



Project Summary Report 4945-S
Project 7-4945: Understanding Road Rage

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Understanding Road Rage: Driver Irritants and Promising Mitigation Measures

Popular opinion has it that “road rage” is increasingly prevalent. Whether or not this is true, driver frustration in congestion may lead to increased aggressive driving. Significant safety benefits might be realized if transportation professionals better understood roadway and environmental factors that contribute to aggressive driving.

For instance, some geometric features may allow, even invite, drivers to perform aggressive maneuvers like driving on shoulders or cutting in line. Likewise, drivers may perceive some recurrent congestion to be unnecessary. Only slight modifications may be needed to fix these problem areas. Frustration that the condition is not getting fixed may also contribute to driver impatience.

Non-recurrent congestion may be an even greater contributor to stress, especially if information comes too late to choose an alternate route or if incidents are not cleared quickly. While the project title is “Understanding Road Rage,” researchers concentrated on aggressive driving because it is more common and it is more amenable to engineering-related mitigation measures.

What We Did . . .

Researchers performed a literature review concerning road rage, aggressive driving, and driver stress. Researchers conducted focus groups with commuters to explore aspects of driving that are particularly frustrating and stressful. Moderators also

discussed measures for mitigating driving stress. Next, a telephone survey was given to 431 Dallas County drivers to assess the prevalence of stressors that may lead to aggressive driving and to evaluate the perceived effectiveness of countermeasures for reducing driving stress.

Researchers used the information collected during the first year to select three promising mitigation measures for evaluation: (1) photogrammetry for incident clearance; (2) freeway bottleneck improvements; and (3) Late Merge concept at a work zone.

What We Found . . .

Literature Review

A problem in assessing road rage and aggressive driving lies in defining the terms. Researchers found large

discrepancies in both definition and use. The research team utilized information from various sources to reach the following definitions:

- *Road Rage*: active hostility directed toward a specific driver; and
- *Aggressive Driving*: selfish, “me-first” attitude that is intentionally inconsiderate of other drivers.

Focus Groups

The list of irritating and stressful things about driving in Dallas emphasized driver behavior issues. The forty participants provided useful information that helped the research team develop the telephone survey.

Telephone Survey

Researchers selected the survey sample from Dallas telephone exchanges using a random sampling



"LET THEM TAKE THEIR TURN" "DON'T LET THEM IN"

Figure 1. Merging dilemma cartoon



procedure that allows the results to be generalized to the driving population of Dallas County. Some of the key survey findings:

- Refusal rate was very low, 8.3 percent, indicating a strong interest in the topic.
 - The majority (57.3 percent) characterized driving as more stressful than a year ago.
 - When asked to describe the one driving behavior most likely to raise stress, over 50 percent cited merging-related behaviors.
 - The most stressful roadway condition was construction (30.4 percent).
 - The top three rated behaviors most likely to raise stress levels were: (1) weaving in and out of traffic; (2) drivers preventing merging; and (3) inattentive driving.
 - The top two rated countermeasures for reducing driver stress were: (1) clear accidents and other incidents faster, and (2) build more freeway lanes where needed and at bottleneck locations.
- Respondents also rated improving signs in advance of lane closures as a highly effective countermeasure.

Evaluation of Mitigation Measures

Photogrammetry for Incident Clearance

Many transportation agencies focus on reducing incident impacts through better detection. The time for police to complete scene investigations has not received as much attention. This component is receiving more consideration as agencies realize the significance of the investigation on incident duration.

This research evaluated the use of photogrammetry (obtaining measurements from photographs using triangulation) to expedite incident clearance. At an incident, the officer takes pictures of vital data (i.e., skid marks, object locations, etc.) and then performs the measurements back in the office using specialized software. The Dallas County Sheriff Department (DCSD) began using photogrammetry for freeway incident investigation in December 2000.

Researchers obtained data for 34 incidents that showed:

- 17 minute average incident clearance time (i.e., time from when the deputy arrived until no lanes were blocked);



Figure 2. “Merge Here Take Your Turn” sign on Interstate 30

- 22 minute average incident blockage time (i.e., time from when the deputy received the call until all freeway lanes were reopened); and
- 26 minute average incident duration (i.e., total time spent on the incident) - all of the incidents were less than 1 hour in duration.

