

1. Report No. TX-01/4945-1		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle UNDERSTANDING ROAD RAGE: SUMMARY OF FIRST-YEAR PROJECT ACTIVITIES				5. Report Date November 2000	
				6. Performing Organization Code	
7. Author(s) Carol H. Walters, Valmon J. Pezoldt, Katie N. Womack, Scott A. Cooner, and Beverly T. Kuhn				8. Performing Organization Report No. Report 4945-1	
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135				10. Work Unit No. (TRAVIS)	
				11. Contract or Grant No. Project No. 7-4945	
12. Sponsoring Agency Name and Address Texas Department of Transportation Construction Division Research and Technology Transfer Section P. O. Box 5080 Austin, Texas 78763-5080				13. Type of Report and Period Covered Research: September 1999 - August 2000	
				14. Sponsoring Agency Code	
15. Supplementary Notes Research performed in cooperation with the Texas Department of Transportation. Research Project Title: Understanding Road Rage					
16. Abstract <p>Popular opinion has it that "road rage" is increasingly prevalent and dangerous in the urban driving environment. Whether or not this opinion is true, driver frustration in congested conditions may lead to an increase in aggressive driving, a less intentionally malignant and more common subset of road rage. The potential for significant safety benefits might be realized if transportation professionals had a better understanding of some roadway factors and characteristics of the congested driving environment that induce irritation and perhaps contribute to the frequency of aggressive driving.</p> <p>This report documents the major first-year activities: literature review, focus groups, telephone survey, and development of potential traffic engineering mitigation measures. Researchers studied five focus groups consisting of six to ten individuals and a telephone survey of over 400 Dallas motorists to identify and quantify the pertinent factors increasing driver impatience, irritation, and stress in the congested driving environment. Based upon the survey responses, the research team developed reasonable and feasible traffic engineering mitigation measures (i.e., those factors related to the roadway itself—geometrics, signs and markings, incident clearance activities, etc.) for further evaluation. The following three items were selected for further evaluation:</p> <ol style="list-style-type: none"> 1. Innovative merge strategies—test concepts such as the late merge and zipping at urban work zones, 2. Bottleneck improvements—evaluate the benefits of adding capacity at freeway bottlenecks for reducing aggressive driving, and 3. Photogrammetric investigation of incidents—assess the ability of photogrammetry to expedite incident clearance. <p>The second year of the project will test these measures, both in a laboratory setting (driving simulator in College Station) and in the real world (field studies on highway facilities in the Dallas area).</p>					
17. Key Words Road Rage, Aggressive, Stress, Irritants, Mitigation, Merging, Driver Behavior			18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161		
19. Security Classif.(of this report) Unclassified		20. Security Classif.(of this page) Unclassified		21. No. of Pages 116	22. Price

**UNDERSTANDING ROAD RAGE:
SUMMARY OF FIRST-YEAR PROJECT ACTIVITIES**

by

Carol H. Walters, P.E.
Senior Research Engineer
Texas Transportation Institute

Valmon J. Pezoldt
Research Scientist
Texas Transportation Institute

Katie N. Womack
Research Scientist
Texas Transportation Institute

Scott A. Cooner, P.E.
Assistant Research Engineer
Texas Transportation Institute

and

Beverly T. Kuhn, Ph.D., P.E.
Associate Research Engineer
Texas Transportation Institute

Report 4945-1
Project Number 7-4945
Research Project Title: Understanding Road Rage

Sponsored by the
Texas Department of Transportation

November 2000

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation, and is not intended for construction, bidding, or permit purposes. The engineer in charge of this project was Ms. Carol H. Walters, P.E. # 51154 (Texas).

ACKNOWLEDGMENTS

The research reported herein was performed by the Texas Transportation Institute (TTI) as part of a project titled *Understanding Road Rage* sponsored by the Texas Department of Transportation (TxDOT). Ms. Carol H. Walters, P.E., # 51154 (Texas) of TTI served as the research supervisor, and Ms. Terry Sams, P.E., of the TxDOT Dallas District served as the project director.

The authors wish to acknowledge individuals that served on an advisory panel for their assistance and guidance throughout the first year of this research project. The advisory panel was composed of the following members in addition to the project director:

- Mr. David Bartz, P.E., Federal Highway Administration (FHWA), Texas Division, Austin;
- Mr. Mike West, TxDOT, Traffic Safety, Dallas District Office;
- Ms. Meg Moore, P.E., TxDOT, Traffic Engineering Section, Traffic Operations Division, Austin; and
- Dr. Khali Persad, TxDOT, Research Program, Construction Division, Austin.

