



# The Use of 'Your Speed' Changeable Message Signs in School Zones

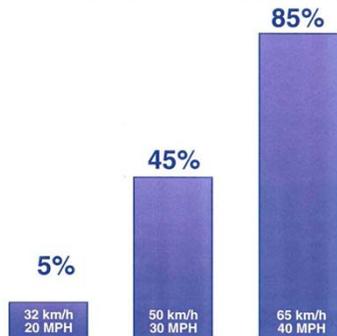
Sarah O'Brien and Carrie Simpson



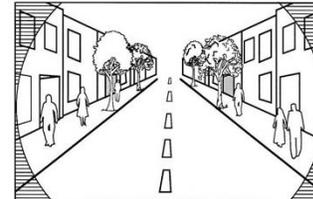
## Introduction – Speed Affects:



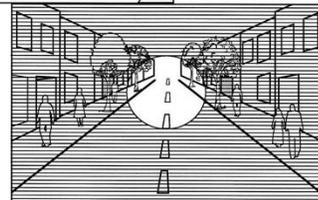
- Driver's ability to react, braking distance
- Crash Severity or potential to avoid a crash
- Driver's field of vision



Pedestrians' chances of death if hit by a motor vehicle  
SOURCE: *Killing Speed and Saving Lives*, UK Department of Transportation



15 MPH



30 MPH



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WHY IS IT IMPORTANT TO REDUCE SPEEDS IN SCHOOL ZONES? (WHY SHOULD YOU CARE)

We know that reducing speeds allow for shorter stopping distances, and also affects how far down the road a driver is looking, as shown by the two images on the right. Drivers going slower have a better chance of seeing if pedestrians are present and are more likely to avoid a collision, but if one occurs, the chances of severely injuring or killing a pedestrian dramatically reduced, as shown in the bar graph.

## Introduction – Why School Zones?

- **Lower Speed Limits Around Schools = GOOD**
  - Increased pedestrian activity
  - More traffic
  - More turning vehicles
  - Potentially longer queues

SO,

Designating school zones and lowering speeds around schools, especially during arrival and dismissal, is a logical thing to do

BECAUSE

there's an expectation of:

- Increased pedestrian activity
- More traffic
- More turning vehicles
- Potentially longer queues

All of which means an increased risk of potential conflicts.

## Introduction – Do They Work?



- **Effectiveness of School Speed Zones = POOR**

- No change roadway characteristics
- No change in environmental setting
- Reduced speed ‘feels’ unnatural
- Child walkers/bikers are MIA
  - 48% walked or biked in 1969
  - 12% walked or biked in 2009



### BUT, DO THEY WORK?

Studies have shown that driver compliance is poor in these special speed zones.

Think about schools you usually drive past. Typically, when a driver approaches a school zone, nothing about the roadway geometry or number of lanes change. The road corridor on which the school is located is designed for a speed limit that governs its operation 90% of the time, so drivers feel comfortable driving at that faster speed.

Often the only visual cue that drivers have to modify their behavior is the reduced speed limit signage and some pavement markings.

### *ANIMATED INTRO*

AND, remember that expectation for increased pedestrian activity as a reason to reduce speeds around school? Well, the visual cue that we traditionally expected around schools is largely missing today – child pedestrians.

## Safe Routes to School Goals



- **Enable and encourage children to walk and bicycle to school**
- **Make walking and bicycling to school safer**
- **Implement projects to:**
  - Improve safety
  - Reduce traffic
  - Reduce fuel consumption
  - Reduce air pollution



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One of the federal SRTS program's primary purposes is to change that trend, by funding projects that can encourage and enable children to safely walk and bike to school again.

NC's SRTS program received several requests from localities interested in installing driver speed feedback signs as a tool to reduce speeding in their communities, which is one of the top barriers for why parents don't allow their child to walk to school.

# Speed Feedback Sign Types



Images clockwise: Dan Burden, FHWA-HRT-08-067, Dan Burden, and Caltrans via FHWA-SA-07-002

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There are lots of variations on speed feedback or dynamic display signs out there:

- They can be portable, like speed trailers, or permanently installed.
- They have been used in transition zones, like going from rural high-speed setting into a lower-speed town setting
- They can be used with flashing beacons or without; they might be shown with the regulatory speed limit as part of an assembly, or not.
- And they may be used around horizontal curves, or in locations where drivers need an extra reminder to slow down .

## Study Objectives



- Do YOUR SPEED signs reduce speeding and increase compliance?
- School time vs. non-school time comparison
- Lessons learned and future recommendations



NCDOT wanted to ensure that using a YOUR SPEED sign in a school zone would actually be effective long-term as a speed reduction tool before allowing these to be potentially widely used across the state.

