

Request for Research Funding for FY 2022-2023

SPR Subpart B Project: TEO-23-03

Requesting Office	State Traffic Engineering and Operations Office	Priority	3 of 22
Proposed Title	Human Factors Study to Understand Driver Behavior on Managed Lane Facilities		
Justification	<p>Managed lanes are “highway lanes where operational strategies are proactively implemented and managed in response to changing traffic conditions”¹. Managed lanes (MLs) are commonly constructed adjacent to general-purpose lanes (GPLs). In Florida, managed lanes are increasingly being constructed to relieve congestion. These facilities include congestion pricing, have vehicle restrictions, and may be operated as reversible flow or bi-directional facilities to best meet peak demands. The Florida Department of Transportation (FDOT) has several managed lane facilities either in operation, under construction, or in the planning phase. The managed lanes in Florida have been deployed in four major regions, Northeast Florida, Central Florida, West Central Florida, and Southeast Florida regions.</p> <p>The geometry of managed lanes varies for different facilities. Since managed lanes are often built within existing freeway facilities, in many cases, right-of-way limitations and roadway constraints may make it difficult to meet all desirable design standards and hence compromise the safety of the facilities. The type of separation between the MLs and the GPLs is one major geometric feature that influences the safety performance of the managed lane facilities. Common separation treatments include barrier separation, buffer separation with pylons (i.e., tubular markers), buffer separation with pavement marking, wide buffer separation, and grade separation. These separation treatments have varying impacts on the overall safety and operational performance of the managed lane facilities.</p> <p>In the ongoing research effort, the Florida International University (FIU) and the Texas Transportation Institute (TTI) researchers are quantifying the safety performance of different managed lanes separation types with concurrent flow and reversible flow operations. More specifically, Crash Modification Factors (CMFs) are being developed to quantify the safety performance of concrete barrier separation and pylons separation types. Since there is a limited sample size on the managed lane facilities with buffer separation (i.e., pavement markings separating the MLs from the GPLs), this separation type has not been analyzed in this current research.</p> <p>Nonetheless, based on the discussions with the State Traffic Engineering and Operations Office, the State Roadway Design Office, and the State Safety Office, the Federal Highway Administration (FHWA) is encouraging agencies to use double solid white pavement markers (i.e., buffer separation) and not the pylons. In fact, the Manual on Uniform Traffic Control Devices (MUTCD) provides guidance for markings for buffer-separated preferential lanes (see Figures 3D-2 and 3D-3). Unlike Florida where pylons were commonly used to separate MLs from GPLs, several other states including California, Colorado, Utah, Virginia, Washington, etc., have used buffer separation with pavement markings. This research focuses on conducting a human factors study to understand driver behavior on managed lane facilities and determine the safety performance of buffer separation vs. pylons separation. Some of the research questions include:</p> <ul style="list-style-type: none"> • Do drivers look at the top or bottom of the pylons (i.e., tubular markers)? • Do drivers avoid the inside lane of the GPLs (i.e., the GPL that is adjacent to the MLs)? • Is the driver speed affected by the managed lane separation type? • Is the driver’s lateral position affected by the managed lane separation type? 		

¹ FHWA. (2008). *Managed Lanes: A Primer*. Publication: Report number FHWA-HOP-05-031. U.S. Department of Transportation, Federal Highway Administration, Washington D.C.
https://ops.fhwa.dot.gov/publications/managelanes_primer/managed_lanes_primer.pdf

