrians cross paths, is a serious matter of concern for traffic and road safety engineers and professionals. The severity of pedestrian-involved crashes is high since a pedestrian is not protected by any automobile safety features (such as the mass and frame of their vehicle, airbags, and seatbelts) as motorists are in crash events. According to the National Highway Traffic Safety Administration (NHTSA), in 2015 there were more than 5,376 pedestrian deaths and over 70,000 pedestrian injuries resulting from traffic crashes. It is estimated that the total cost of pedestrian fatalities and injuries in the year 2000 was $20.8 billion; in today's dollars, this would be equivalent to $30.75 billion. Due to the severity of pedestrian-related crashes, these crashes merit special attention and additional analysis. Over the past few years, a considerable number of studies have been performed to identify the factors that contribute to pedestrian crashes and develop effective safety countermeasures. Several other studies focused on pedestrian behaviors and countermeasures to change pedestrian risky behaviors. Although several engineering countermeasures (e.g., traffic sign, traffic signal controls, pavement markings, and roadway geometry) can be employed to enhance pedestrian safety, the behavior of pedestrians and drivers can play an important role in crash risk. Education programs and public outreach efforts provide an opportunity for motorists and pedestrians to address observed or documented behaviors such as speeding, stopping, and crossing. A goal in New Jersey is to mitigate the rate of violations associated with pedestrian and driver behavior to enhance pedestrian safety at intersections.

The literature shows that outreach campaigns can effectively change behavior for pedestrians, but the results are not as conclusive for using these methods to change driver behaviors. A goal in New Jersey is to reduce the rate of violations among both pedestrians and drivers in order to improve pedestrian safety at intersections.

The goals of the Street Smart NJ campaign are to:

- Change pedestrian and motorist non-compliant behavior to reduce the incidence of crashes resulting in injury and/or death to pedestrians.
- Educate motorists and pedestrians about their roles and responsibilities for safely sharing the road (i.e., driving and walking in compliance with laws).
- Increase enforcement of pedestrian safety laws and roadway users' awareness of that effort.

Using the messages such as 'Obey Speed Limit," "Stop for Pedestrians," Use Crosswalk," and "Wait for the Walk" thecampaign educated motorists through public outreach about the importance of obeying traffic rules. The safety campaign promotes education materials (see Figure 1) through paid advertising, earned media, signage, and social media.

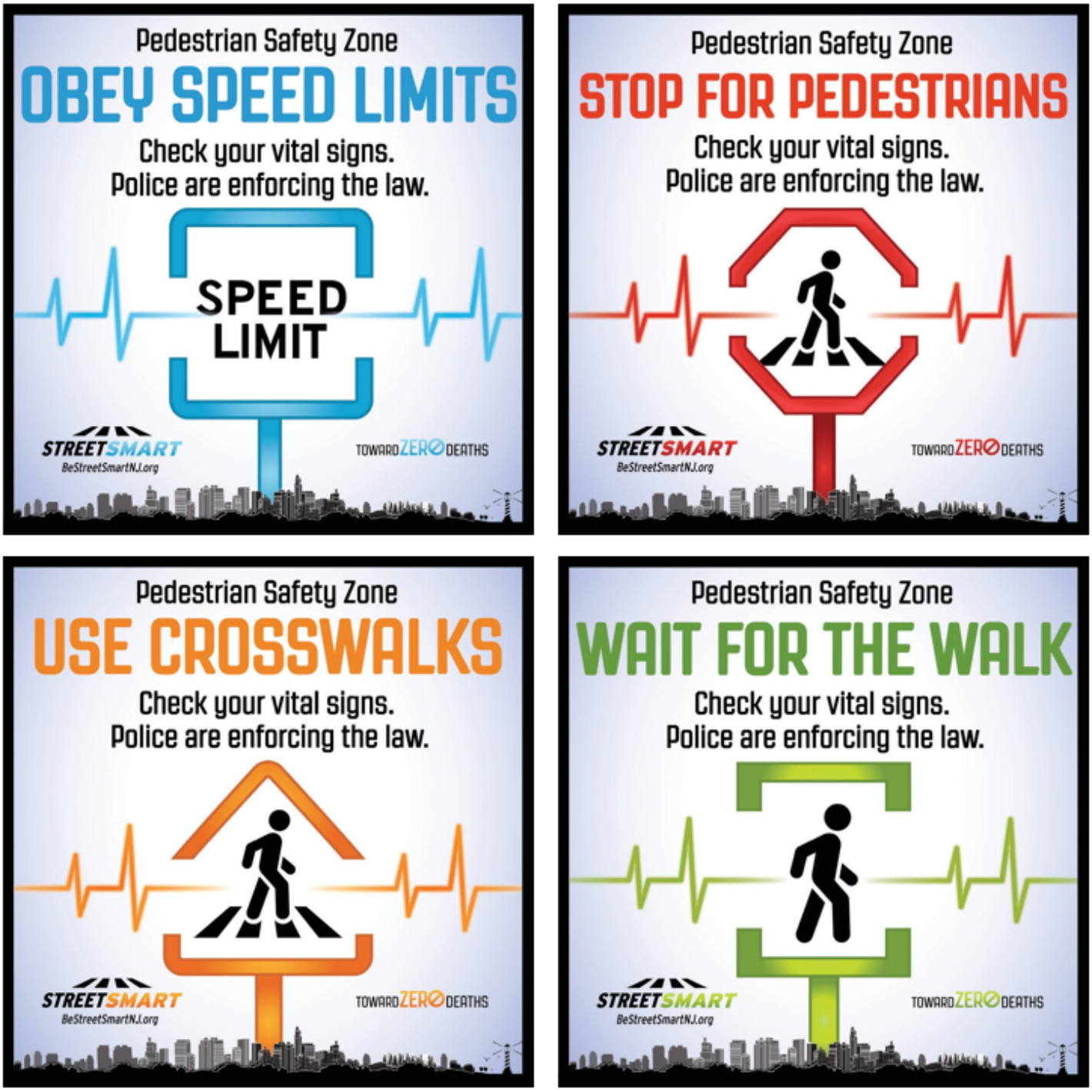


Figure 1. Graphical Messages Used in the *Street Smart NJ* Campaign to Change Driver and Pedestrian Behaviors

STUDY COMMUNITIES

Community Selection Methodology

The goal of selecting sites for the Street Smart NJ campaign and observational study is 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 major 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 intervention. This fact indicates that locations with high numbers of historical crashes are likely to have measurable non-compliant behaviors that could be improved through the community's participation in the Street Smart NJ campaign.

Additional considerations for side selection may include diverse sizes of communities and diverse geographic coverage of the region. It is expected that locations with high traffic and pedestrian volumes are likely to be selected to provide sufficient data for comparison. Notably, coordination with local communities is another factor in site selection and scheduling.

The project team conducted a preliminary five year-historic crash analysis of New Jersey pedestrian-involved crashes (2012 - 2016), to assist in identifying the locations most likely to exhibit vehicle and pedestrian proxy behaviors in an observational study and benefit from Street Smart NJ campaign intervention. In this analysis, fatal and incapacitating crashes receive the highest weight, followed by other injury crashes, and lastly, non-injury crashes. This Highway Safety Manual (HSM) approved crash severity weighting methodology allows safety planners to direct interventions to the locations where they are most needed. Table 1 shows the crash severity weighting methodology.

Table 1: Crash Severity Weights

Severity	Dollar Value (2017)	K + A Weight	K = A Weight
Killed	5,586,843.81	541.74	29.19
Incapacitating	301,019.80	29.19	29.19
Moderate	110,095.20	10.68	10.68
Complaint of Pain	62,573.10	6.07	6.07

According to the analysis, the top three municipalities in terms of the frequency of severity-weighted pedestrian-involved crashes are the City of Newark, the City of Jersey City, and the City of Paterson.

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METHOD

The primary objective of the behavioral study is to supplement the observational study to evaluate the effects of the *Street Smart NJ* pedestrian safety campaign at the municipal level and the entire communities as a whole. In doing so, a web-based survey was designed and administrated online through the Qualtrics program (Appendix 1). Safeguards are incorporated in the survey to ensure results are from persons 18 years and older from people who live in or frequent the campaign location(s), and to stipulate that survey results will remain strictly confidential.

It should be noted that the survey will only be truly valuable when the results are reliable and represent the entire population. To do so, it is very critical to determine the ideal survey sample size for the population being measured. Using a precise survey sample size is crucial for any research project. 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 as follows:

•**Margin of error** is the positive and negative deviation we allow on our survey results for the sample. In other words, the difference between the opinions of the respondents and the opinion of the entire population. For instance, suppose a survey is conducted with a 5% margin of error where 90% of the survey respondents select a given category of answer. Using this 5% margin of error enables the prediction that between 85% (90%-5%) and 95% (90%+5%) of the entire population share a preference for that category.

•**Confidence level** (also referred to as confidence interval) 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% confidence interval would predict that 95% of the time between 85% and 95% of the population shares a preference for that answer category.