The research team also appreciates the support and participation of the City of Dallas, Texas Instruments, Pantego Bible Church, and the Dallas Morning News in providing subjects for the focus groups. The research team extends a special thanks to Mr. Gerry Barker of the Dallas Morning News for the use of the newspaper's website to recruit subjects for two of the focus groups.

TABLE OF CONTENTS

	Page
List of Figures	ix
List of Tables.....	x
List of Abbreviations.....	xi
1 INTRODUCTION.....	1
1.1 Background and Significance of Research.....	1
1.2 Research Objectives	1
1.3 Work Plan.....	1
1.4 Report Organization	2
2 FIRST-YEAR LITERATURE REVIEW SUMMARY	5
2.1 Introduction.....	5
2.1.1 Definitions.....	6
2.2 Driver Stress and Aggression.....	9
2.3 Reducing Driver Stress and Aggressive Driving	17
2.3.1 Social, Behavioral, and Educational Approaches	18
2.3.2 Traffic Engineering and Roadway Design Approaches	19
2.3.3 Enforcement and Legislative Approaches.....	22
2.4 Focus Group and Survey Research	22
2.5 Study of Aggressive Driving Behavior on Freeways.....	29
3 FOCUS GROUP RESULTS	31
3.1 Focus Groups on Driving in Stressful Environments	31
3.2 Group and Participant Characteristics.....	31
3.3 Summary of Focus Group Discussions	32
3.3.1 Discussion of Driver Behavior Irritants	35
3.3.2 Discussion of Roadway-Related Irritants.....	36
3.3.3 Discussion of Construction-Related Irritants	37
3.3.4 Discussion of Enforcement/Emergency Response Irritants	37
3.3.5 Discussion of HOV Lane and Tollway Irritants.....	37
3.3.6 Discussion of Merging-Related Irritants.....	37
3.3.7 Participant Driving Behaviors.....	38
3.3.8 Participant Ideas for Reducing Stress and Aggressive Driving	39
4 TELEPHONE SURVEY RESULTS	41

	Page
4.1	Background 41
4.2	Telephone Survey Methodology 41
4.3	Sample Characteristics 42
4.4	Survey Results—Perception of Aggressive Driving 43
	4.4.1 Stressors—Definition and Frequency 44
	4.4.2 Countermeasures 45
4.5	Summary of Telephone Survey Finding 47
5	DEVELOPMENT OF TRAFFIC ENGINEERING MITIGATION MEASURES 49
5.1	Education-Related Mitigation Measures 49
	5.1.1 Dynamic Message Sign Usage 49
	5.1.2 Traffic Emotions Education Cards 49
	5.1.3 Drivers Education/Defensive Driving Courses 50
	5.1.4 Media Exposure 51
	5.1.5 Public Service Announcements 51
5.2	Enforcement-Related Mitigation Measures 52
	5.2.1 Legal Penalties 52
	5.2.2 Cellular Hotlines 53
	5.2.3 Selective Enforcement Techniques 54
	5.2.4 Expediting Incident Clearance 56
5.3	Traffic Engineering–Related Mitigation Measures 57
	5.3.1 Signing, Marking, and Traffic Control Issues 57
	5.3.2 Speed Trailers 59
	5.3.3 Entrance Ramp Improvements 59
	5.3.4 Improved Construction Scheduling 60
	5.3.5 Improved Public Information 60
	5.3.6 Bottleneck Improvements 61
	5.3.7 Innovative Merging Strategies 62
5.4	Recommended Measures for Further Testing 65
	5.4.1 Mitigation Measure #1—Innovative Merge Strategies 65
	5.4.2 Mitigation Measure #2—Bottleneck Improvements 66
	5.4.3 Mitigation Measure #3—Using Photogrammetry to Expedite Incident Clearance 66
	REFERENCES 69
	APPENDIX A: Summary of Aggressive Driving Enforcement and Legislative Activities 77
	APPENDIX B: Focus Group Discussion Guide for Driving in Stressful Environments 95
	APPENDIX C: Telephone Survey Questions and Response Frequencies 97

