EXHIBIT A
SCOPE OF SERVICES

IN-VEHICLE WORK ZONE MESSAGES-EXAMINING SIGNING OPTIONS FOR IMPROVING SAFE DRIVING BEHAVIORS IN WORK ZONES

BACKGROUND

Speeding and distraction are two significant issues that can increase the risk of a crash in a work zone. Work zones often present tight safety margins where workers and equipment are located near passing vehicle traffic. Reduced speeds and signing are intended to mitigate crash risks, but are only effective if drivers adhere to the posted limits and resist distractions from driving. This project proposes to design and evaluate auditory, in-vehicle messages presented by a smartphone to catch drivers' attention, especially those who might be already engaged in smartphone use. Behavior change strategies (for short and long-term change) advocate the use of positive messages to reach the cultural values and beliefs of drivers. Static or dynamic variable message road signs can be effective, but can also be missed by drivers due to work zone clutter or driver distraction. The objectives of this research are to:

1. Identify 1-2 key work zone use cases in which advance safety messages have the best chance of mitigating crash risk;
2. Identify common safety culture elements associated with work zones in Minnesota;
3. Design in-vehicle dynamic safety messages intended to reduce speeding and/or distraction in work zones, and;
4. Evaluate the in-vehicle messages in comparison to static or dynamic roadway signs with the same or similar messages to determine if driver safety behaviors are significantly improved using the in-vehicle messages (e.g., improved response times, reduced speeds, more attention directed at the roadway) when drivers are distracted and less likely to see road signs.

OBJECTIVE

The key benefit of the proposed research is to use behavioral change theories to design and evaluate work zone safety messages with the intention of improving safe driving behaviors on approach to and within work zones to reduce crashes and incidents. In particular, tackling distraction issues inside the vehicle is a key objective of this work because of the benefits it can yield. Although it is often simple to indicate smartphones or mobile device use should be banned while driving, this is not practical in application. Bans on text messaging or phone use are hard to enforce efficiently because the behavior can be difficult to observe. By including push-to-phone, auditory notifications about work zones, we can attract the attention of the driver in the vehicle and bypass the difficulties associated with eyes-off-road distraction that causes drivers to miss critical work zone road signs. From an implementation standpoint, the design phase will identify key safety elements with which to construct meaningful and influencing safety messages. This will apply to in-vehicle auditory messages as well as road side variable message and static signs. At the end of the project, guidelines about designing safety-related messages specifically related to Minnesota drivers and MnDOT's ability to deploy such messages in one or more formats will be available. This work will also produce a new understanding of how to implement safety culture strategies with respect to road signing for specific types of conditions. This work is also applicable to larger, long-term goals associated with vehicle-to infrastructure deployments and in-vehicle messaging to reduce distracted driving and improve communications with drivers about upcoming roadway situations that require attention.

SCOPE

The first phase of this project includes the required design tasks to develop relevant safety messages for work zones. Task 1 will identify the features of work zones that are most likely to increase risk to the workers in the zone, as well as drivers. This task will involve a small literature review and, in particular, an examination of Minnesota work zone crashes to determine key crash factors that might influence work zone safety or crash risk. For example, narrow lanes have smaller safety margins and reductions in speed and more attention to the driving task would be important in a zone with a narrower lane width than normal to reduce risk to drivers and workers. Alternatively, work zones with barrels instead of jersey barriers might pose an increased risk to workers should a vehicle breach the barriers. From this task, 2-3 work zone use cases will be developed to provide context to the message set development. Use cases are critical for framing research results and expected outcomes associated with safety interventions.

Task 2 will examine traffic safety culture of a sample of Minnesota drivers to identify values and attitudes that can most likely be leveraged to create the safety messages. Understanding local traffic safety culture with respect to behaviors in work zones is critical to developing safety interventions because research has demonstrated that there are many types of driving safety cultures (e.g., Coogan, Campbell, Adler, Forward, 2014). For example, rural Minnesotans might hold different values and beliefs influencing their driving behaviors compared to urban Minnesotans. This task will include an online survey of drivers using standard social cognitive (e.g., risk perception, personality traits, safety online survey of drivers using standard social cognitive (e.g., risk perception, personality traits, safety attitudes) and cultural measures (e.g., road traffic culture, general culture such as attitudes towards community cooperation) as well as self-reported road user safety behavior (e.g., propensity to speed, behavior in work zones, etc) to create an understanding of how drivers make safety decisions and what information or messages might influence those decisions.

The resulting information from the use case and survey work will be to develop a candidate set of messages. In Task 3, several messages will be created using known design principles and the information from Tasks 1-2. The larger set of messages will then be subjected to a heuristic evaluation to narrow down a subset of 2-3 messages to be tested against roadway signing in the evaluation phase of this work.

The design tasks will also take into account how far away from the work zone messages should occur and for what duration such messages should be presented to drivers via the smartphone.

The second phase of this project (Tasks 4-6) will be experimental testing of the messages. The experimental evaluation will take place in a driving simulator in which the work zone use cases will be programmed. Drivers will be recruited to drive in a baseline condition, which will be a work zone with regular signage where none of the contextual safety messages are presented. Drivers will also complete two comparison conditions: one which will present the contextual safety messages on the smartphone and one which will present the VMS or static sign safety messages along the roadway. A distracting secondary task will be employed to identify how well the safety messages can interrupt secondary task distraction and refocus the driver's attention to the roadway. Objective measures of driver performance will be collected during the drives, including (but not necessarily limited to) speed in various zones of approach and through the work zones, lane deviations, and vehicle inputs (e.g., brake pedal, accelerator).