Based on the necessary accuracy and reliability thresholds (margin of error and confidence level) of for the sample, the required number of respondents (people who have filled in the survey) can be calculated. It should be noted that many research studies use a 95% confidence interval and a margin of error of between 5% and to 10%. The following table provides a better understanding regarding the required sample size based on different study populations at a 95% confidence level and margins of error between 5% and 1%.

	Confidence level = 95%			Confidence level = 99%		
	Margin of error			Margin of error		
Population size	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	663	2.647	16.317

Figure 1. Example of Required Sample Size for Different Confidence Intervals and Margins of Errors

Table 2 provides more detailed information to figure out how the values of population size, sample size, confidence interval, and margin of error affect the accuracy of results.

Table 2: The Effect of Survey Parameters on the Accuracy of its Results

	Value Increased	Value Decreased
Population Size	Accuracy Decreases	Accuracy Increases
Sample Size	Accuracy Increases	Accuracy Decreases
Confidence Level	Accuracy Increases	Accuracy Decreases
Margin of Error	Accuracy Decreases	Accuracy Increases

Subgroup Analysis

It should be noted that a larger sample size may be required to perform sub-group analysis. An example of sub-group analysis is comparing responses between people who primarily walk and drive, or comparing responses between demographic groups, such as

differing impacts of the campaign based on the recipient's gender, age, or income. When conducting subgroup analysis, a larger overall sample size is required because the size of each subgroup is, by definition, only a portion of the overall sample. The size of each subgroup could depend on a variety of factors, including the sampling strategy used, the availability of representative survey participants to comprise the given subgroup, and the overall size of the available study population (i.e., campaign location population).

Generally speaking, as sample size, the number of sub-groups to be analyzed, and qualification requirements for participants (i.e., members of a particular community participating in the Street Smart campaign and over 18 years of age) increase, so do the time and cost required to recruit a complete sample. These tradeoffs must be considered when determining the chosen sample size and sub-groups to be analyzed, keeping in mind the specified accuracy, reliability, temporal, and geographic requirements. It should be noted that the subgroup analysis would likely not be done on individual communities, but on all eight evaluated communities collectively.

Survey Methodology

In addition to the observational evaluation, people who lived, worked, or regularly frequented Street Smart communities were surveyed about their knowledge, behavior, and perceptions of pedestrian safety. The survey was designed to determine the effectiveness of the Street Smart 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 because a longitudinal study was cost- and time-prohibitive based on the structure of the evaluation project. NJTPA may wish to consider a longitudinal design for future evaluation studies to more robustly ensure that changes in the post-campaign survey are due to the campaign itself (rather than random or systematic differences between independent samples). More importantly, a longitudinal study would also allow for long-term follow-up at 6 months, 1 year, or longer periods post-campaign to determine the sustained effectiveness of the campaigns in increasing pedestrian and bicyclist safety. This long-term evaluation data is a prerequisite to conducting any benefit cost analysis of the Street Smart program compared to permanent solutions such as enhanced driver education, modified traffic officer training and standard operating procedures, or capital investments in bicycle and pedestrian facilities[1].

Survey participants were recruited during a period of two weeks 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 sufficient sample size was collected for each community and to reduce sampling bias based on recruitment method. Individual results for each Street Smart community are analyzed in the following section. Figures 2 through 4 illustrate samples of flyers used in different recruitment methods, including different survey links. Figure 5 also show samples of collected data in the field.

[1]As of 2016, New Jersey ranked 47th in per capita spending on bicycle and pedestrian projects, while it ranked 15th in pedestrian fatalities (Sources: https://www.aarp.org)

Figure 2. Sample of Flyer Used in Direct Mail Advertising Method

Figure 3. Sample of Flyer Used in Social Media Advertising Method

Figure 4. Sample of Flyer Used in In-person Flyer Distribution Method

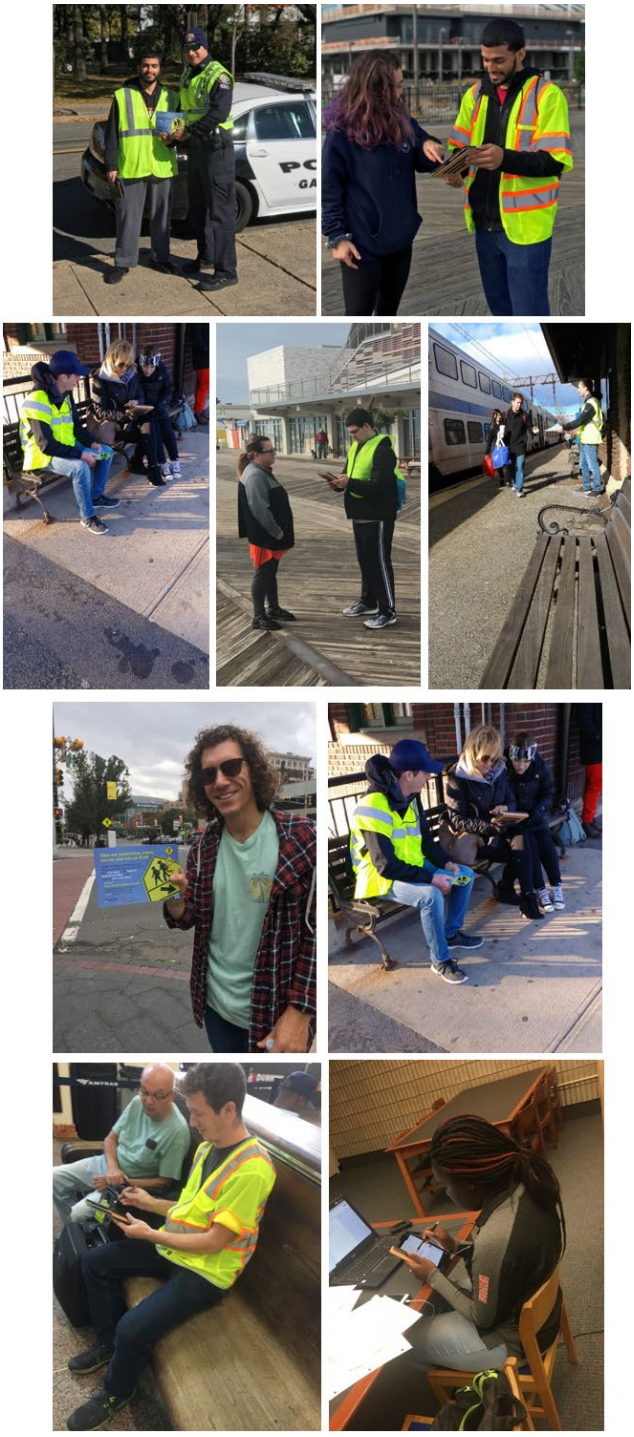


Figure 5. Sample of Collected Data in this Study

Mann-Whitney U Test:

Mann-Whitney U Test is a prevalent test which is used to compare two independent samples. Mann-Whitney U test falls under the non-parametric test category to confirm if two sample means are equal or not (Salkind, 2010). Therefore, the test does not assume any assumptions related to the distribution of scores. Initially, the test was proposed for the equal sample sizes, but later its application was even 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 the mean ranks to be different for the two samples. The calculation procedure for the Mann-Whitney test is as follows:

Assuming n_1 is the number of respondents for pre-campaign and 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. Man-Whitney for pre-campaign, U_1, and post-campaign, U_1 , can be calculated as follows:

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

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

If the U value is equal or less than critical value, the two samples are statistically significant.

Effect Size:

The effect size for the survey sample can be calculated by dividing absolute Standardized test statistic, *Z*, by the square root of the total sample size, *n*, as follows:

$$\text{Effect Size} = \frac{Z}{\sqrt{n}}$$

According to the Cohen's Classification of effect size, the 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.

campaign (p= 0.970).

Morris Plains Survey Recruitment

Method of Recruitment	Pre-Campaign	Post-Campaign	Total
Flyer	3	17	20
Mail	54	38	92
Social	306	255	561
Tablet	10	11	21
Total	373	321	694

The Survey contributors were recruited both before and after the Street-Smart campaign, which begin on October 4th, 2018 and continued for roughly a month.

Flyers advertising participation in the survey were mailed to residences in the zip code 07952 on September 12th pre-campaign and November 12th post-campaign. In addition, flyers were handed out in person to passers-by on the following dates: September 22nd, September 27th, September 30th, October 2nd, November 10th, November 11th, November 12th, November 17th, and November 18th. Intercept surveying was conducted on September 22nd, September 27th, September 30th, November 10th, November 11th, November 17th, and November 18th to recruit survey participants. Lastly, the survey was advertised by community leaders via social media in Morris Plains; though, based on presently available responses to the community leadership survey, data are unavailable on the specific timing or methods of social media survey advertising for Morris Plains.

In total, 694 participants participated in the whole survey. Wherein, 373 pre-campaign and 321 post-campaign survey participants. In addition, 345 (92.7%) pre-survey respondents resided in Morris Plains, and 284 (88.5%) post-campaign participants were the local residents. Survey responses by recruitment method are summarized below.