LIST OF FIGURES

Figure		Page
1	Theory of Planned Behavior	12
2	Relationship Between Workload, Cognitive Skills, Personality, Driving Performance, and Driving Stress.....	15
3	A Transactional Model of Driver Stress Traits and Their Effects on Cognitive Processing, Mood State, and Behavior.....	17
4	Concept of Driver’s Stress and Strain.....	21
5	Example of DMS Educational Display for “Move-It” Law.....	50
6	Colorado State Patrol Aggressive Driving Hotline.....	53
7	Schematic of ADVANCE Vehicle.....	55
8	Example Output from Red Light Running Video Enforcement System.....	55
9	Using Photogrammetry for Incident Investigation.....	56
10	Beware of Aggressive Drivers Sign.....	58
11	Example Speed Trailer.....	59
12	Flexible Delineators for Restricting Movements across Ramp Gore Areas	60
13	Example Before and After Bottleneck Improvement.....	61
14	Late Merge Traffic Control Plan.....	63
15	Lane Changing Phases and Maneuvers at a Lane Drop.....	64
16	Zippering Traffic Control Plan.....	64
17	TTI Driving Simulator	66

LIST OF TABLES

Table		Page
1	Lexis-Nexis Citations for Road Rage and Aggressive Driving	5
2	Candidate Measures for Monitoring Stress	15
3	Behaviors Perceived as Being Aggressive by Canadian Drivers	25
4	Perceptions of Contributors to Aggressive Driving	25
5	Frequency of Observing Dangerous or Aggressive Driving	26
6	Perceived Reasons for Increased Aggressive Driving	26
7	Frequently Encountered Unsafe Driving Behaviors on Urban Interstate Highways	27
8	Prevalence of Self-Reported Unsafe Driving Behaviors	28
9	Percent of National Sample Who Believe Countermeasures Effective and Approve of Implementation	29
10	Summary of Focus Group Participant Characteristics	32
11	Irritating/Aggravating Things about Driving in Dallas	33
12	Group-Generated Suggestions to Ameliorate Problems Identified by Participants	39
13	Demographic Characteristics of Telephone Survey Sample	43
14	Driving Behaviors That Raise Stress Levels	45
15	Rating of Potential Countermeasure Approaches	46
16	Example TEE Card—Test Your Road Rage Tendency	51
17	Summary of Status of 1999 State Legislature Bills Addressing Aggressive Driving	87
18	Summary of Status of 2000 State Legislature Bills Addressing Aggressive Driving	91

LIST OF ABBREVIATIONS

AAA	American Automobile Association
ADAPT	Aggressive Drivers Are Public Threats
ADIE	Aggressive Driver Imaging and Enforcement
ADVANCE	Aggressive Driving Video and Non-Contact Enforcement
AHS	automated highway system
CAD	computer aided dispatch
CHP	California Highway Patrol
CSP	Colorado State Patrol
DART	Dallas Area Rapid Transit
DESi	driving environment simulator
DFW	Dallas/Ft. Worth
DMN	Dallas Morning News
DMQ	decision-making questionnaire
DMS	dynamic message sign
DSQ	driving style questionnaire
DUI	driving under the influence
FHWA	Federal Highway Administration
HOV	high occupancy vehicle
IRC	Insurance Research Council
MDOT	Michigan Department of Transportation
NCUTLO	National Committee on Uniform Traffic Laws and Ordinances
NHTSA	National Highway Traffic Safety Administration
NSC	National Safety Council
PennDOT	Pennsylvania Department of Transportation
PPRI	Public Policy Research Institute
PSA	public service announcement
SDSU	San Diego State University
SSS	sensation seeking scale
TEE	traffic emotions education
TPB	theory of planned behavior
TRIAD	Targeting Reckless and Intimidating Aggressive Drivers
TTI	Texas Transportation Institute
TxDOT	Texas Department of Transportation

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND SIGNIFICANCE OF RESEARCH

Popular opinion has it that “road rage” is increasingly prevalent and dangerous in the urban driving environment. Whether or not this opinion is based on fact, driver frustration in congested conditions may lead to an increase in aggressive driving, a less intentionally malignant and more common subset of road rage. The research staff believes the potential for significant safety benefits might be realized if transportation professionals had a better understanding of some roadway factors and characteristics of the congested driving environment that induce irritation and perhaps contribute to aggressive driving. For instance, some geometric features may allow (or even invite) aggressive drivers to exacerbate an already difficult congested driving environment by driving on shoulders, cutting in line, weaving unsafely, or performing other erratic driving maneuvers. Likewise, drivers may perceive some recurrent congestion problems to be unnecessary, requiring only slight geometric or signing/stripping modifications to resolve. Frustration that the condition is not being fixed may also contribute to driver impatience. Non-recurrent congestion, unexpected by definition, may be an even greater contributor to driver stress, especially if advance information about construction zones comes too late to choose an alternate route or if there seems to be slow progress in clearing freeway incidents.