Eye tracking measures will also be collected to evaluate visual attention to the roadway during each drive and to the secondary task. A set of subjective measures related to usability and perceptions of safety and risk will also be evaluated during the experimental phase. The analysis phase will identify which key elements of the messages most influenced safety behavior.

WORK PLAN

Task Descriptions

Task 1: Crash Factor Identification and Use Case Development
Under this task, the University will conduct a review of factors associated with work zone crash risk. This task will benefit from input from local stakeholders, such as MnDOT engineers charged with managing work zones, and the Technical Advisory Panel (TAP) for the project to help identify the use cases to be investigated.

Task 2: Traffic Safety Culture Survey
Under this task, the University will develop and deploy an online survey related to work zone safety and based on known factors expected to influence safety behaviors among drivers. The research team has already identified most of the candidate survey questions that will be incorporated into this task from a previous effort. This means the survey development in the online system can begin immediately for this project. The University will incorporate crash factor results from Task 1 in Month 2 of this task. This task will include finalizing the questions for the survey, creating the survey in Qualtrics (the University's secure online survey software), and deploying the survey to appropriate populations. Institutional Review Board (IRB) approval is required for the survey. IRB approval for survey research is typically under Expedited Review and takes approximately 4-6 weeks.

Task 3: Design of Work Zone Safety Messages
This task directly depends on the outcomes of Tasks 1 and 2 to develop the safety messages to be tested. The University will begin this task with a design phase conducted by the research team and usability methods will be used to narrow down design options of the work zone safety messages.

Task 4: Experimental Design
Under this task, the University will specify experimental methods, including recruiting methods, participant screening, experimental tasks, IRB approval, simulated driving scenarios, and proposed analyses. IRB approval for the research will be submitted and obtained prior to Task 6.

Task 5: Simulation Development
Under this task, the University will program the simulated driving worlds based on the experimental design created in Task 4. The simulated driving worlds are programmed by Peter Easterlund, using the developer software associated with the HumanFIRST Lab's Driving Simulator. The simulation programming includes incorporating the in-vehicle safety messages onto a smartphone linked to the simulated world, as well as pilot testing the simulations before beginning the experiment. The University will begin this task after the comments are received for the draft deliverable for Task 4: Experimental Design. Programming and pilot testing is expected to take about 8-weeks. The University will commence simulation development in conjunction with Task 4.

Task 6: Conduct Experiment
Under this task, the University will recruit and run participants through the experiment. Participants will complete the study tasks for each experiment in one session and it is expected it will take eight weeks to collect all the data needed for analyses.

Task 7: Data Analysis
Under this task, the University will reduce and analyze data obtained from the eye tracking records and video as well as the driving behaviors from the simulation-based studies as they are described in Task 5. The University will clean data to ensure that no outlying data will be included which may unnecessarily bias later analyses. The University will provide a draft summary of the initial data analyses to the TAP for review.

Task 8: Compile Report, TAP Review and Revisions
Under this task, the University will prepare a draft report, following MnDOT's publication guidelines, to document project activities, findings and recommendations. This report will need to be reviewed by the TAP, updated by the Principal Investigator to incorporate technical comments, and then approved by Technical Liaison before this task is considered complete. Holding a TAP meeting to discuss the draft report and review comments is strongly encouraged. TAP members may be consulted for clarification or discussion of comments.

Task 9: Editorial Review and Publication of Final Report
During this task, the Approved Report will be processed by MnDOT's Contract Editors. The editors will review the document to ensure it meets the publication standard. This task must be completed within the contract time because the editors will provide editorial comments and request information from the Principal Investigator.

Task Deliverables

Task:	Deliverable(s):
1:	Written summary of crash factors and description of Use Cases
2:	Summary of the identified traffic safety culture factors that are likely to contribute best to the design of the Work Zone Safety Messages
3:	Summary document of designs and usability outcomes
4:	Written description of the proposed experimental design and methods; IRB approval
5:	A video and/or in-person demonstration to the TAP of the simulated drives and experimental tasks for each experiment will be conducted as the deliverable
6:	A memo summarizing the demographics of participants, descriptions of any issues encountered during data collection (e.g., data losses), and a summary of preliminary results
7:	Completed data reduction and analysis and summary report of results
8:	A Draft Report and Final Report Approved for Publication

9:	Final Published Report

PROJECT SCHEDULE

	2015					**2016**												**2017**
Months:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Task 1	X	X	X															
Task 2	X	X	X	X	X	X												
Task 3					X	X	X	X										
Task 4						X	X	X	X									
Task 5							X	X	X	X								
Task 6									X	X	X	X						
Task 7											X	X	X	X				
Task 8													X	X	X	X		
Task 9																	X	X

Task:	**Draft Deliverable Due Date:**	**Final Task Approval Date:**
1:	August 31, 2015	October 31, 2015
2:	December 1, 2015	January 31, 2016
3:	February 1, 2016	March 31, 2016
4:	March 1, 2016	April 30, 2016
5:	April 1, 2016	May 31, 2016
6:	June 1, 2016	July 31, 2016
7:	August 1, 2016	September 30, 2016
8:	October 1, 2016	November 30, 2016
9:		January 31, 2017

KEY MILESTONES

Key Milestones	**Target Date**	**Description**
1. Project Kick-off meeting	August 17, 2015	TAP Meeting to Familiarize TAP with project goals and tasks
2. Task 2 IRB	October 1, 2015	University approval to conduct survey using human subjects before survey deployment
3. Task 4 IRB Approval	March 31, 2016	University approval to conduct simulation experiment using human subjects
4. Final TAP Meeting	April 1, 2016	TAP meeting after completion of Task 5 (simulation tour or video demo)