Table 11: Survey Responses by Recruitment Method

Demographics

Demographic data depicts equivalent sample composition for the pre- and post- campaign surveys, which supports the theory that variations obtain in pre- and post-campaign responses were because of the campaign. Detailed demographic survey results for Morris Plains can be found in Appendix 4: Comprehensive Survey Results, which shows very equivalent distribution for the pre-and post-campaign surveys. The demographic characteristics of the survey samples is abridged below.

In respect of gender, out of entire sample there were 32.9% male and 65.4% female, while based on the US Census Bureau[2] Morris Plains is estimated to have 48.8% female as of 2018, signifying that even being less females in the region, they overrepresented in the survey response. Base on the NHTSA Traffic Safety Facts, males are far more likely to be injured or killed in pedestrian-related accidents than females (males comprise over two thirds of pedestrian fatalities)[3], in upcoming studies additional effort may be essential to collect a representative sample by gender.

[2] US Census Quick Facts, Morris Plains, NJ (2018): https://www.census.gov/quickfacts/fact/table/morrisplainsboroughnewjersey/PST045218

[11] NHTSA Traffic Safety Facts: Pedestrians 2016 Data (March 2018 Revised): https://crashstats.nhtsa.dot.gov/Api/Public/Publication/812493

Further, looking towards the race of the respondents, mostly White i.e. 85.9%, while 3.5% of respondents indicated to be an Asian or Pacific Islander, 3.2% were Hispanic or Latino, and only 1.2% state to be Black or African American. Comparing based on the 2018[4], Morris Plains region has 91.9% White alone, 9.1% Hispanic or Latino, 4.7% Asian, and only 2.2% Black or African American, representing that White overrepresented than other races, that was likely based on the regional population. Upcoming surveys should employ precise efforts to recruit participants that construct a representative sample of the demographics in each campaign location.

Considering of education fulfillment, highly educated participants i.e. 76.7% (bachelor's degree or higher) overrepresented roughly similar to the Morris Plains overall population (60.1%)[5].

Mode Share

Based on the survey result, maximum number of the respondents use car as their mode of transport. In detail, from all 326 pre-campaign respondents, 319 (97.9%) prefer to use car on weekly basis, 175 (53.7%) stated that they like to walk, 45 (13.8%) travel around by public transportation, 28 (8.6%) respondents stated that they use bicycle, 4 (1.2%) prefer motorcycle or moped and only 2 (0.6%) specified that they use personal transportation or other mode of transportation.

Considering the post-campaign survey, from 279 pre-campaign respondents, major number of participants i.e. 276 (98.9%) prefer to use car, 171 (61.3%) stated they prefer to walk, 40 (14.4%) travel around by public transportation, 17 (6.1%) respondents stated that they use bicycle, 4 (1.4%) use motorcycle or moped and only 2 (0.8%) specified that they use personal transportation or other mode of transportation. Below Table (12) depicts the detail mode choice obtain.

Table 12: Survey Responses for Mode of Transportation

	Pre - Frequency	Pre- Percent of Respondents	Pre- Percent of Total Responses	Post-Frequency	Post- Percent of Respondents	Post- Percent of Total Responses
Bicycle	28	8.6	4.89%	17	6.1	3.33%
Bus	4	1.2	0.70%	9	3.2	1.76%
By Car	319	97.9	55.67%	276	98.9	54.12%
Commuter Boat, Ferry	2	0.6	0.35%	1	0.4	0.20%
Commuter Rail	27	8.3	4.71%	22	7.9	4.31%
Motorcycle, Moped	4	1.2	0.70%	4	1.4	0.78%
Personal Transportation Device (Mobility Scooter, Skateboard, Rollerblades, etc.)	1	0.3	0.17%	1	0.4	0.20%
Subway	12	3.7	2.09%	8	2.9	1.57%
Walk	175	53.7	30.54%	171	61.3	33.53%
Other	1	0.3	0.17%	1	0.4	0.20%
Total	573	N/A	100.0%	510	N/A	100.0%

Pedestrian Safety Observations

As per the results of the survey, there was no significant difference observed in both the pre and post-campaign survey for all the aspects; the pedestrians crossing against the signal or mid-block or crossing while using cellphone, drivers using cell phone while driving, drivers not stopping for pedestrians in cross walk and drivers speeding in areas with lots of pedestrian. Based on the Cohen's classification of effective size, the effective size of these changes was small in each and every case. Overall, there was not a significant difference observer in the result of pre- and post-campaign in all the case.

Table 13: Survey Responses for Pedestrian Safety Observation

[12] US Census (2018).
[5] US Census Quick Facts, Morris Plains, NJ (2018): https://www.census.gov/quickfacts/fact/table/morrisplainsboroughnewjersey/PST045218

In the past week how often have you seen...	Pre (n)	Post (n)	Total (n)	Delta Mean Rank	Mann-Whitney U	Z	p	Effect Size
Q1 a: Pedestrians cross against the signal	365	314	679	-10.71	55497.5	-0.742	0.458	0.028
Q1 b: Pedestrians cross mid-block (without crosswalk)	364	314	678	-0.01	57115.0	-0.014	0.989	0.0003
Q1 c: Pedestrians cross while using cell phone	363	310	673	8.27	54883.0	-0.570	0.569	0.022
Q1 d: Drivers not stop for pedestrians in crosswalk	362	311	673	0.02	54154.0	-0.877	0.380	0.034
Q1 e: Drivers speed with lots of pedestrians	359	309	668	0.05	51979.5	-1.451	0.147	0.056
Q1 f: Drivers run red lights or stop signs	359	309	668	-11.97	53478.0	-0.830	0.406	0.032
Q1 g: Drivers using cell phone	356	308	664	0.1	54807.5	-0.007	0.994	0.0003
***Significant change between pre- and post-campaign response**								

Pedestrian Safety Behaviors

In reference to the personal behaviors, there was no significant improvement that was self-reported in terms of the pedestrians crossing against the signal or mid-block or crossing while using cellphone, drivers using cell phone while driving, drivers not stopping for pedestrians in cross walk and drivers speeding in areas with lots of pedestrian. Additionally, looking in terms of the effect size based on the Cohen's classification of effective size, all the aspects have small effective size.

Table 14: Survey Responses for Pedestrian Safety Self-Behavior

In the past week how often have you... (emphasis original)	Pre (n)	Post (n)	Total (n)	Delta Mean Rank	Mann-Whitney U	Z	p	Effect Size
Q2 a: Crossed against the signal	329	290	619	-5.18	46907.0	-0.398	0.691	0.016
Q2 b: Crossed mid-block (without crosswalk)	331	290	621	-1.35	47786.0	-0.102	0.919	0.004
Q2 c: Crossed while using cell phone	329	283	612	-2.40	46189.0	-0.206	0.837	0.008
Q2 d: Not stopped for pedestrians while turning (as a driver)	346	295	641	11.65	49180.0	-1.122	0.262	0.044
Q2 e: Sped while driving in area with lots of pedestrians	342	292	634	4.56	49214.0	-0.330	0.741	0.013
Q2 f: Run red lights or stop signs while driving	339	291	630	-7.6	48134.5	-1.043	0.297	0.042
Q2 g: Driven while using a cell phone	339	291	630	-20.07	46181.0	-1.652	0.099	0.066
*Significant change between pre- and post-campaign response								

Pedestrian Safety Knowledge

Pertaining to the knowledge of pedestrian traffic signals, most of the respondents indicated the knowledge that it is proper to start crossing the street when the walk signal in enable (n=632, 91.1%) and respondents (n=694, 99.7%) indicated not to start walking when the orange don't walk sign is enable. Whereas, a moderate percentage of respondents depicted misunderstanding about whether to begin to cross during a pedestrian signal count-down clock (during which time it is only legal for a pedestrian to complete crossing the street, not start crossing). Wherein, two images were shown to identify knowledge of this condition, with short (8 second) and longer (23 second) count-down clocks displayed. By laws, pedestrians are not legally supposed to begin crossing during a count-down

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?	592	95.2%
Crossing the street illegally (against signal or mid-block)	554	89.8%
Using a hand-held cell phone while crossing	223	36.2%
Not stopping for pedestrians in crosswalk	598	96.5%
Using a hand-held cell phone while driving	609	98.2%
Total	620	100.0%

clock of any length, 84 respondents (12.1%) indicated they believed one should begin to cross in the 8 second count-down condition, and a huge number i.e. 228 respondents (32.9%) indicated they thought one should begin to cross during the longer (23 second) count-down clock. In conclusion, it demonstrates a primary lack of public understanding among few people about how pedestrian count-down signals work and may explain at least some observed behavior of pedestrians "crossing against the signal" in the companion observational study. More nuanced and precise education or advertising outreach about how to properly use a pedestrian signal may be integrated into future versions of the Street Smart program.

