Literature Search: Road Weather Messages on Dynamic Message Signs and Impact on Driver Behavior

June 28, 2019
Prepared by Marilee Tuite, MnDOT Library
marilee.tuite@state.mn.us, 651-366-3797

Request
NS567: Evaluation of Road Weather Messages on DMS Based on Roadside Pavement Sensors
“This research project would evaluate the effectiveness of the system being deployed on Hwy 12 in changing driving behavior by measuring any reduction in speed or increase in following distance of vehicles after viewing the message. This project should utilize in-place and temporary traffic detectors to measure changes in driver behavior in order to get immediate results showing the benefits of the system rather than looking at before/after crash data. This project should NOT be an analysis of crash data, which requires at least 3-years of after data.”
This project is focused on real-time measurements (i.e. speed, following distance) of driver behavior in response to information on the message signs. Past 5 years is sufficient.

Resources searched
MnDOT Library catalog; TRID, RiP, Transport ASCE; Google Scholar

Results
Results are listed in chronological order (newest to oldest).

1) Title: Safety Assessment of the Integration of Road Weather Information Systems and Variable Message Signs in British Columbia
Abstract: Adverse weather conditions create an environment in which it is difficult for drivers to navigate safely. Reducing weather-related collisions is a target for road safety professionals in British Columbia (BC), Canada. This study reports the safety benefits of installing road weather information systems (RWISs) coupled with variable message signs (VMSs) on provincial rural highways in BC. The RWIS/VMS system comprises road and weather sensors, as well as two VMSs. The road and weather sensors collect data on pavement surfaces and weather conditions. Information on adverse road/weather conditions are conveyed to road users via the VMSs. The system had been installed at six different locations on rural undivided highways in BC between 2011 and 2014. The analysis made use of police-attended serious crashes (i.e., fatal + injury) that took place during winter seasons. Depending on the implementation date, three or four winter seasons were available as a before-implementation period, while three to six winter seasons were available as an after-implementation period. An Empirical Bayes (EB) approach was employed to ensure that the evaluation results were reliable and to account for the regression-to-the-mean artifact. Safety performance functions (SPFs) were developed using data collected at similar sites. The EB evaluation results showed an overall statistically significant reduction of 32.7% in all winter serious collisions (WSC). An economic evaluation showed that the systems led to a benefit-cost ratio of 4.8 and an overall net present value of more than Can$12 million. The results of this study may motivate transportation agencies and stakeholders to pursue similar systems for mitigating weather-related safety problems.
Full text available to MnDOT employees: https://journals.sagepub.com/doi/10.1177/0361198119840335

2) Title: Analysis of Dynamic Advisory Messaging – Phase II
Source: Iowa DOT and Iowa State University CTRE (2018)
Abstract: This project is a continuation of the project titled Evaluation of Dynamic Advisory Messaging – Phase I that further supports the Iowa Department of Transportation’s (DOT’s) desire to explore how a
dynamic advisory system might work within the Iowa DOT Intelligent Transportation Systems (ITS) platform through data obtained for a segment of I-35. The evaluation contrasted sensor-driven messages (dynamically derived), based on an algorithm developed in Phase I, with measurements of speed data under various winter weather conditions. In addition, other data inputs such as friction sensors were considered by comparing their outputs to traffic sensor data. Overall, the dynamic advisory messaging system performed as desired by providing alerts of deteriorating conditions during severe winter events. The system can also identify other sources of traffic impacts outside of winter weather conditions, such as slow speeds that occur as a result of an incident. The signature of winter events was present in both the friction and traffic data; however, the friction data at times had more latency. This may be due to the different data reporting frequencies. The findings showed that speed sensors provided awareness of winter events as well as other non-weather related traffic slowdowns.

Full text via https://intrans.iastate.edu/research/completed/analysis-of-dynamic-advisory-messaging-phase-ii/

3) Title: Effects of Weather Related Safety Messages on the Motorway Traffic Parameters
Abstract: Intelligent transport systems have a huge importance during adverse weather conditions. These systems call the drivers’ attention to possible dangers by the use of variable message signs installed along the motorways. Several researchers have dealt with the connection of weather and traffic safety in the last decades, but they have not investigated the effects of weather related messages. This paper examines the impact of weather-related warning messages on traffic in adverse weather circumstances on the Hungarian motorways. Three independent databases were analyzed in order to compare the speed-reducing effect of specific signs during different weather events and precipitate intensities.
Full text via https://pp.bme.hu/tr/article/view/9117

4) Title: Evaluation of a Traffic and Weather Responsive Variable Advisory Speed System in Portland, Oregon
Abstract: The first variable advisory speed (VAS) system in Portland, Oregon was recently installed as part of a comprehensive active traffic management (ATM) project on OR-217. This system, designed to be both congestion-responsive and weather-responsive, was installed to address a series of noted issues along the corridor, including unreliable travel times, high crash rates and a tendency to experience significant declines in performance during adverse weather. To assess the merits and effectiveness of VAS, a “before and after” analysis of corridor performance in terms of capacity, reliability and safety is being conducted. This paper summarizes the findings of the “before” analysis along with some preliminary results from the “after” analysis. Though the system was only activated on July 22, 2014, limiting the present ability of the researchers to identify and study its effects, some evidence of travel time reliability improvements have already been noticed.

5) Title: Impact of Dynamic Message Signs on Speeds Observed on a Rural Interstate
Source: Journal of Transportation Engineering, vol. 140, no. 6 (June 2014)
Abstract: Dynamic message signs (DMSs) are a component of intelligent transportation systems (ITSs) used to convey real-time travel information to motorists, enabling them to make better decisions in response to real-time roadway conditions such as congestion, crashes, and adverse weather. The purpose of this paper is to analyze the existing DMS system implemented by the Wyoming Department of Transportation (WYDOT) along a rural segment of Interstate 80 in southeastern Wyoming between the cities of Laramie and Cheyenne. The research uses speed, weather, and DMS message data collected from the winter season of 2009 to 2010 along the corridor to determine how driver speed behavior is affected by DMS signs. A linear regression model utilizing four different weather severity categories was estimated and the results indicate that the DMS message signs are effective at reducing drivers’ speeds along rural interstate corridors from 8 km/h to 32 km/h (5 mi/h to 20 mi/h) above the speed reductions that can be accounted for by weather conditions alone.
Full text available to MnDOT employees: https://ascelibrary.org/doi/10.1061/%28ASCE%29TE.1943-5436.0000664
This result is much older than 5 years but has been cited in many articles on this topic:

6) Title: Effects of variable message signs for slippery road conditions on driving speed and headways


Abstract: This field study investigated the effects of two variable message signs (VMS) on driver behaviour. Specifically, the signs were a warning sign for slippery road conditions and a minimum headway sign. The study was performed as a before-and-after experiment at three test sites in Finland with an after period covering two winter seasons. The results showed that the slippery road condition sign reduced the mean speed on slippery roads by 1–2 km/h in addition to the decrease caused by the adverse road conditions. The minimum headway sign decreased the proportion of headways shorter than 1.5 s for cars in car-following situations, in addition to a speed reduction of 1 km/h. The effects were somewhat smaller during the second winter than the first.

Full text available upon request: https://doi.org/10.1016/S1369-8478(00)00018-8