

Research Report Summary



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Driver Behavior at Toll Plazas—Phase II

Objective

The objective of this study is to investigate driver behavior at toll plazas with different lane configurations and traffic conditions using a driving simulation environment. The same toll plaza used in Phase I of the study was modeled in Real Time Technology (RTI) SimCreator software and tested in a full-cab, fixed-base driving simulator.

The term *lane configuration* means placing lanes with different toll collection technologies in a specific order at a toll plaza [1].

Participants

A total of 20 licensed drivers, 10 females and 10 males, between the ages of 18 and 60 participated in this experiment.

Subjects needed to have a valid U.S. driver's license and no special physical or health conditions that might eliminate

or affect their driving abilities. Participants were compensated for their time and effort upon completion of their experiment session.

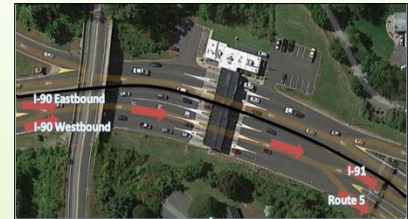
Variables

Independent variables were lane configuration, origin/destination of the subject vehicle, traffic queue, traffic composition (passenger vehicles versus heavy vehicles), and costumer type (cash versus EZPass).

Table 1 shows the factors considered in the experimental design, and Figure 1 shows a top-down view of two scenarios with and without a queue at the toll plaza.

Results

The results show that having a queue (of 5 vehicles in the closest cash lane to the subject's origin and with a transaction time of 3 seconds at the toll booth) and a slow



West Springfield toll plaza. An off-ramp plaza with a short distance (about 500 feet) between merging and diverging ramps, which causes a lot of weaving maneuvers and gives less longitudinal space for the drivers to switch lanes.



Full-cab, fixed-base simulator at the Human Performance Laboratory, UMass Amherst. A Saturn sedan in front of three screens with three overhead projectors, which provides 150 degrees of horizontal view and 30 degrees of vertical view.

lead heavy vehicle both statistically significantly affect the driver's lane choice in the cash and EZPass scenarios, respectively. With EZPass drivers, origin-destination is also a factor in their lane choice. According to the results, drivers are more prone to choose the right lane than the left lane. In

scenarios without a queue or a lead vehicle and with left-to-left origin-destination, 5 to 10 percent of drivers, depending on the lane configuration of the plaza, still switched from the left ramp to the right lane at the toll booth and went back to the left ramp after the plaza. It cost them between 2 and 3 lane

crossings before the plaza and 2 and 3 lane crossings after the plaza, depending on the lane configuration. Further investigations with different plaza geometries and designs can give a better understanding of these behaviors and drivers' lane-decision-making approach.

Table 1. Description of factors

Factor	Description	Specifications
Lane Configuration	Combination of E-ZPass and cash lanes	Cash–E-ZPass–E-ZPass–Cash
		E-ZPass–Cash–E-ZPass–Cash
		E-ZPass–E-ZPass–Cash–Cash
Origin/Destination	On/off ramps	Right-to-right
		Right-to-left
		Left-to-right
		Left-to-left
Traffic Queues	Having queue or not	With queue
		Without queue
Traffic Composition	Having lead heavy vehicles or not	With lead heavy vehicle
		Without lead heavy vehicle
Customer Type	E-ZPass or cash customer	E-ZPass customer
		Cash customer



Figure 1. Sketch of two cash scenarios: Scenario 1 (left) and Scenario 2 (right)

Reference

1. Mohamed, A.A., & Klodzinski, J.G. (2001). Safety considerations in designing electronic toll plazas: case study. *ITE Journal*, 71(3): 20-33.