In relations to the knowledge of pedestrian safety law enforcement, most respondents (n=592, 95.2%) specified that pedestrians could receive a ticket for violating

pedestrian traffic laws. A slightly less respondents than above, indicated knowledge that a ticket could be received specifically for crossing against the signal (n=554, 89.8%). A certain proportion of respondents (n=223, 36.2%) thought one could receive a ticket for crossing while using a cell phone, but there's no state law exists to regulate this specific behavior. Almost all respondents (n=598, 96.5%) indicated knowledge that a ticket could be given for not stopping for pedestrians, indicating that efforts to promote public education about this law since its passage have been successful. In addition, almost all respondents specified knowledge that it is illegal to drive while using a hand-held mobile device (n=609, 98.2%).

Q: In the last 30 days, have you read, seen or heard any messages addressing the following… (check all that apply)							
	Total (n)	Total (%)	Pre (n)	Pre (%)	Post (n)	Post (%)	p
Speeding/aggressive driving	230	36.6%	112	33.1%	118	40.7%	0.050*
Driving under the influence of alcohol	238	37.9%	120	35.5%	118	40.7%	0.182
Driving under the influence of a drug	110	17.5%	53	15.7%	57	19.7%	0.192
Drowsy driving	28	4.5%	8	2.4%	20	6.9%	0.006*
Seat belt use	184	29.3%	93	27.5%	91	31.4%	0.290
Distracted driving	283	45.1%	130	38.5%	153	52.8%	0.000*
Pedestrian safety	205	32.6%	74	21.9%	131	45.2%	0.000*
Bicycle safety	84	13.4%	42	12.4%	42	14.5%	0.451
None of the above	164	26.1%	103	30.5%	61	21.0%	0.007*
*Significant change between pre- and post-campaign response							

Overall, the responses show that almost all respondents are knowledgeable regarding to pedestrian safety traffic laws. Thus, observed noncompliance may be due to conscious choice to disregard the law or lack of knowledge about how to appropriately apply knowledge of the law to a specific intersection context.

Campaign Exposure

4.5% (Drowsy Driving) to 45.1% (Distracted Driving) of all respondents indicated experience to some highway safety campaign messaging in the past 30 days. There was a significant difference observed between the pre- and post-campaign surveys result in experience to pedestrian safety, distracted driving, drowsy driving and speeding/aggressive driving. While, there was no significant difference detected between pre- and post-campaign in relation to bicycle safety, seat belt use, driving under influence of alcohol and drug.

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
"Use Crosswalks"	192	30.5%	47	13.9%	145	50.0%	0.000*
"Wait for the Walk"	113	18.0%	20	5.8%	93	32.3%	0.000*
"Stop for Pedestrians"	161	25.6%	42	12.4%	119	41.3%	0.000*
"Obey Speed Limits"	97	15.5%	30	8.8%	67	23.4%	0.000*
"Heads Up Phones Down"	154	24.8%	49	14.5%	105	36.8%	0.000*
Any Street Smart sign	281	40.5%	94	25.2%	187	58.3%	0.000*
*Significant change between pre- and post-campaign response							
Twenty-three second count-down clock		228		32.9%			
Don't walk signal		692		99.7%			
Total		694		100.0%			

Based on the survey result, it was observed that more than three-fourth of the total respondents (n=632) indicated they had not seen or heard messaging that mentions "Street Smart", in either the pre- or post-campaign survey (Pre-campaign n =315, 92.4%; Post-campaign n = 183, 62.9%).

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
Crossing against signal or outside crosswalk	81	13.7%	37	11.9%	44	15.7%	0.184
Not stopping for pedestrians in crosswalk	145	24.6%	70	22.6%	75	26.8%	0.237
Other	21	3.6%	11	3.5%	10	3.6%	0.988

On the other hand, there was a significant difference observed between the two surveys (p= 0.000). This indicates that public knowledge of the Street Smart campaign name may be still limited, but it changed due to the campaign.

Survey responses to question below, which shows participants pictures of specific Street Smart campaign signs and asks if they have seen them, indicate higher rate of recognition for all the signs. There was a significant increase in recognition after the campaign for all the 5 signs i.e. "Use Crosswalks, wait for the Walk, Stop for Pedestrians, signs, Obey Speed Limits, Heads Up Phones Down", and even for "Any street smart sign" case there was

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)	%
Very strictly	29	5.7
Somewhat strictly	88	17.2
Not very strictly	230	44.8
Not at all	166	32.4
Total	513	100.0

a significant increase observed after the campaign.

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)	%
Very strictly	92	16.8
Somewhat strictly	205	37.4
Not very strictly	175	31.9
Not at all	76	13.9
Total	548	100.0

Enforcement Awareness

Mostly all the respondents showed they have not read, seen, or heard about police efforts to enforce pedestrian safety laws in the neighborhood. In consideration to all respondent, 24.6% state that they were aware of local efforts to enforce the law to stop for pedestrians in the crosswalk, whereas only 13.7% of all respondents indicated having seen or heard about efforts to enforce pedestrian safety laws for crossing against the signal or outside the crosswalk. There was no noteworthy increase response after the campaign, indicating that survey respondents did not observe a growth in pedestrian safety enforcement.

This awareness was reinforced by responses to Question below, that asked how strictly participants think police in their area enforce pedestrian-related safety laws. Most respondents indicated they thought pedestrian-safety laws were enforced “Not very strictly” or “Not at all” (n=396, 77.2%). Further, there was a slight improvement seen, but still there was no substantial increase opt from the post-campaign response (p= 0.196).

Above half of participants in the survey, reported that police impose driver-related pedestrian safety laws (e.g. Speeding, stopping for pedestrians in the crosswalk) “Very strictly” or “Somewhat strictly” (n=297, 54.2%). Similarly, there was no significant difference observed in response following the campaign (p= 0.152).

References:

Salkind, N. J. (2010). *Encyclopedia of research design* Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288

Appendix 1: Online Survey Questionnaire

You are invited to participate in a research study being conducted by Rutgers University on behalf of the North Jersey Transportation Planning Authority (NJTPA) to evaluate the effectiveness of the Street Smart NJ pedestrian safety education campaign program. In the following survey, the team seeks information about your knowledge, behaviors, and attitudes toward this campaign.

This survey should take you approximately 5 to 10 minutes to complete. Your participation in the survey is completely voluntary, and there are no risks to participation. You may skip any questions you are not comfortable answering. If at any time you wish to stop participating, you are free to do so with no penalty to you. This research is confidential. Confidential means that the research records will include some information about you, such as your job title. However, the research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the full set of data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All study data will be kept for three years post study.

If you have any questions at any time about the research or the procedures described above, or if you need assistance in completing the survey, you may contact the study principal investigator Dr. Mohammad Jalayer at mohammad.jalayer@rutgers.edu. If you have any questions about your rights as a participant in this study, you may contact the Rutgers University Institutional Review Board for the Protection of Human Subjects Office of Research and Sponsored Programs at 335 George Street Liberty Plaza / 3rd Floor I Suite 3200 New Brunswick, NJ 08901, Tel: 732-235-9806, Email: humansubjects@osrp.rutgers.edu.

Please print a copy of this consent form for your records. If you are 18 years of age or older, understand the statements above, and will consent to participate in the study, click on the "I Agree" button to begin the survey. If not, please click on the "I Do Not Agree" button which you will exit this pro

The North Jersey Transportation Planning Authority (NJTPA) is working to improve pedestrian safety in New Jersey. Your answers to this survey will help make this effort a success. All responses will remain **STRICTLY CONFIDENTIAL**.[6,7]

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?

c) I live in New Jersey
→ **If Yes,** S2
d) 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?

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

[6] There will be a progress bar across the top of the screen showing the participant's progress through the survey.
[7] There will be a statement at the bottom of the screen mentioning "This information is strictly confidential. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated."

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:

k) Zip Code
l) 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:

j) Zip Code
k) 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

l) If outside study area, terminate.

Questions

1. In the past week, how often **have you seen…**
People who crossed the street in an unsafe manner against the "walk" signal?

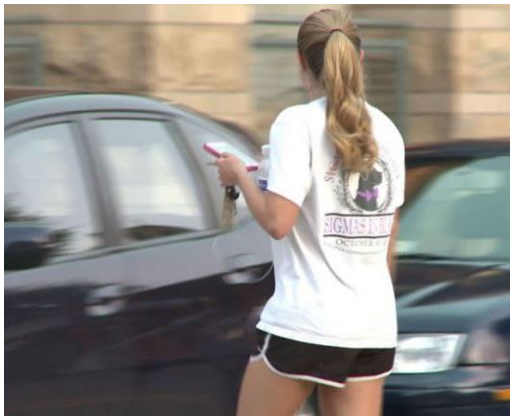
a) Never
b) Rarely
c) Occasionally
d) A moderate amount
e) A great deal

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

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)*

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

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

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

D6. Do you speak any languages besides English at home?

a) No
b) Yes

→ If Yes-> (Please specify_____)

D7. 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

D8. Are you enrolled in any type of education institution like university, college, community college or technical training program?
Yes, full time

a) Yes, part time
b) No

If selected a NJ location for home address during pre-screen, ask D9. Else skip to D10.