The outcome of the study would also help the NCDOT SRTS program determine whether it would allow these signs as an eligible cost reimbursement item on future SRTS projects.

## SRTS Project Overview



- **CM Eppes Middle School Site Description**
- **SRTS at CM Eppes**
- **YOUR SPEED Sign Assembly & Operation**



So, our study focused on the first site in NC to install these signs as part of a local SRTS project. To give you some context for our particular study, I'd like to quickly go through

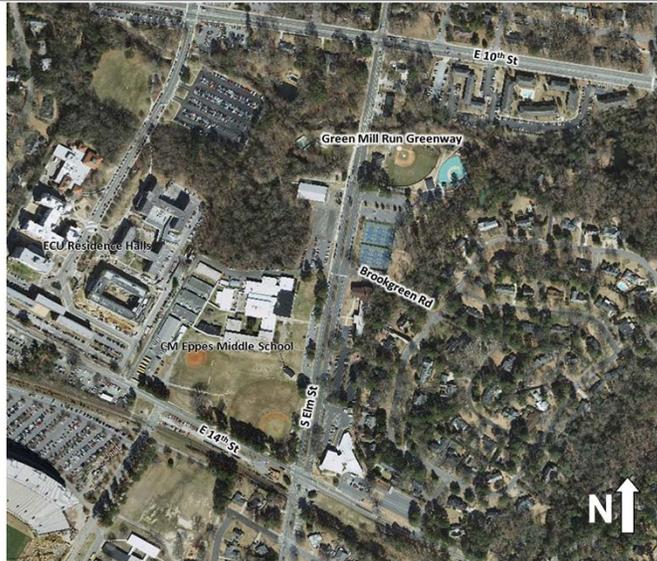
- a site description for our study school
- Explain the other SRTS activities also being undertaken by the middle school during the project period
- And discuss the specific features and operational functions for the Your speed sign studied.

# CM Eppes Middle School



## S. Elm St. School Zone

- 11,000 vpd
- 1,500 ft zone
- 35 mph, non-ST
- 25 mph, ST



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Eppes MS is located in Greenville near East Carolina University in an urban/suburban area. The school is off of S. Elm St – a 4-lane road with unmarked bike lanes divided by a tree-lined median, which has on-street parking and sidewalk on both sides. The average daily traffic count is 11,000 vehicles/day. During arrival and dismissal when the reduced speed limit is in effect (i.e. during school time), the speed limit is 25 mph. Otherwise, it is 35 mph.

When NCDOT observers were out collecting data for this study, they also noted non-motorized activity, which was common in the area due to the college campus, residential neighborhood, greenway, park and schools in the vicinity.

The school zone along S. Elm had Reduced School Speed Limit signage with flashing beacons for each direction of travel approaching the school drive, which is just across from the Brookgreen intersection.

## CM Eppes SRTS Project



- **Identify unsafe pedestrian scenarios**
- **Participate in International Walk to School Day**
- **Start a frequent walker/cyclist program**
- **Conduct citation study with local police dept.**



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CM Eppes applied for and was awarded funds to implement a year-long SRTS project including several activities beyond the installation of the YOUR SPEED signs:

- Students conducted a photojournalism project to identify unsafe pedestrian issues around campus
- The school participated in WTS Day in October
- They started a frequent walker/cyclist program
- And the local law enforcement conducted a citation study in conjunction with the Your Speed sign installations.

For our study purposes, we ensured that the Your Speed signs were installed in both directions of travel on S. Elm St and were operational in time for the WTS day events.



## Sign Assembly



### Features and Operations

- **Steady Number**  
0 < Speed Limit ≤ 5 mph
- **Flashing Number**  
Speed Limit ≤ 6 – 20 mph
- **Flashing Pattern**  
Speed Limit ≤ 21 mph+
- **Operate during school times**
- **Breakaway compliant**
- **Collect speed data**


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NCDOT gave recommendations for the placement, assembly and operation of the Your Speed signs and felt it was important to have it be part of the School Speed Limit sign assembly.

Firstly, the sign only operates during school times when the designated reduced school speed limit is in effect based on local ordinance

- *For speeds below to up to 5 mph over the speed limit, drivers would see steady numerals*
- *For speeds 6-20 mph over the speed limit, the feedback sign flashes the driver's speed.*
- *Anyone going 21 mph or more over the speed limit just sees a flashing pattern – to try to minimize folks using it as a way to track their “personal bests” at how high they might be able to get it to go.*

Although we did not use this capability for the purposes of our study, NCDOT also wanted the signage to have the ability to collect speed data over time.

## Data Collection



- **Pre-installation; 1, 3, 6 and 12 months post**
- **During school time (morning and afternoon)**
- **During non-school time (morning and afternoon)**
- **Both directions of travel**



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At this site, the current School Speed Limit signage was appropriately located, so they simply replaced the existing assembly with what is shown here, and kept the flashing beacons, since they had those previously.