1.2 RESEARCH OBJECTIVES

The research staff developed the following three objectives to provide guidance to this project:

1. define and characterize the elements of aggressive driving that relate to driver irritation due to the roadway environment under congested conditions,
2. identify and prioritize the contributory factors for possible mitigation, and
3. develop practical mitigation measures that might be implemented at minimal cost to TxDOT.

1.3 WORK PLAN

The research staff devised a work plan for this project to accomplish the research objectives listed in the previous section. The following subsections provide descriptions of the work tasks contained in the first year of this research:

Task 1. Establish and Periodically Convene Research Project Committee. In order to provide guidance, the research staff established an advisory panel of transportation professionals interested in the project. The advisory panel consisted of representatives from TxDOT (Dallas District and Traffic Operations Division) and the FHWA. The research staff convened this group three times during the first year to provide feedback and direction. For the remainder of this

document the term “research team” will be defined as all individuals associated with both the TTI research staff and the advisory panel.

Task 2. Literature Review. The second task involved updating and expanding a literature review completed as part of an earlier project sponsored by the Southwest University Transportation Center. This effort monitored popular, scholarly, print, and Internet-based literature to assure the relevance of this research within the context of the efforts of others around the nation and world grappling with the issues surrounding road rage and aggressive driving. The research staff paid particular attention to efforts within the traffic engineering community to address aggressive driving.

Task 3. Focus Groups. The third task involved conducting focus groups of Dallas-area commuters. Researchers conducted a total of five focus groups that involved a total of 40 participants. The research staff performed an analysis of the focus groups prior to the start of Task 4.

Task 4. Telephone Survey. The fourth task in year one involved a telephone survey of Dallas-area commuters. Researchers developed the telephone survey instrument based on the results of the literature review and focus groups. TTI staff conducted the telephone survey to document the extent of aggressive driving on a broader basis, that is, to apply the findings from the literature review and focus groups and determine their applicability to a larger driving population (approximately 400 Dallas-area commuters). Researchers analyzed the results of the telephone survey prior to completion of Task 5.

Task 5. Develop Candidate Traffic Engineering Mitigation Measures. The final task in year one involved the development of mitigation measures that have potential for significant improvements in addressing the driver irritation factor in roadway design and operation. The research staff developed the traffic engineering–related mitigation measures with consensus from the advisory panel based on the information obtained during the literature review, focus groups, and telephone survey. Some effort during this task was also spent on consideration of educational- and enforcement-related mitigation measures.

The research staff, during the second year of research, will test selected mitigation measures in field application and in a driving environment simulator when field tests cannot feasibly be conducted.

1.4 REPORT ORGANIZATION

This report is divided into five chapters. [Chapter 1](#), “Introduction,” contains the background and significance of this research, the research objectives, and the work plan utilized to accomplish the stated objectives.

[Chapter 2](#), “First-Year Literature Review Summary,” provides a brief summary of the literature reviewed during the first year of the project. The literature review concentrated on research performed in the previous five years that was relevant to the research objectives. The research

staff dedicated the majority of material in this chapter to the psychological and behavioral aspects of driver stress, aggression, and road rage.

[Chapter 3](#), “Focus Group Results,” explains the results of the focus groups that researchers conducted with motorists in the Dallas area. A brief overview of the purpose, discussion guide, and methodology of the groups is presented in this chapter.

[Chapter 4](#), “Telephone Survey Results,” presents the results of a telephone survey of over 400 Dallas-area drivers. The survey methodology and analysis techniques are also covered.

[Chapter 5](#), “Development of Traffic Engineering Mitigation Measures,” describes all of the potential mitigation measures for reducing the prevalence and impact of road rage/aggressive driving considered during the first year of this project. This chapter provides more detailed information regarding mitigation measures acquired during the literature review. The final portion identifies the three mitigation measures selected by the research team for inclusion in the evaluation and testing phase of the second-year project activities.

CHAPTER 2

FIRST-YEAR LITERATURE REVIEW SUMMARY

2.1 INTRODUCTION

In recent years, references to road rage and aggressive driving have been ubiquitous, appearing with great regularity in the headlines and news articles of the popular press nationally and internationally. A search of general circulation newspapers through the *Lexis-Nexis Academic Universe*® (trademark of 2000 Lexis-Nexis, a division of Reed Elsevier Inc.) provides some indication of the extent to which the press has reported on these issues (1). As shown in Table 1, there were no references to road rage in the 58 newspapers included in the Lexis-Nexis database in 1993. Starting with a modest number of citations in 1994, the term was used increasingly more often until 1998 when 1212 citations were catalogued. Though the number went down in 1999, it is apparent that its use has not faded: in just the first six months of 2000, 541 articles include the term. The use of aggressive driving follows a similar, though less prolific course, apparently peaking in 1999. Texas newspapers appear to have been somewhat slower to print road rage reports, but by 1997 clearly hit their stride.