D9. 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 D10.1 & D 10.2. Else, skip to D13.

D10.1 Have you ever lived in New Jersey in the past?

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

D10.2 How long did you live in New Jersey?

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

D11. What is the ZIP Code where you lived in New Jersey? _____

S12. 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

Appendix 2: Demographic Information for Asbury Park

Q: What is your gender?	Percentage (%)
Male	40.2
Female	57.1
Rather not say	2.7

Q: What is your age?	Percentage (%)
18-24	4.7
25-34	13.6
35-44	17.8
45-54	24.0
55-64	21.0
65 years and over	16.0
Don't know/rather not say	3.0

Q: What is your race?	Percentage-pre (%)	Percentage-post (%)
White	78.1	76.4
Hispanic or Latino	6.3	7.5
Black or African American	3.8	5.7
Native American or American Indian	0	1.1
Asian/Pacific Islander	1.3	2.3
Multiracial	0	1.1
Other, please specify	1.9	0
Rather not say	8.8	5.7

Q: Do you speak any languages besides English at home?	Percentage (%)
Yes	12.2
No	87.8

Q: What is the highest level of education you have completed?	Percentage (%)
Less than a high school diploma/equivalent	1.5
Some high school or high school graduate	6.3
Some college	14.3
Associates' degree	4.2
Bachelor's degree	40.8
Advanced degree	33.0

Q: Are you enrolled in any type of education institution (community college, university, technical school)?	Percentage-pre (%)	Percentage-post (%)
Yes, full time	5	9.1
Yes, part time	3.7	3.4
No	91.3	87.4

Q: How long have you lived in New Jersey (in total)?	Percentage-pre (%)	Percentage-post (%)
Less than one year	1.3	1.2
1-5 years	6.9	5.2
5 or more years	91.8	93.6

Appendix 3: Demographic Information for Garfield City

Q: What is your gender?	Percentage (%)
Male	40.2
Female	56.9
Rather not say	2.9

Q: What is your age?	Percentage (%)
18-24	6.9
25-34	24.5
35-44	21.6
45-54	21.6
55-64	15.7
65 years and over	7.8
Don't know/rather not say	2.0

Q: Do you speak any languages besides English at home?	Percentage (%)
Yes	35.6
No	64.4

Q: What is the highest level of education you have completed?	Percentage (%)
Less than a high school diploma/equivalent	2.0
Some high school or high school graduate	22.5
Some college	16.7
Associates' degree	7.8
Bachelor's degree	35.3
Advanced degree	15.7

Q: Are you enrolled in any type of education institution (community college, university, technical school)?	Percentage-pre (%)	Percentage-post (%)
Yes, full time	8.7	7.1
Yes, part time	6.5	1.8
No	84.8	91.1

Q: How long have you lived in New Jersey (in total)?	Percentage-pre (%)	Percentage-post (%)
Less than one year	2.2	0.0
1-5 years	6.7	7.1
5 or more years	91.1	92.9

Q: What is your race?	Percentage-pre (%)	Percentage-post (%)
White	60.9	62.5
Hispanic or Latino	26.1	19.6
Black or African American	6.5	5.4
Native American or American Indian	0	0
Asian/Pacific Islander	2.2	3.6
Multiracial	0	0
Other, please specify	2.2	0
Rather not say	2.2	8.9

Appendix 4: Demographic Information for Morris Plains

Q: What is your gender?	Percentage (%)
Male	32.9
Female	65.4
Rather not say	1.7

Q: What is your age?	Percentage (%)
18-24	1.8
25-34	9.1
35-44	20.4
45-54	27.9
55-64	20.1
65 years and over	18.6
Don't know/rather not say	2.2

Q: Do you speak any languages besides English at home?	Percentage (%)
Yes	9.3
No	90.7

Q: What is the highest level of education you have completed?	Percentage (%)
Less than a high school diploma/equivalent	0.2
Some high school or high school graduate	5.2
Some college	12.7
Associates' degree	5.3
Bachelor's degree	43.5
Advanced degree	33.2

Q: Are you enrolled in any type of education institution (community college, university, technical school)?	Percentage-pre (%)	Percentage-post (%)
Yes, full time	4.0	4.0
Yes, part time	2.2	1.1
No	93.8	95.0

Q: How long have you lived in New Jersey (in total)?	Percentage-pre (%)	Percentage-post (%)
Less than one year	0.3	1.1
1-5 years	3.4	3.2
5 or more years	96.3	95.7

Q: What is your race?	Percentage-pre (%)	Percentage-post (%)
White	86.3	85.3
Hispanic or Latino	3.1	3.2
Black or African American	0.3	2.2
Native American or American Indian	0	0
Asian/Pacific Islander	3.1	3.9
Multiracial	0	0
Other, please specify	0.9	0.4
Rather not say	6.2	5.0

RUTGERS
Center for Advanced Infrastructure and Transportation

Rowan University

North Jersey Transportation Planning Authority (NJTPA)

Observational Pedestrian Safety Study: Final Report

Authors
Dr. Mohammad Jalayer, Rowan University
Dr. Patrick Szary, Rutgers CAIT
Mr. Thomas Hillman, Rutgers CAIT

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ABSTRACT

This report provides the results of the observational study to compare the rates of risky pedestrian and driver behaviors before and after the North Jersey Transportation Planning Authority (NJTPA) pedestrian safety education and enforcement campaign (*Street Smart NJ*) in eight communities across the state of New Jersey. The behaviors – including jaywalking and crossing against a signal, failing to stop for pedestrians when turning, failing to stop before turning at a red light, and running the red light signal – were compared and measured in eight communities (Teaneck, Asbury Park, Garfield, Morris Plains, Newark, Princeton, Rutherford,……) in 2018-2019.

EXECUTIVE SUMMARY

Pedestrian safety at intersections, where motor vehicles and pedestrians cross paths, is a serious matter of concern for traffic and road safety engineers and professionals. The severity of pedestrian-involved crashes is high since a pedestrian is not protected by any automobile safety features (such as the mass and frame of their vehicle, airbags, and seatbelts) as motorists are in crash events. According to the National Highway Traffic Safety Administration (NHTSA), in 2015 there were more than 5,376 pedestrian deaths and over 70,000 pedestrian injuries resulting from traffic crashes. It is estimated that the total cost of pedestrian fatalities and injuries in the year 2000 was $20.8 billion; in today's dollars, this would be equivalent to $30.75 billion. Due to the severity of pedestrian-related crashes, these crashes merit special attention and additional analysis.

Over the past few years, a considerable number of studies have been performed to identify the factors that contribute to pedestrian crashes and develop effective safety countermeasures. Several other studies focused on pedestrian behaviors and countermeasures to change pedestrian risky behaviors. Although several engineering countermeasures (e.g., traffic sign, traffic signal controls, pavement markings, and roadway geometry) can be employed to enhance pedestrian safety, the behavior of pedestrians and drivers can play an important role in crash risk. Education programs and public outreach efforts provide an opportunity for motorists and pedestrians to address observed or documented behaviors such as speeding, stopping, and crossing. A goal in New Jersey is to mitigate the rate of violations associated with pedestrian and driver behavior to enhance pedestrian safety at intersections.

To improve pedestrian safety, the NJTPA conducted a four-week pedestrian safety education and enforcement campaign called *Street Smart NJ* in eight communities during 2018 and 2019.

The goal of the program is to enhance the pedestrian safety by increasing awareness of pedestrian safety risks and improve compliance with pedestrian and motorist laws. In order to evaluate the effectiveness of the campaign program, four non-compliant behaviors were identified to assess the level of pedestrian risk:

1. Jaywalking and Crossing Against the Signal
2. Turning Vehicle Fails to Stop for Pedestrian
3. Failure to Stop before Right Turn at Red Signal
4. Red Light Signal Running

Observations were collected to measure the effect of the campaign in eight geographically, and demographically diverse communities in northern, central, and southern New Jersey and the impact of the campaign was assessed by observing pedestrian and driver behaviors at a key intersection in each community. The communities and intersections observed were:

- The Township of Teaneck: State Street and Queen Anne Road
- The City of Newark: Raymond Boulevard and Mulberry Street
- The City of Princeton: Nassau Avenue and Washington Road
- The City of Morris Plains: Franklin PI and Speed Avenue
- The City of Garfield: Midland Avenue and Winkle Avenue
- The City of Asbury Park: Memorial drive and Springwood Avenue

- The Township of Rutherford: Park Avenue and Glen Road

The sites in Princeton, Teaneck, Newark, and Asbury Park are 4-Leg intersections (with 4 approach roads) controlled by traffic signals. The site in Garfield is a 3-Leg intersection controlled by traffic signal and the site in Rutherford is a 3-Leg controlled by stop signs. The site in Morris Plains is a 5-Leg intersection controlled by traffic signal. The proxy behaviors were observed at each site before and after the *Street Smart NJ* campaign to determine if the education and enforcement activities resulted in a change in *pedestrian* and driver behaviors.

