# Exploring Travelers' Behavior in Response to Variable Message Signs Using a Driving Simulator

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## Paper Summary

Variable Message Signs (VMS) have been increasingly utilized in the United States. Transportation agencies strive to ensure that posted messages are consistently informative – especially regarding incidents – so that drivers can make the appropriate decision regarding the recommended or desired route to take without significantly reducing their speed in order to read the message displayed. However, drivers respond to VMS messages differently and their reaction to the displayed messages will affect the usefulness of these signs [Pee3]. With this in mind, a study to identify the human factors involved (driver perception, reaction time, etc.) when displaying travel and safety related messages will help transportation agencies to assess the effectiveness of existing VMS message formats, make changes where necessary, and promote driver education and awareness.

Driving simulator can be a useful tool to make identical controlled traffic and environmental scenarios for each driver and observes their behavior. There are very few studies to use driving simulator to identify the drivers' behavior in response to VMS [Dut1]. However, most of the existing simulators allow the drivers to drive on a route of a pre-determined scenario and have limited number of choices over an imaginary network [Kou2]. This study employs a driving simulator which is capable of supporting a realistic route selection environment.

The authors built a midsize (20*20-km) real road network, in Baltimore, Maryland. The network was constructed using the driving simulator software, UC-Win Road, which is accurate and realistic with respect to road geometry, interchanges, intersections, and traffic signals, in addition to roadside objects (signs, buildings, trees, sidewalks, and VMSs) to represent the real world environment. Different scenarios of traffic regimes, time of day, weather conditions, and various VMS messages was provided. The driver received travel time information for two major alternative routes toward a predefined destination from the first VMS, and decided to take one of them or a third route that is mainly local roads and VMS does not show its travel time information. Drivers were subject to the second VMS with supplementary traffic information. All the test subjects were given a fixed pair of origin-destination and were free to decide their routes. The subjects were from different ages, gender, network familiarity, and socio-economic backgrounds to have a fairly unbiased sample. Fig. 1 shows the VMS on the driving simulator while a subject is driving.

**Fig. 1. VMS simulation with the driving simulator.**

The drivers' choices and performance measures (speed, actual travel times, and reaction time) were recorded. After driving each scenario, the participants' perceived travel time was asked in order to develop a learning process in response to the contents of VMS. Three questionnaires were also given to the participants. The first one captured participants' age, gender, socio-economic information, their usage of navigation systems and ATIS, and their general attitudes about VMS. The second one was a stated preference questionnaire asking participants which route they would take in each hypothetical scenario with different VMS information before they actually drive the simulator. This stated preference data was then compared to their revealed preferences. The third questionnaire was given to the subjects after the driving task. It mostly addressed their perceived travel time, experience with the VMS and the accuracy of the information given to them, if their idea toward the reliability of applying ATIS has been changed, and what they learned about each route after driving on the network several times. The results of the questionnaires were used to compare the drivers' intention and perceptions with reality.

The collected data from the simulator as well as the questionnaires were processed and a data-base was made to present drivers' responses and choices as well as their attitudes and perceptions along with their socio-economic information. This study conducts statistical analysis and discrete choice models to find the effectiveness of VMS and analyze drivers' diversion decisions. Assuming shortest path as a base choice, driver's route diversion in response to different travel time information on the VMS is formulated with respect to various factors as Eq. 1. The effect of real travel time on the diversion probability demonstrates the effectiveness of VMS content. According to survey questionnaires and preliminary analysis of drivers' choice, road familiarity, aesthetic, and road safety along with driver demographic explain the route diversion significantly.

$$\text{Diversion rate} = F\,(\Delta T, PT, PC, f, A) \qquad (1)$$

Where:

$\Delta T$ = real travel time difference

$PT$ = perceived travel time of the current route

$PC$ = past route choice

$f$ = familiarity

$A$ = route aesthetic

Recent studies argued that travel time is not the only factor affecting traveler's route choice and many novel determinants are perceived to be significant. Environmental components and human characteristics, along with real time information influence driver's route choice with different trip purposes. In addition, it is shown that cognitive route knowledge explains route choice behavior better than perceived route attributes, which itself is a better explainer of route choice than observed attributes [Zha4]. The result of this study demonstrates that slight differences in travel time (e.g. 5 min in a 30 min trip), may not cause drivers, in particular commuters, to divert to a new route. This may happen basically because of the consequence of past experiences compared to the reliability of VMSs. There is however an uncertainty with different drivers' perception of travel time, which varies likely by drivers' value of time, familiarity, and trip purpose.

# References

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