The Chattanooga Police Department (CPD) used both photogrammetry and traditional techniques (laser and roller tape) between November 2000 and June 2001. This comparison revealed that:

- Photogrammetry reduced the overall clearance time by 58 percent, an average of 61 minutes for each of the 11 incidents included in the comparison.
- Only one officer was needed for photogrammetry while three were necessary for the traditional method.
- The comparison of measurement accuracy for 7 of the incidents revealed only a 2.3 percent difference between photogrammetry and traditional techniques.

Freeway Bottleneck Removal

Bottlenecks on freeways create congestion, increase fuel consumption and emissions, and negatively impact safety. Previous Texas Transportation Institute (TTI) projects (1232-17 and 1994-11) have examined these effects; however, this project concentrated on quantifying the stress-related impacts of bottlenecks. Researchers found several studies that support the concept that traffic congestion

contributes to higher stress levels. This finding supports the hypothesis that bottleneck improvements that reduce congestion also relieve driver stress and frustration. Two bottlenecks, Loop 12 near IH 30 and eastbound Woodall Rodgers near US 75, were utilized as case studies. Researchers assessed the effectiveness of these improvements by: (1) collection of before and after data (volumes, travel times, and queue lengths); and (2) commuter feedback from the *Dallas Morning News* web site.

Loop 12 Bottleneck Case Study

The Texas Department of Transportation (TxDOT) converted an inside shoulder into a fourth lane in each direction on Loop 12 near IH 30 to relieve a bottleneck. However, the new northbound lane was striped as an inside lane “pop-out” rather than a lane addition at the IH 30 entrance as originally intended. This improvement decreased congestion on Loop 12; however, TTI collected only “before” driver surveys since the intended striping was not yet in place. Using the Internet, researchers collected feedback from 258 motorists between November 2000 and January 2001. The results showed that:

- Over 90 percent rated their stress level as either medium or high. In fact, almost two in every three perceived a high stress level, with an average stress rating of 7.7 on a 10-point scale.



- Almost all (97.3 percent) had experienced an act of rage or aggression at this location, and almost 75 percent experienced these behaviors on a regular basis (often or very often).
- Over 90 percent had expressed rage or aggression, almost 45 percent on a regular basis.

Woodall Rodgers Bottleneck Case Study

TxDOT made improvements to the connection from eastbound Woodall Rodgers to northbound US 75, striping it from a one- to a two-lane ramp. Approximately two months later, researchers gathered feedback from 154 drivers through an Internet survey. Key findings included:

- Almost three in four observed aggressive behavior at this site often or very often.
- Close to 90 percent witnessed drivers preventing others from merging, cutting across solid white lines, and cutting in at the last second.
- The improvements reduced the frequency and seriousness of aggressive behaviors (59.1 percent) more so than personal stress level (43.5 percent) or commute time (52.6 percent).

These findings corroborate the behaviors observed on the videotapes used to gather operational data. Over 50 percent cited improved commute times, which were confirmed in the operational data.

Late Merge Evaluation

Merging at work zones can be a difficult driving task and the rules in this situation do not seem as well understood as those in other traffic situations. In fact, the stressful environment of a lane closure coupled with lessened understanding of rules often creates frustration that can lead to aggression and/or rage. [Figure 1](#) provides a humorous way of looking at the dilemma of when to merge. Typical signing identifies the closing lane(s) and distance to the merge point which creates two distinct groups of motorists: one that vacates the closing lane as soon as possible and another that stays in the closing lane until it ends. These groups exhibit vastly different behaviors but both perceive their way of driving to be the right way.

Researchers evaluated the Late Merge as a mitigation measure at work zones. The Late Merge encourages drivers to use all available lanes to the merge point and then take turns merging. A Pennsylvania study, in work zones where two lanes were reduced to one, documented reduced queue lengths and increased work zone capacities of 15 percent using the Late Merge.

Driving Simulator

Researchers evaluated the Late Merge in the driving simulator. Test subjects drove through a work zone in the simulator to gather feedback on the Late Merge signs and to observe driving behavior. The preliminary result, based on a limited number of subjects, is that the simulator is a promising tool for applications such as a freeway work zone environment. As with any simulation model or tool, calibration to real-world conditions and proper experimental procedures are necessary to obtain the best overall results. Still, more research is needed to optimize the simulator's effectiveness for modeling congested conditions like the Late Merge.