Speed data were collected using a Lidar gun before the signs were installed and then again at 1,3,6, and 12 month intervals post-installation.

For each time interval, at least 100 samples of the data were collected during school time (i.e. during arrival or dismissal when a reduced speed limit was in effect) and non-school time hours, both morning and afternoon, on a given day.

Vehicles in platoons were avoided, and collectors targeted only unimpeded vehicles that were setting their own speed.

<h2>Data Analyzed</h2>		
<ul style="list-style-type: none"><li>• <b>% exceeding the speed limit</b></li><li>• <b>Average speed</b></li><li>• <b>85<sup>th</sup> percentile speed</b></li><li>• <b>Standard deviation</b></li><li>• <b>Pace speed</b></li> <li>• <b>Data grouped by school time, non-school time, and direction of travel</b></li></ul>		
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We looked at the data in various ways including by direction of travel, school time vs. non-school time and by data collection period.

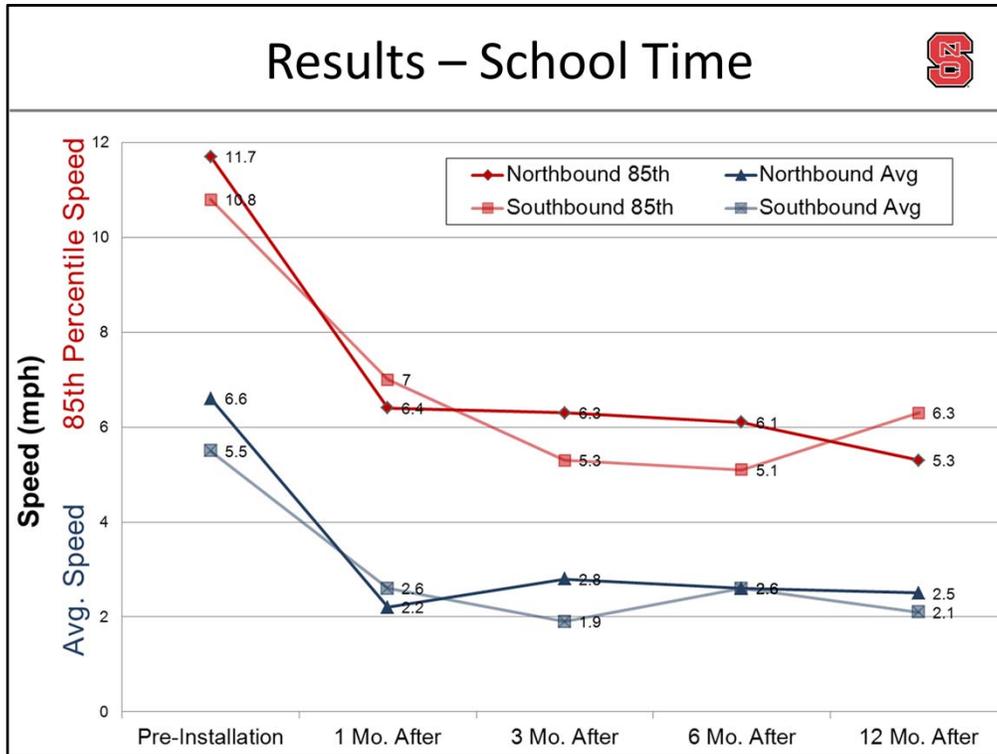
For each data set, we looked at the percentage of vehicles exceeding the speed limit (either 25 or 35 mph, depending on whether it was a school time or non-school time data set).

We also looked at average speed, and the 85<sup>th</sup> percentile speed, which is the speed at or below which 85% of the vehicles are going.

We also looked at standard deviation and pace speed, which measure speed dispersion – the broader the spread of speeds, the less safe a road is, and the higher the likelihood of crashes.

Our speed measurements generally followed a normal distribution, so we used basic statistical methods to analyze the data assuming normality in order to determine the significance of our findings.

## Results – School Time



The speed here for the y-axis is shown as speed above the 25 mph speed limit in effect during school time.

Average speed significantly decreased by at least 2.9 mph and up to 4.5 mph depending on direction of travel.

85<sup>th</sup> percentile speed decreased anywhere from 3.8 to 6.4 mph

So, average speeds above the 25 mph speed limit were reduced by at least 9.8%, and 85<sup>th</sup> percentile speeds decreased by at least 12.6% when the YOUR SPEED signs were installed.