INTRODUCTION

Pedestrian safety at intersections, where motor vehicles and pedestrians cross paths, is a serious matter of concern for traffic and road safety engineers and professionals. The severity of pedestrian-involved crashes is high since a pedestrian is not protected by any automobile safety features (such as the mass and frame of their vehicle, airbags, and seatbelts) as motorists are in crash events. According to the National Highway Traffic Safety Administration (NHTSA), in 2015 there were more than 5,376 pedestrian deaths and over 70,000 pedestrian injuries resulting from traffic crashes. It is estimated that the total cost of pedestrian fatalities and injuries in the year 2000 was $20.8 billion; in today's dollars, this would be equivalent to $30.75 billion. Due to the severity of pedestrian-related crashes, these crashes merit special attention and additional analysis. Over the past few years, a considerable number of studies have been performed to identify the factors that contribute to pedestrian crashes and develop effective safety countermeasures. Several other studies focused on pedestrian behaviors and countermeasures to change pedestrian risky behaviors. Although several engineering countermeasures (e.g., traffic sign, traffic signal controls, pavement markings, and roadway geometry) can be employed to enhance pedestrian safety, the behavior of pedestrians and drivers can play an important role in crash risk. Education programs and public outreach efforts provide an opportunity for motorists and pedestrians to address observed or documented behaviors such as speeding, stopping, and crossing. A goal in New Jersey is to mitigate the rate of violations associated with pedestrian and driver behavior to enhance pedestrian safety at intersections.

The literature shows that outreach campaigns can effectively change behavior for pedestrians, but the results are not as conclusive for using these methods to change driver behaviors. A goal in New Jersey is to reduce the rate of violations among both pedestrians and drivers in order to improve pedestrian safety at intersections.

The goals of the Street Smart NJ campaign are to:

- Change pedestrian and motorist non-compliant behavior to reduce the incidence of crashes resulting in injury and/or death to pedestrians.
- Educate motorists and pedestrians about their roles and responsibilities for safely sharing the road (i.e., driving and walking in compliance with laws).
- Increase enforcement of pedestrian safety laws and roadway users' awareness of that effort.

Using the messages such as "Obey Speed Limit," "Stop for Pedestrians," Use Crosswalk," and "Wait for the Walk" the campaign educated motorists through public outreach about the importance of obeying traffic rules. The safety campaign promotes education materials (see Figure 1) through paid advertising, earned media, signage, and social media.

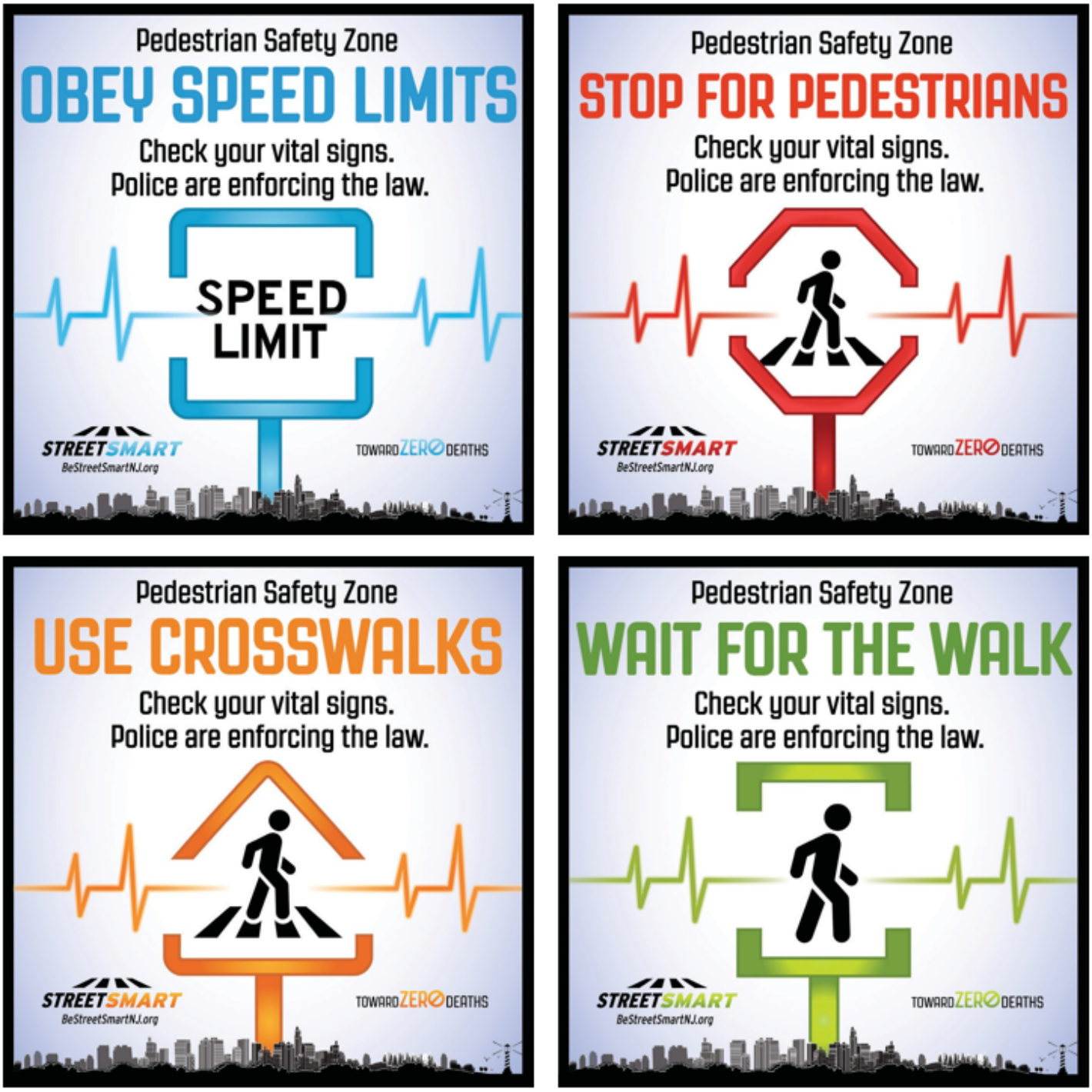


Figure 1. Graphical Messages Used in the *Street Smart NJ* Campaign to Change Driver and Pedestrian Behaviors

STUDY SITES

Site Selection Methodology

The goal of selecting sites for the Street Smart NJ campaign and observational study is 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 major 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 intervention. This fact indicates that locations with high numbers of historical crashes are likely to have measurable non-compliant behaviors that could be improved through the community's participation in the Street Smart NJ campaign.

Additional considerations for side selection may include diverse sizes of communities and diverse geographic coverage of the region. It is expected that locations with high traffic and pedestrian volumes are likely to be selected to provide sufficient data for comparison. Notably, coordination with local communities is another factor in site selection and scheduling.

The project team conducted a preliminary five year-historic crash analysis of New Jersey pedestrian-involved crashes (2012 - 2016), to assist in identifying the locations most likely to exhibit vehicle and pedestrian proxy behaviors in an observational study and benefit from Street Smart NJ campaign intervention. In this analysis, fatal and incapacitating crashes receive the highest weight, followed by other injury crashes, and lastly, non-injury crashes. This Highway Safety Manual (HSM) approved crash severity weighting methodology allows safety planners to direct interventions to the locations where they are most needed. Table 1 shows the crash severity weighting methodology.

Table 1. Crash Severity Weights

Severity	Dollar Value (2017)	K + A Weight	K = A Weight
Killed	5,586,843.81	541.74	29.19
Incapacitating	301,019.80	29.19	29.19
Moderate	110,095.20	10.68	10.68
Complaint of Pain	62,573.10	6.07	6.07

According to the analysis, the top three municipalities in terms of the frequency of severity-weighted pedestrian-involved crashes are the City of Newark, the City of Jersey City, and the City of Paterson.

