ABSTRACT

One of the most significant problems in urban transportation is traffic congestion. As traffic flow evolution relies on the aggregate route choices of drivers, effective and adaptive traffic management solutions should be on the basis of a comprehensive understanding of drivers' decision-making behavior. In this context, understanding the comprehensive impacts of real-time travel information systems on drivers' route choices and/or overall travel experiences has been profound with the enhanced accessibility of diverse en route real-time travel information, especially from multiple dissemination sources enabled by technology advancements. Although the impacts of information are associated with drivers' cognition and psychology in terms of perceiving and processing the information and affecting their route choices and further travel satisfaction, multiple aspects of driver-related latent factors associated with real-time travel information have not been sufficiently addressed in the existing studies. This dissertation analyzes drivers' cognitive and psychological factors associated with perceiving and processing real-time travel information and its impacts on their route choices and travel satisfaction from a comprehensive perspective using interactive driving simulator experiments.

This dissertation seeks to propose modeling frameworks that explicitly address drivers' information-induced latent factors (i.e., cognitive burden, cognitive decisiveness) in the effects of real-time travel information on drivers' route choice and travel satisfaction. Using self-reported data collected from driving simulator experiments, the latent psychological effects of real-time travel information and the impacts on drivers' route decision-making processes are examined with human factors considerations related to the perception and processing of information along with conventional route choice determinants such as driver attributes, route characteristics, situational factors, and information characteristics. The proposed framework is also extended to include latent classes and elicit the roles of attitudes towards real-time travel information as an intrinsic attribute of drivers in the formation of the psychological effects of information and their intention to use the information.

The provision of real-time travel information affects drivers' travel satisfaction not only through travel time savings associated with informed route choices, but also through improvements in travel experiences from cognitive and emotional perspectives in terms of enhanced reassurance and reduced uncertainty. In this context, this dissertation investigates the psychological benefits of

information related to enhanced travel experiences with real-time travel information within a structural equation modeling framework integrating conventional time-based physical benefits. The comprehensive understanding of travel satisfaction with respect to information characteristics (i.e., location of provision, contents) contributes to better prediction of drivers' route choice behavior from a long-term perspective and to the effective design of information dissemination strategies.

Moreover, this dissertation proposes an interactive driving simulator-based experiment design to collect quasi-realistic behavioral data for the aforementioned studies in the context of driver behavior under real-time travel information provision. It discusses several design features to address the key limitations of the existing simulator-based experiments, including dynamic and consistent traffic flows based on integration with a microscopic traffic simulation and drivers' intended urgency of the trip as a proxy for trip purposes. In addition, multiple dissemination sources and different content of real-time travel information are considered to create diverse information contexts. Hence, the proposed design bridges the gap between real-world driving and experimental research, thereby enabling the collection of realistic behavior data, including driving and route choices, with consideration of such complex cognitive processes.

The findings of this dissertation can assist multiple transportation stakeholders, including traffic system operators and planners, to incorporate drivers' unobservable characteristics related to real-time travel information and their latent impacts on route choice decision-making and travel satisfaction, thereby enabling the design of effective information strategies for traffic flow management. In addition, the study insights regarding the comprehensive benefits of real-time travel information can be leveraged by transportation policymakers as a justification for the development and investment of future travel information system infrastructure. Further, the study findings provide valuable insights for information vendors and auto manufacturers to design and implement driver-friendly in-vehicle information delivery solutions from a human factor perspective.

Defense Information:

Date: Monday, November 27th

Time: 2:30 to 4:30 pm (Eastern Time)

Room: HAMP G212

Meeting link:

https://purdue-edu.zoom.us/j/93699522613?pwd=YmRxNmE0aHJYL3VpWlZWWDAvVEYxZz09