## Results – School Time



	Northbound			Southbound		
	Sample #	% Exceeding SL	% w/in Pace Speed	Sample #	% Exceeding SL	% w/in Pace Speed
Pre-Install	292	89	67	255	85	72
1 Mo. After	207	64	74	201	62	76
3 Mo. After	207	67	84	218	59	82
6 Mo. After	240	66	83	227	76	92
12 Mo. After	240	65	77	213	62	86



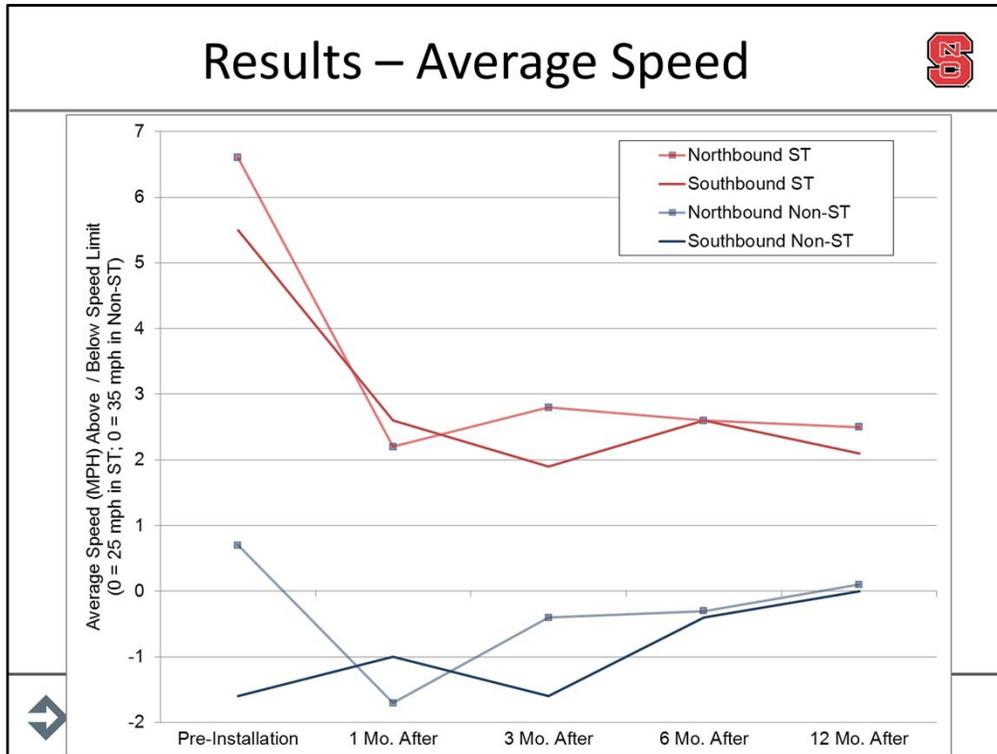
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In general, the percent of drivers exceeding the speed limit went down after signs were installed, while the percent of drivers within the pace speed increased by anywhere from 4 to 20%. This indicates a narrower spread of speed dispersion, after the signs were installed, which is what we want to see.

And, although it the majority of drivers were still above the speed limit after the signs were installed, they were driving more like 2-3 mph over rather than 5-6 mph over. As shown here...



During school time when the Your Speed signs were in effect, average speed significantly decreased by at least 2.9 mph and up to 4.5 mph depending on direction of travel. In either direction of travel during school time, all decreases were found to be significant after installation.

Non-school time data sets served as our control group, and we would expect to see no significant changes in speed parameters post-installation. However, during non-school time, shown by the blue lines, direction of travel seemed to indicate mixed results – a significant decrease was observed 1 month after installation in the northbound direction, but speeds began creeping back up as time progressed. In the southbound direction, average speed fluctuated, but ultimately increased significantly by 1 year after installation.

So, average speeds above the 25 mph speed limit were reduced by at least 9.8%.

Results – Non-School Time 						
	Northbound			Southbound		
	Sample #	% Exceeding SL	% w/in Pace Speed	Sample #	% Exceeding SL	% w/in Pace Speed
Pre-Install	287	47	76	267	29	79
1 Mo. After	228	29	78	240	35	76
3 Mo. After	324	39	87	349	29	81
6 Mo. After	209	40	86	207	43	84
12 Mo. After	214	42	80	234	42	79