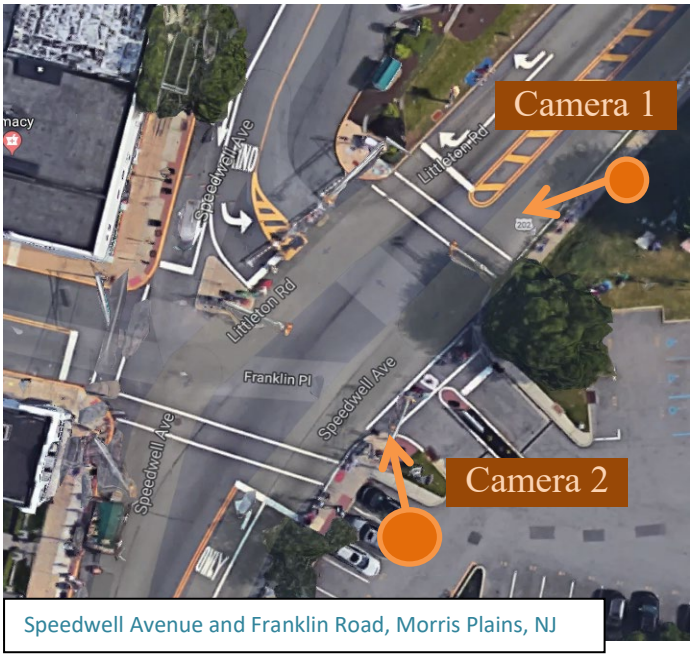
Township of Morris Plains– Speedwell Avenue and Franklin Road Intersection

The intersection of Speedwell Avenue and Littleton Road is located approximately a quarter mile from the Morris Plains 9/11 Memorial Park. A half mile to the south resides the Alfred Vail Elementary School. Two blocks to the west is the Morris Plains library. Running to the north Speedwell turns into Granniss Avenue. The intersection features the Morris Plains train station facing west. Store fronts on either side of Franklin Place face east at the intersection.

Speedwell Avenue is a two-way street running in the north-south direction. Speedwell Avenue has one lane running in each direction. On the south side of the intersection the northbound lane splits into two to allow for left hand turns. On the north side of the intersection, the southbound lane splits into two with a left turn only lane.

Littleton Road runs from east to west. Littleton Road has one lane running in both directions. Coming from east to west the westbound direction splits into two lanes at the intersection for right hand turns. There is No Turn On Red from this direction.

Franklin Road runs east-west. It has one lane in both directions. At the traffic signal no lane splitting occurs. Right Turn On Red are allowed at this intersection.



Speedwell Avenue and Franklin Road, Morris Plains, NJ

Figure 3. Intersection of Speedwell Avenue and Franklin Road, Morris Plains, NJ

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METHOD FOR DATA COLLECTION

The primary objective of the observational study is to determine if the campaign is effective in mitigating non-compliant behaviors by pedestrians and drivers, resulting in enhancing safety for pedestrians at the study locations. Given the fact that crashes are not frequent events, it is better to observe the occurrence of risky non-compliant behaviors by pedestrians and motorists that can serve as proxy measures for safety. Safety improvement 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 for both pre- and post-campaign. In doing so, it is required to identify which data needs to be collected, how this information will be collected in the field, and how the raw data should be processed to provide a useful dataset for analysis purposes.

Data Required to Assess Pedestrian and Driver Behavior

To conduct the observational evaluation, for each proxy measure, two types of data are required to be collected: 1) counts of the occurrences of non-compliant behavior, and 2) counts of a measure of exposure or the number of opportunities that pedestrians or drivers have a chance 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 and is used to compare the pre- and post-campaign datasets to identify if there is a statistically significant change in pedestrian and driver behavior. In this project, four proxy measures were selected by NJTPA to measure the impact of its Street Smart NJ campaign messaging. These proxy behaviors allow the evaluators observe the non-compliant behavior and determine the relevant measure of exposure in each substantive area focus for the Street Smart NJ campaign:

- ***Proxy 1: Jaywalking and Crossing Against the Signal:*** a pedestrian crosses 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 total number of pedestrians crossing the street.

- ***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 total number of left or right turning vehicles when pedestrians are present so that turning vehicles have an opportunity to properly stop for pedestrians.

- ***Proxy 3: Failure to Stop before Right Turn at Red Signal:*** 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 total 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 STOP sign. The measure of exposure is the total number of right turning vehicles that approach the STOP sign.

- ***Proxy 4: Red Light Signal Running:*** a vehicle passing an intersection when the traffic signal is red. The measure of exposure is the total number of vehicles that enter the intersection during the green and yellow time. For unsignalized intersections, this proxy is a vehicle passing the intersection fails to make a complete stop at STOP sign. The measure of exposure is the total number of vehicles that enter the intersection.

Data Collection Schedule

To evaluate the safety proxy behaviors of community members before and after the Street Smart NJ campaign, each measure must be observed and recorded at pre-determined study locations. In order to ensure high-quality data collection occurs in each Street Smart NJ community, several activities must be coordinated including pre-campaign data collection, the campaign duration, and post-campaign data collection. Pre-campaign observations were collected as close as possible to the launch of the campaign, within a window of approximately two weeks before the campaign. Similarly, the post-observations were collected as close as possible to the campaign conclusion, within a window of approximately two weeks after the campaign. To minimize the source of bias and number of external, non-campaign factors that can influence on the behavior of pedestrians and drivers, data were collected under the most similar external conditions possible. These external factors include time of day, the day of the week, intersection location and geometry, weather, season, and special events. Pedestrian and motor vehicle traffic volumes are additional crucially important external factors that play a central role in the analysis. These volumes are heavily influenced by the above factors, although there are additional influences, such as economic trends and random chance that also contribute significantly to these total counts. As a result, vehicle and pedestrian volumes were controlled for in the analysis by collecting vehicle and pedestrian counts during the observation and calculating the proxy behaviors based on an exposure rate: i.e., observed proxy behaviors as a percentage of the overall vehicle and pedestrian volumes. Data were collected only on weekdays as shown in Table 2

Data Collection Method

As previously stated, in this project, four non-compliant behaviors and four measures of exposure were observed for multiple intersection approaches at each study site. To ensure accurate counts, student workers were employed to capture video recordings of each intersection approach to capture the occurrence of proxy safety variables quantify overall pedestrian exposure risk. The video data enabled the extraction of behaviors of interest and represent the information in a manner that can be used for further analysis. It should be noted that the students who were collecting data in the field were also collected conventional traffic counts of the proxy safety behaviors by hand in 15-minute aggregations. Conventional traffic count data was used to supplement and double-check observations logged from the video observations.

To collect high-quality data, Sony HDR-CX160 high-resolution video recorders were used at each site, where up two to four cameras on tripods were placed at the intersection corners to record four hours of HD video. The cameras were equipped with wide-angle lenses in order to monitor at least one approach and one crosswalk at all times. 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. It should be noted that each camera was equipped with an extended-life battery pack and a 64GB memory card to allow for uninterrupted video collection for six-hour time blocks. The start of each recording was synchronized with a clock so that an accurate time range was captured. The video recordings established a time reference that allowed the confirmation of proxy behaviors and counts during the data collection period at study locations.

Table 2. Pre- and Post-Campaign Data Collection Dates and Times by Study Site

Community and Intersection	Pre-Campaign	Post-Campaign
Teaneck – State Street and Queen Anne Road	Tuesday, May 1st, 2018 10 am to 2 pm	Tuesday, June 26th, 2018 10 am to 2 pm
Asbury Park – Memorial Drive and Springwood Avenue	Tuesday, August 14th, 2018 9 am to 1 pm	Tuesday, October 23rd, 2018 9 am to 1 pm
Garfield – Midland Avenue and Van Winkle Avenue	Tuesday, August 21th, 2018 8 am to 1 pm	Wednesday, November 7th, 2018 8 am to 1 pm
Morris Plains – Speedwell Avenue and Franklin Road	Tuesday, October 2nd, 2018 7 am to 11 am	Monday, November 12th, 2018 7 am to 11 am
Newark – Raymond Boulevard and Mulberry Street	Thursday, September 20th, 2018 8 am to 1 pm	Thursday, November 29th, 2018 8 am to 1 pm
Princeton – Nassau Avenue and Washington Road	Monday, October 8th, 2018 9 am to 1 pm	Monday, November 26th, 2018 9 am to 1 pm
Rutherford – Park Avenue and Glen Road	Monday, October 15th, 2018 9 am to 1 pm	Monday, December 3rd, 2018 9 am to 1 pm

Processing Data for Analysis

One of the benefits of collecting data using video recorders compared to only tallying proxy behavior counts in real time in the field is that the recordings can be reviewed several times in the lab and analyzed in far greater detail. Moreover, multiple simultaneous behaviors can be captured at the same location by playing back the video multiple times, increasing the efficiency and accuracy of collected data. In this project, a computer program developed at the University of California, Berkeley, called Simple Player, was utilized to facilitate the logging of each proxy behavior occurrence and overall pedestrian and vehicle counts a time-stamped observation. This tool uses the Quicktime video player and provides the analysts an opportunity to watch the video, change the speed of video playback, and record relevant behaviors and volumes. These observations were recorded in a text file log; therefore, a comprehensive list of the time-stamp on the video frame corresponding to when the analyst logged each proxy behavior or vehicle/pedestrian count was created. This provides information not only on total counts and proportions but also information about when the non-compliant behaviors were observed.

SUMMARY OF RAW DATA

The raw data in this project includes the counts of the number of compliant and non-compliant behaviors observed at each site and for each proxy behavior. These counts were directly logged from the video recordings and are summarized in Table 3.