Field Test

The field test is believed to be the first evaluation of an urban site with a three- to two-lane closure scenario. [Figure 2](#) shows a picture of the field site. Due to the project scope and budget, researchers performed a feasibility evaluation of the Late Merge instead of a traditional field test.

The site was not ideal because congestion happened only a small amount of the time the lane closure was in effect. Typically, the contractor personnel closed the left lane only from 9:30 am to 3:00 pm because of air quality restrictions. This off-peak closure caused less congestion.

The field test data revealed that the Late Merge scenario delayed the onset of congestion at the merge point by approximately 14 minutes. Furthermore, the length of the maximum queue was shortened from approximately 7800 feet in the before case to 6000 feet in the after case. The volume and lane proportion data for the entire day and the congested time period suggested that the Late Merge concept did influence driver behavior,

especially near the merge point with more vehicles staying in the left lane in accordance with the Late Merge signing. Finally, not enough data (one day of before and one day of after) was collected to support significant conclusions on the operational effectiveness of the Late Merge; however, researchers believe the concept is feasible for application in Texas based on the successful trial at an urban site with a three- to two-lane closure scenario.

The Researchers Recommend . . .

1. Further implementation of photogrammetry, perhaps via pilot projects with several police agencies in major urban areas throughout the state of Texas, is recommended to validate the promising preliminary results exhibited by the DCSD and CPD. TxDOT should pursue funding grants through the Intelligent Transportation Systems (ITS) peer-to-peer (training) and Congestion Mitigation and Air Quality (equipment) programs.
2. TxDOT should increase efforts to fund and implement bottleneck improvements and other early action projects that can reduce traffic congestion and the associated driving stress and aggressive driving impacts.
3. TxDOT, in cooperation with the media outlets such as the *Dallas Morning News*, should continue to gather driver feedback about bottlenecks and the effectiveness of improvements.
4. When the driving environment simulator is used on future research projects similar in scope, researchers suggest further calibration to optimize modeling of congested conditions.
5. Further testing of the static Late Merge is recommended to more comprehensively investigate the effectiveness of the strategy. This testing should include both three- to two-lane and two- to one-lane closure scenarios. Researchers believe that shorter-term work zones (e.g., activities such as pavement overlays, etc.) would make good test sites because drivers would not have preconceived ideas about how to drive approaching the lane closure.



For More Details . . .

The research results, conclusions, and recommendations are documented in:

Report 4945-1, *Understanding Road Rage: Summary of First-Year Project Activities*

Report 4945-2, *Understanding Road Rage: Evaluation of Promising Mitigation Measures*

Report 4945-3, *Understanding Road Rage: Implementation Plan for Promising Mitigation Measures*

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TxDOT Implementation Status February 2002

The product required for this project was traffic engineering mitigation measures for road rage. The researchers had three recommended practices: (1) using photogrammetry to expedite the clearing of incidents, (2) using the static Late Merge concept at work zone closures, and (3) involving motorists in locating freeway bottlenecks and using their feedback to assess the improvements.

Photogrammetry is being used by some local law enforcement agencies in both the Dallas and Houston districts. Although not directly responsible for clearing incidents, TxDOT encourages the use of this new tool. In some cases, TxDOT has helped local agencies secure grants for purchasing photogrammetry training. Implementation of the Late Merge concept will be the responsibility of TxDOT districts. The static Late Merge concept was used for a lane closure in the Dallas District and the district intends to use this method again when appropriate.

The researchers recommend a more comprehensive investigation of the effectiveness of the static late merge strategy. The investigation should include both three-to-two lane and two-to-one lane closure scenarios. Shorter-term work zones such as maintenance activities for pavement overlays might make good test sites for the static Late Merge because drivers would not have preconceived ideas about how to drive approaching the lane closure.

Project 0-2137, "Improving Work Zone Safety Through Better Work Zone Traffic Management and Enforcement" is evaluating the feasibility of a dynamic Late Merge where changeable message signs are used and the late merge concept is triggered by congestion.

For more information, please contact the Research and Technology Implementation Office at (512) 465-7403 or e-mail at rtmain@dot.state.tx.us.

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