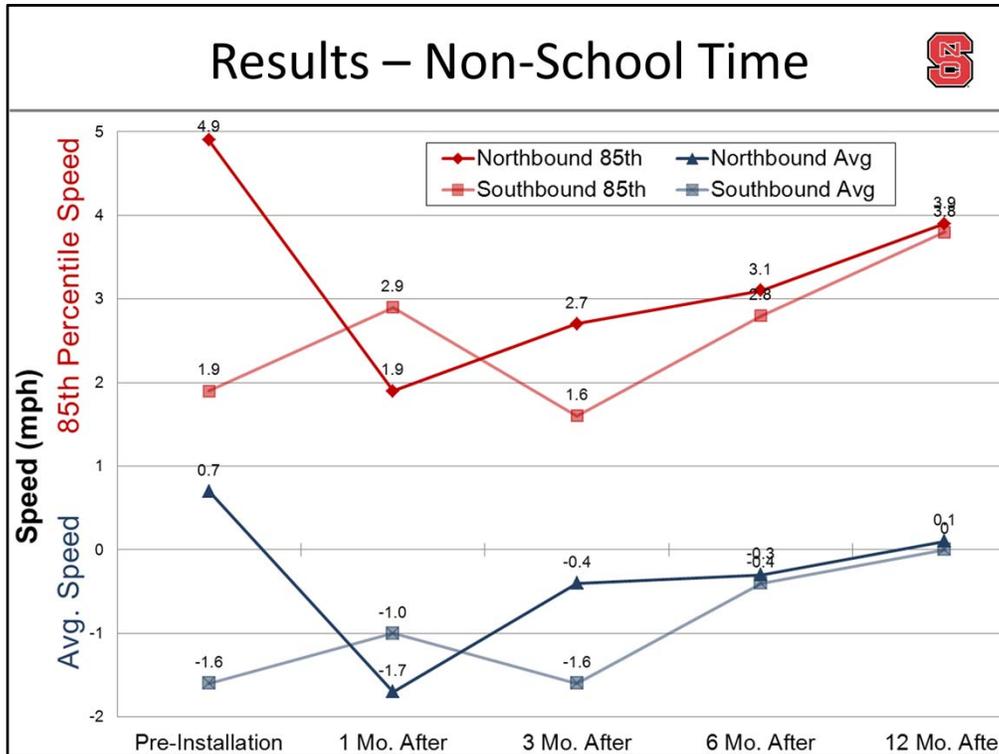
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Again, looking just at non-school time, although the majority of drivers did not go over the 35 mph speed limit, we still saw an increase over time in the percentage who exceeded the speed limit in the southbound direction.

The percentage of drivers within the pace speed was relatively unchanged in the southbound direction, but did increase an average of 6.8% for northbound vehicles.

We know that the police department was conducting their citation study, which overlapped with the initial data collection period for our study, and in fact, our data collectors noted a heavy law enforcement presence in the northbound direction of travel during the 1 month interval, which might have contributed to the sharper decline in speeds in that direction for both school and non-school times.

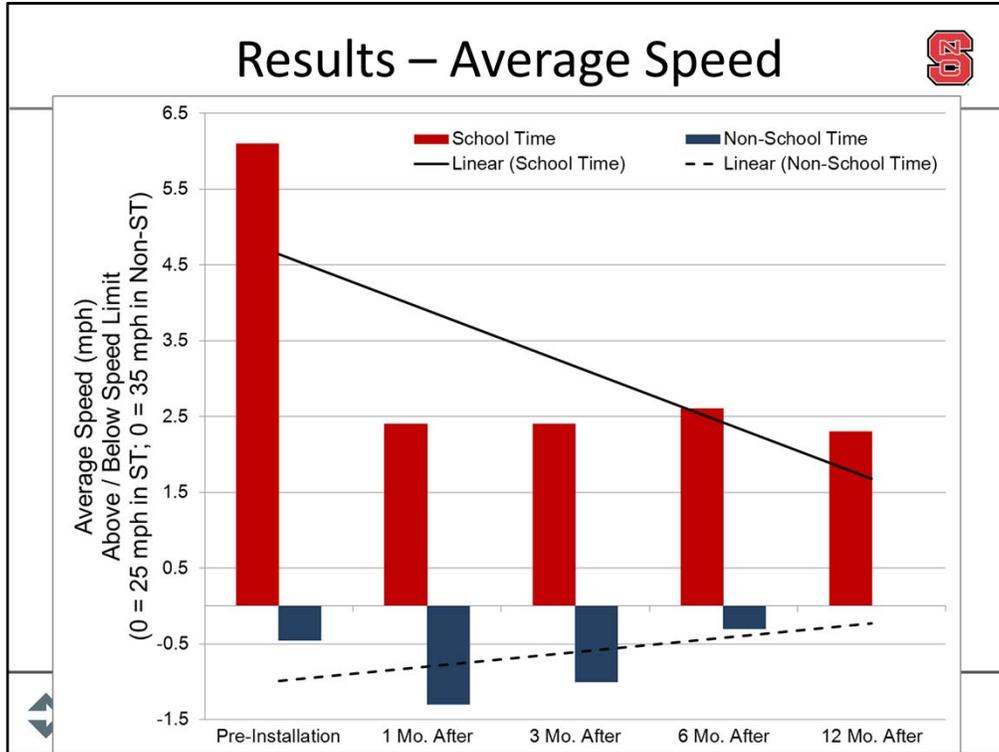


For non-school time, we would expect to see no real change in before and after conditions. The y-axis reflects changes in speed based off of a 35 mph base.