	<p>These questions cannot be answered using traditional crash data analysis and requires using human factors approaches. As such, this research proposes to conduct two types of analyses, one using the naturalistic driving data, and the other using the driving simulator with the eye tracking equipment. These two approaches will complement each other in addressing the range of research questions in human factors pertaining to the managed lanes separation types.</p> <p>Approach 1: Naturalistic Driving Study The Second Strategic Highway Research Program (SHRP 2) Naturalistic Driving Study (NDS) dataset, hosted by the Virginia Tech Transportation Institute (VTTI), will be used to answer the research questions. The naturalistic driving study offers two key advantages: (a) detailed and accurate pre-crash information, including objective information about driving behavior; and (b) exposure information, including the frequency of behaviors in normal driving, as well as the larger context of contributing factors.</p> <p>This NDS dataset comprises data from more than 3,000 participants in six states. This dataset includes non-identifying time series data, such as profiles of speed, acceleration, steering, and distance and relative speed to other objects, and GPS data on certain road segments. Analyzing this dataset would give us invaluable insights into the driver behavior on managed lane facilities.</p> <p>Approach 2: Driving Simulator Study While the NDS dataset could be used to analyze the driver behavior in real-world scenarios, the driving simulator study will focus on analyzing the specific driver behavior at locations with different managed lane separation types. Using an eye-tracking equipment in the driving simulation environment, the study will collect the point of gaze (where one is looking) or the motion of the eye relative to the head (eye movement). Such data would provide unique insights into the driver behavior, glances, and reactions relative to different separation types. Along facilities with pylons, the data would tell if drivers look at the top or bottom of the pylons (i.e., tubular markers). The study participants will constitute young, middle-aged, and older drivers, and will also be diverse with respect to gender and race/ethnicity.</p>		
Impact	<p>While the ongoing research project focuses on quantifying the safety performance of managed lanes separation types using traditional crash data analysis, the research is unable to answer specific questions related to the driver behavior on these facilities.</p> <p>This proposed study will provide answers to the questions related to the performance of pavement markings vs. tubular markers (i.e., pylons) from a human factors perspective. It will provide the necessary information to assist agencies make an informed decision on the type (and width) of the separation between MLs and GPLs.</p>		
Affected Offices	State Traffic Engineering and Operations Office, State Roadway Design office, State Safety Office		
Existing Work	FIU is currently wrapping up a research project to quantify the safety performance of different managed lanes separation types with concurrent flow and reversible flow operations. This proposed research is an extension to this ongoing research effort.		
Keywords Used In Existing Work Search (Cannot leave blank)	Managed lanes + human factors (7 studies): None of these studies focus on human factors. Driver behavior + freeway safety (10 studies): None of these studies focus on managed lanes.		
Related Contracts (Give contract numbers)	BE975: Developing Safety Performance Functions and Crash Modification Factors for Managed Lanes Separation Treatments		
Funding Request	\$249,000	Anticipated Duration	21 months
Project Manager	PM: Raj Ponnaluri Co-PM: Gail Holley	Contracting Method	FIU (Lead) FSU (Sub)
Equipment	Estimated equipment cost (or N/A)	NA	
Urgency	1	The ongoing research effort on the safety performance of different managed lanes separation types provides the CMFs for separation types. However, it does not answer other critical and urgent questions related to driver behavior on managed lanes facilities. The Department needs this information to make critical decisions on the type and width of separation between the MLs and GPLs. As there are	

		several managed lanes construction projects in the planning and design phases across the state of Florida, this research is of utmost urgency.
Implementability	1	The research results will be readily implementable. The results will be disseminated to the DTOEs, design engineers, DSEs, District TSM&O Engineers, and other stakeholders for immediate adoption.
Project Benefits (Succinct, complete explanation)		
<ul style="list-style-type: none"> ✓ This research will help understand driver behavior on managed lane facilities and determine the safety performance of buffer separation vs. pylons separation. ✓ This project will provide the necessary information to assist agencies make an informed decision on the type (and width) of the separation between the managed lanes and the general-purpose lanes. 		
Project Benefits (Select all that apply and explain)	Quantifiable Benefits (units, dollars, etc...if applicable)	Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits
<input type="radio"/> Materials Enhancement		
<input type="radio"/> Materials Savings		
<input type="radio"/> Time Savings		
<input type="radio"/> Lives Saved/Injuries Prevented	Reduce crashes on managed lanes facilities	This project will provide the necessary information to assist agencies make an informed decision on the type (and width) of the separation between the managed lanes and the general-purpose lanes.
<input type="radio"/> Other (Explain)		

*Comments should explain and support urgency, financial benefit, and implementability scores