UTC Project Information	
Project Title	Safety and Human Factors of Adaptive Stop/Yield Signs Using Connected-Vehicle Infrastructure
University	Virginia Tech
Principal Investigator	Alexandria Noble
PI Contact Information	ANoble@vtti.vt.edu
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Project Duration	2 years
Brief Description of Research Project	In the United States, intersection crashes, especially those occurring at stop-controlled intersections, are a great safety concern. In past vehicle and infrastructure treatments that have been identified with the intention to inform the driver to correct poor or distracted driving behavior. But all past treatments have merely provided supplemental information, not active in-vehicle information that will act in a preventative manner, instead of only serving as a warning. It has been proposed that by using connected vehicle (CV) technology, the traffic control sign may be varied between “stop” and “yield” to help mitigate intersection collisions, improve traffic flow, and positively impact the environment. However, to complete a full evaluation of CV technology, the human factors and driver perceptions must be considered to ensure that implementation will be easy for drivers to understand and will not be a detriment. A closed-course study is proposed to test the effectiveness of adaptable stop/yield signs. Drivers will be run through multiple scenarios to determine how the signs affect their driving and to test worst-case scenarios to verify drivers will react properly. Data will be collected through pre- and post-drive surveys completed by participants and through the collection of video and kinematic information from the vehicle. From these data, an analysis will be conducted to measure driver acceptance and potential safety benefits of adaptable signs. Conclusions will be drawn, and a report will be drafted to discuss the findings.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	In 2009, more than 7,000 people died at intersections, with more fatalities occurring at stop-controlled intersections than at signal-controlled intersections (Bryer 2011). Many treatments have been implemented in some states, such as signs that alert the main road drivers of traffic on a minor road or vice versa (Bryer 2011; Laberge et al. 2006). While such implementation has not been in the field long enough to conduct proper before/after studies to evaluate effectiveness, there is a potential to reduce crashes at these intersections that all too often are serious (Bryer 2011). Another concern in the field is that stop signs are being placed too often, therefore leading the driving public to reduce their respect for all stop signs (Tenges and Souleyrette 2005). The placement of a sign type (either stop or yield) has been traditionally based upon traffic conditions. However, more stop signs are being placed instead of yield signs due to liability risks, resident concerns, and potential worst-case crash scenarios. With the advent of connected-vehicle (CV) technology, the ability exists to have these signs change (i.e., adapt) based on vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communications via dedicated short-range communication (DSRC) or by cellular communication (USDOT 2012). It may also be possible to change signs based on current travel conditions not only by roadway sensors but by direct communication via V2I to the sign, which could then provide additional real-time data to drivers. Adaptable stop/yield signs have been proposed by some traffic professionals to improve travel time, reduce air pollution, increase fuel economy, and adjust to different traffic conditions such as peak hours, weather, or emergency vehicles. While adaptable signs have great potential, they must be properly designed and tested to ensure that: 1. The net safety benefits are positive, 2. Drivers interpret and respond correctly to the signs, 3. Drivers pay appropriate attention to the signs without adaptation in the form of relying on past history (e.g., the sign may be different than the prior 10 times the intersection was crossed), 4. There are no other unintended consequences when signs are deployed, and 5. Driver acceptance of the technology is high. However, when any change is made to a traffic sign (especially ones that are so ingrained into drivers' minds such as stop and yield signs) an evaluation of the perceptions and reactions of naïve people must be considered. According to Dewar and Olson (as cited by Salvendy 2006), the traffic control device must "attract the driver's attention (conspicuity), it must be easily read or interpreted (comprehension), and its information must be acquired quickly, within 1 or 2 seconds." This explains the need for a human factors study. Before a sign or any change is made to the driver/vehicle/roadway system, an analysis

	must be conducted to assess the driver's first impressions of the system and what it means to him/her. Performance data should also be analyzed to assess whether the system will produce the desired results or will cause unintended consequences that make the system undesirable for implementation. This analysis is best facilitated by a closed-course study using naïve drivers to obtain initial feedback about how professionals should move forward with the technology.
Impacts/Benefits of Implementation (actual, not anticipated)	This study is still in progress, actual impacts and benefits of implementation will be determined in Summer 2013 when the study is completed. This page will be resubmitted in the next round of reporting to state these actual impacts and benefits.
Web Links • Reports • Project Website	http://www.connectedvehicleinfrastructure-utc.org/?q=node/62 http://rip.trb.org/browse/dproject.asp?n=32357