Our results were mixed based on direction of travel.

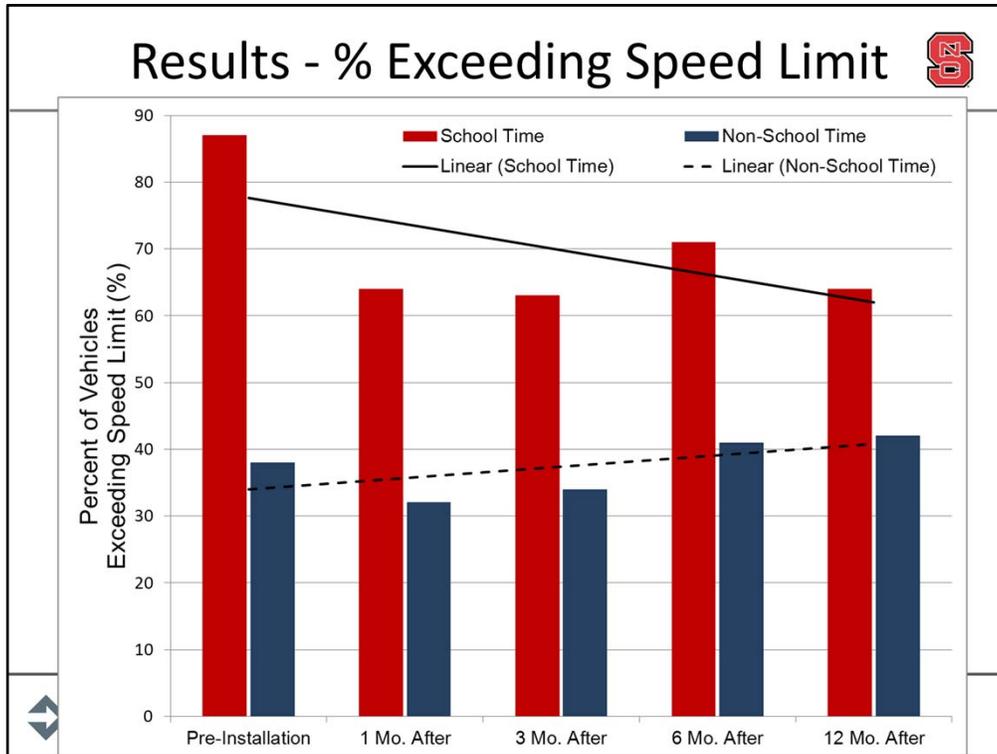
Southbound speeds actually increased over time, while northbound average speeds decreased between .6 to 2.4 mph.

85<sup>th</sup> percentile speeds fell as much as 3 mph in the northbound direction, but increased up to 1.9 mph in the southbound direction



So, the next series of histograms do not take into consideration the direction of travel, and simply compare school time results with non-school time results, to show whether the Your Speed signs had an effect during school time.

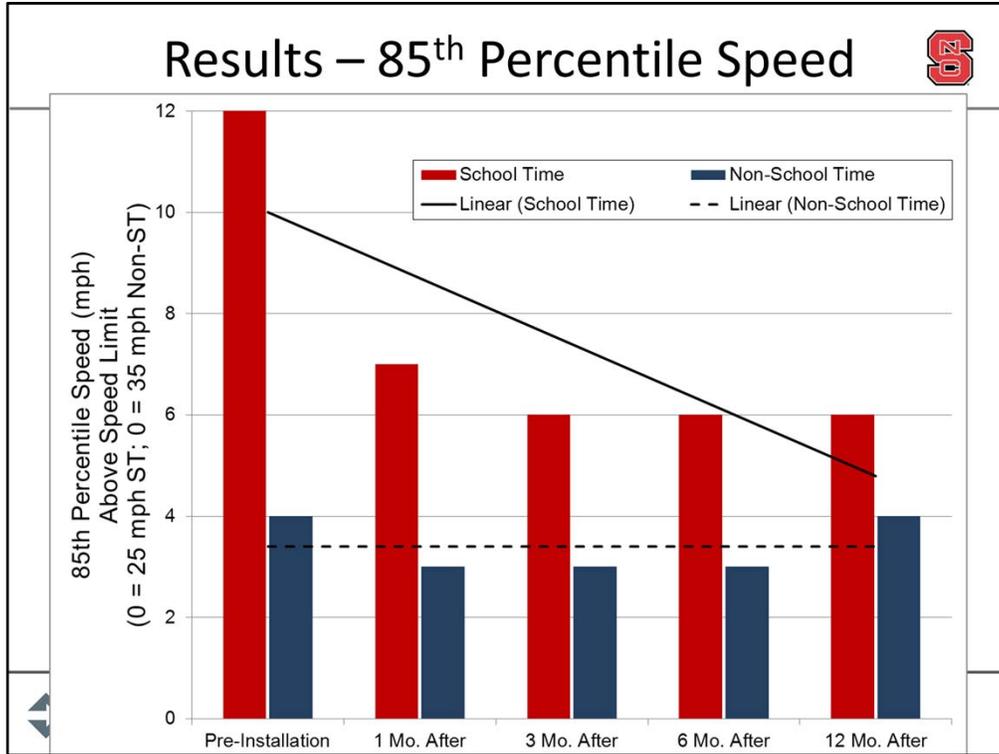
Looking at average speeds through this lens, we see a sharp rate of reduction when the signs are in effect. In fact,, average speeds dropped by 3.7 mph, on average after installation.