Table 3. Counts of Compliant and Non-Compliant Behaviors by Location and Measure During Pre- and Post-Campaign (Proxy 1: Proper Pedestrian Crossings, Proxy 2: Turning Vehicles Stop for Pedestrians, Proxy 3: Turning Vehicles Stop for Pedestrians before Right Turn at Red Signal, Proxy 4: Vehicles Stop at Red Signal or Stop Sign)

Community	Proxy	Pre-Campaign			Post-Campaign		
		Compliant	Non-Compliant	Rate of Non-Compliance	Compliant	Non-Compliant	Rate of Non-Compliance
Teaneck	Proxy 1	358	109	0.233	167	86	0.340
	Proxy 2	116	49	0.297	120	32	0.211
	Proxy 3	N/A	N/A	N/A	N/A	N/A	N/A
	Proxy 4	3972	37	0.009	4905	26	0.005
Morris Plains	Proxy 1	85	28	0.248	81	33	0.289
	Proxy 2	17	10	0.370	27	13	0.325
	Proxy 3	29	30	0.508	13	5	0.278
	Proxy 4	6727	303	0.043	5020	94	0.018
Asbury Park	Proxy 1	10	114	0.919	96	56	0.368
	Proxy 2	45	11	0.196	38	13	0.254
	Proxy 3	35	6	0.146	45	5	0.100
	Proxy 4	3173	11	0.003	2902	7	0.002
Garfield	Proxy 1	62	44	0.415	58	33	0.362
	Proxy 2	28	13	0.317	24	13	0.351
	Proxy 3	31	129	0.806	170	71	0.294
	Proxy 4	3334	59	0.017	3626	20	0.005

DATA ANALYSIS AND RESULTS

To identify the effectiveness of Street Smart NJ Campaign in changing behavior, behaviors of pedestrian and drivers before and after the campaign (pre- and post-campaign) were compared. It is assumed that each individual driver or pedestrian who drivers or walks through the intersection make a decision to obey or disobey traffic regulations with some probability that is independent of other drivers' and pedestrians' behaviors. Given this fact, each driver or pedestrian that has an opportunity to be involved in risky, 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 is occurs when a safe, compliant behavior is observed. In this situation, the success rate specifies how likely people are to be involved in risky 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 were used for hypothesis testing and quantifying the magnitude of the effect. As discussed earlier, by counting non-compliant and compliant behaviors, it is possible to measure a percent or proportion of the total drivers or pedestrians who have an opportunity to comply with regulations or not. More specifically, for each proxy, two different proportions were calculated, including proportions of non-compliant behavior in the pre-campaign data, and proportion of non-compliant behavior in the post-campaign data.

To test whether a change in the rate of non-compliant behavior is significant, it is required to statistically 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:

$$z = \frac{p\hat{}_1 - p\hat{}_2}{\sqrt{P\hat{}(1-P\hat{})\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

$$P\hat{} = \frac{x_1 + x_2}{n_1 + n_2}$$

$$p\hat{}_1 = \frac{x_1}{n_1}$$

$$p\hat{}_2 = \frac{x_2}{n_2}$$

where:

- x1: number of non-compliant events in pre-campaign data
- x2: number of non-compliant events in post-campaign data
- n1: measure of exposure to pre-campaign data
- n2: measure of exposure to post-campaign data
- p^1: probability that a person did not comply with the regulations in pre-campaign data
- p^2: probability that a person did not comply with the rules in post-campaign data
- p^: pooled sample proportion or combined average of probabilities

The estimate of the change in the rate of non-compliance is the difference (p^1- p^2). A positive value indicates a drop in the proportion of the drivers and pedestrian engaging in the risky behaviors, representing an improvement in the traffic safety. The null hypothesis indicates that there is no difference between the two population proportions (H0: p^1 = p^2) and the alternative hypothesis is defined as H1: p^1 ≠ p^2 which indicates that there is a difference between two population proportions ($z > z\alpha/2$ or $z < z -\alpha/2$).

Therefore, it is required to determine the significance level, which varies between 0 and 1 but researchers most often use significance values of 0.01, 0.05, or 0.10, corresponding to 99%, 95%, and 90% confidence level, respectively. In the observational analysis, a 95% confidence level was specified. Given this fact, to be 95% certain that an observed drop shows an actual change in behavior as opposed to random fluctuation, the data would have to indicate a rejection of the null hypothesis at the level α=0.05. The magnitude of the effect was also calculated for each proxy measure.

Results of the Statistical Analysis

Taking advantage of statistical methods described above, the significance in the change of each proxy measured at each location was evaluated. Table 4 presents a summary of the results with the observed change in the rate of non-compliance, $\hat{p}_1 - \hat{p}_2$, and the *P*-value associated with this change. For a change to be statistically significant at the 95% level (α=0.05), the *P*-value must be less than 0.05.

Township of Morris Plains – Speedwell Avenue and Franklin Road

The results for the City of Morris Plains demonstrate significant improvements in rates of non-compliance for drivers but no statistically change in pedestrian behaviors (Figure 9). This data is important to note because the total number of pedestrians between the pre and post campaign were 113 pre and 114 post campaign. It should stand to reason that if the campaign is successful in reaching out to pedestrians then a reduction in non-compliance should be observed for the post campaign. The way in which the information is delivered to the pedestrians in this intersection may need to be altered as the data shows that pedestrian behavior remained the same.

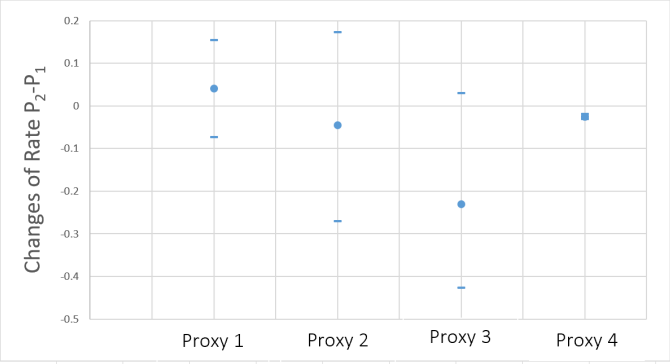

Figure 9. Changes in Rates of Non-Compliance in Morris Plains, NJ

There were statistically significant reductions in red light signal running and turning vehicles failing to stop for pedestrians. These proxies were reduced by 58.1 and 45.3 percent, respectively. It should be noted that the pre-campaign and post campaigns were done on different days. The pre-campaign was done on Thursday, while the post campaign was observed on a Monday. This may have inflated the percent increase in the driver's non-compliance behavior. These results indicate that the campaign in this community was effective at reducing risky driving behaviors, which resulted in increased safety for both pedestrians and drivers.

The northbound approach shares many characteristics with the southbound approach, so it is believable that the patterns observed in this study are a good indicator of the performance of the whole intersection.

Table 3. Change in Rates of Non-Compliant Behaviors from the Pre- to Post-Campaign
(Proxy 1: Proper Pedestrian Crossings, Proxy 2: Turning Vehicles Stop for Pedestrians, Proxy 3: Turning Vehicles Stop for Pedestrians before Right Turn at Red Signal, Proxy 4: Vehicles Stop at Red Signal or Stop Sign)

Community	Proxy	Pre-Campaign		Post-Campaign		Change			
		Sample	Rate ($p\hat{}^1$)	Sample	Rate ($p\hat{}^2$)	%	Rate Difference ($p\hat{}^2$-$p\hat{}^1$)	95% Confidence Interval	P-Value
Teaneck	1	467	0.233	253	0.340	+45.9	+0.107	(-0.176, -0.037)	0.99*
	2	165	0.297	152	0.211	-28.5	-0.086	(-0.009, 0.181)	0.04†
	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	4009	0.009	4931	0.005	-44.4	-0.004	(-0.008, -0.001)	0.01†
Morris Plains	1	113	0.248	114	0.289	+16.5	+0.041	(-0.073, 0.155)	0.76*
	2	27	0.370	40	0.325	-13.8	-0.045	(-0.270, 0.174)	0.35*
	3	59	0.508	18	0.278	-45.3	-0.231	(-0.427, -0.031)	0.04†
	4	7030	0.043	5114	0.018	-58.1	-0.025	(-0.031, -0.019)	0.00†
Asbury Park	1	124	0.919	152	0.368	-59.9	-0.551	(-0.461, -0.641)	0.00†
	2	56	0.196	51	0.254	+29.5	+0.058	(-0.100, 0.217)	0.77*
	3	41	0.146	50	0.100	-31.5	-0.046	(-0.182, 0.090)	0.25*
	4	3184	0.003	2909	0.002	-33.3	-0.001	(-0.003, 0.001)	0.23*
Garfield	1	106	0.415	91	0.362	-12.8	-0.053	(-0.189, 0.084)	0.23*
	2	41	0.317	37	0.351	+10.7	+0.034	(-0.175, 0.244)	0.62*
	3	160	0.806	241	0.294	-63.5	-0.512	(-0.427, -0.569)	0.00†
	4	3393	0.017	3646	0.005	-70.5	-0.012	(-0.017, -0.007)	0.00†

*Statistically insignificant increase/reduction in rate of non-compliance
† Statistically significant increase/reduction in rate of non-compliance