As you can see, the percent of drivers exceeding the speed limit trended down over time when the Your Speed signs were in effect – translating to a 22% reduction on average

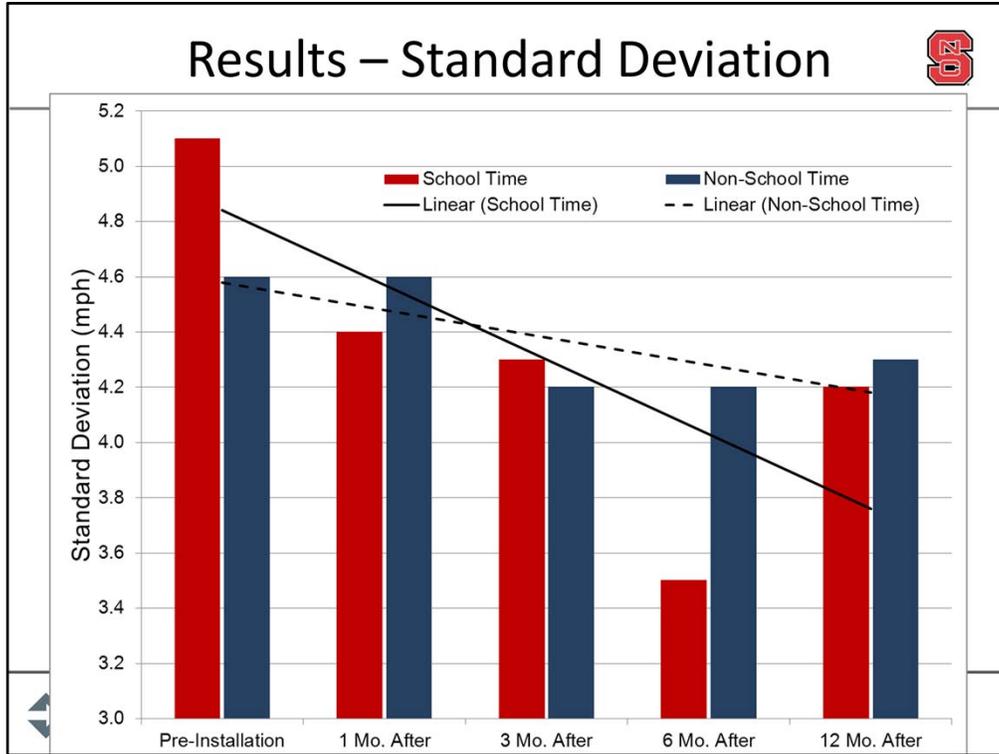
- compared to non-school time, where speeds actually increased - but minimally.

So, we know the signs got drivers' attentions.



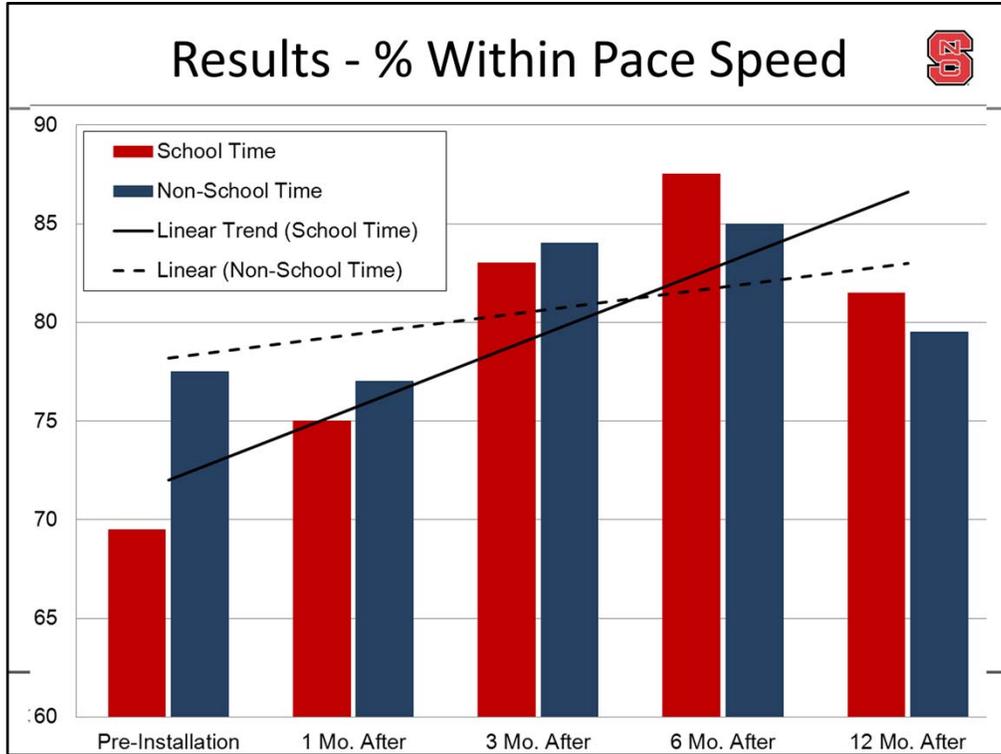
Note that speeds shown on the y-axis are those above the speed limit (either 25 mph for school time or 35 mph for non-school time).

Again, we saw improvements in driver compliance when the Your Speed signs were in effect, with a reduction of almost 6 mph on average in 85<sup>th</sup> percentile speeds.



The next two graphs compare the speed dispersion parameters for the two groups. This was interesting, in that the spread of speeds narrowed both during school and non-school times. However, the changes in standard deviation post-installation for the non-school times were, for the most part, found to be insignificant, where as the decrease in same speed parameter when the You Speed signs were operational were all found to be significant.

AND...



Likewise, the percentage of drivers within the pace speed increased for both groups, albeit the increase was around an 18% on average when the signs were in effect, vs. a 6% increase during non-school time.

## Conclusions



- **Yes, YOUR SPEED signs worked!**
  - Significant, sustained reductions in speed
  - Avg. speed was 12% lower 1 yr after install
- **Enhance Effectiveness:**
  - Periodic police presence
  - Active SRTS Program  
(encouragement/education)



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So, what do all those figures, graphs, and data mean? Well, we think it means that these signs do impact driver compliance with reduced school zone speed limits in a sustained way.

Average speeds were almost 4 mph lower 12 months after the signs were installed – a 12% reduction in speed.

We also know, though, that CM Eppes was carrying out a comprehensive SRTS project that focused not only on enforcement through traffic calming with these signs, but through an active police presence, encouragement and education activities. This may be why we saw some changes in driver behavior during non-school times as well, or it may be that the other activities being conducted as a part of their larger SRTS efforts enhanced our study results.

Through the PD's citation study, they documented that citations for speeding in the school zone decreased from an average of 2/day to 1 every 2 days. But, again – since the increase in driver compliance was sustained up to a year after installing the Your Speed signs, we think that the law enforcement presence alone cannot be attributed to our results.

## Conclusions



- **Additional Research Needs**

- Context sensitivity: Do they work in all school settings?
- Optimal speed enforcement strategy (frequency of police presence with use of sign)
- Comparison to other possible traffic calming techniques



Now, we know that our study just looked at one specific site at a school in a well established suburban setting with local commuter traffic. **NCDOT actually plans to study these signs at 9 other schools based on these promising results to see if they are universally effective in school zones, or whether they are more effective in certain school settings, with certain road characteristics, land use contexts, or speeds.**

Although we did not use the data collection capability of these signs as a part of this study, it can be valuable to know how effective speed compliance is when combined with law enforcement presence. The data collection can allow local PDs a way to monitor long-term effectiveness and be more strategic in when they deploy manpower to provide a physical presence once a pre-determined threshold of non-compliance is reached. It may be that a using both the YOUR SPEED signs balanced by an identified frequency of police activity can be determined to model an optimal speed enforcement strategy.

And finally, the use of this sign is just one of many traffic calming treatments available. Considering the effectiveness of this particular treatment in relation to its cost and in comparison to other traffic calming strategies will help practitioners in choosing the best treatment or combination of tools out of the 'traffic calming toolbox' for a particular location.

## Contact Information



[www.itre.ncsu.edu](http://www.itre.ncsu.edu)



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Questions?