Table 1. Lexis-Nexis Citations for Road Rage and Aggressive Driving.

Year	Large Circulation ¹ Newspapers		Texas Newspapers ²	
	Road Rage	Aggressive Driving	Road Rage	Aggressive Driving
1993	0	25	0	1
1994	11	11	0	0
1995	176	18	0	0
1996	515	32	12	4
1997	895	97	267	53
1998	1212	119	83	4
1999	1039	130	79	3
2000 (Jan-Jun)	541	61	25	3
Total	4389	493	466	68

News sources searched: ¹Thirty-three U.S. and 25 international newspapers.
²Eight Texas newspapers plus *Texas Monthly*, AP State & Regional, and Video Monitoring Service of America.

A 1998 *Atlantic Monthly* article critical of the media's apparent preoccupation with road rage reports a broader citation search that found even more road rage references (2, p. 12):

In fact, there's been a tremendous proliferation of the term "road rage" itself. It was, apparently, coined in 1988, and appeared in up to three stories yearly until 1994, when it began to catch on. After twenty-seven mentions that year the numbers escalated sharply, to almost 500 in 1995, more than 1,800 in 1996 and more than 4,000 in 1997.

Of course, a simple count of citations does not provide an accurate reflection of the number of unique references; many articles are reprinted in multiple papers. Nor does it constitute an accurate estimate of the frequency of use of these terms in the context of interest here. Note, for example, that 11 of the 25 references to aggressive driving in 1993 (Table 1) relate to motor sports competition, not public driving behavior. More importantly, citation counts likely have little or no relation to the actual incidence of either road rage or aggressive driving. Nonetheless, the growth in the use of these terms and their apparent staying power over several years does suggest at least an increase in media and public concern with these issues, whether or not it coincides with an increase in aggressive behaviors on the road. The widespread attention given to road rage and aggressive driving in the popular media can also be seen to have had a significant, if not always positive, influence in the political, legal, and traffic safety domains.

The review of the literature summarized in this chapter has the following objectives:

- identify current or recent approaches that have been implemented to reduce driver stress and aggression that might be appropriate for further development and testing in the second phase of this project; and
- review and, as suitable, adopt the methods and substance of previously conducted focus groups and surveys addressing aggressive driving to those activities in this project.

Secondary to those goals, the review also serves to provide a very selective overview of some of the theoretical and empirical issues and findings about driver stress and aggression.

The summary provided here first discusses some of the difficulties in defining road rage and aggressive driving. A sampling of some of the theoretical and empirical issues and findings about driver stress and aggression follows. Then, current and previous efforts to reduce driver stress and aggressive driving, including social, behavioral, and educational; enforcement and legislative; and traffic engineering approaches are presented. Finally, previously conducted focus groups and surveys addressing aggressive driving are reviewed.

2.1.1 Definitions

A major problem in assessing the extent to which either road rage or aggressive driving occurs and in determining if they are becoming increasingly prevalent lies in the definitions used to operationalize the terms.

The usefulness of the terms themselves, especially “road rage,” in any scientific or technical sense is suspect, in part because of the inconsistency in usage. Researchers found that confusion and discrepancies in how the term is used are by no means restricted to the popular press. Much of the highway safety technical and practitioner literature also reveals significant inconsistencies and, often, confusion in the definition and application of “road rage,” “aggressive driving,” and related constructs. Like “obscenity,” they seem to defy a widely agreed-upon definition while, at the same time, most people are certain they “know it when they see it.” Judith Stone, president of Advocates for Automobile and Highway Safety, expressed exactly this sentiment at a symposium addressing the scope of aggressive driving, suggesting that an operational definition

of aggressive driving is not needed (3). “Knowing it when we see it” may suffice for communicating the general sense of aggressive driving and road rage. However, the difficulty with the interchangeable, inconsistent, and vague use of terminology becomes apparent when one attempts to make sense of widely reported statements such as:

- “Twenty eight thousand Americans died in 1996 because of aggressive driving.”
- “There are estimated to be close to two billion episodes of road rage per year in our nation.”
- “Eighty-three percent of commercial drivers will be involved with a road rage incident.”

Many writers (2, 3, 4, 5) have made a case for restricting “road rage” to colloquial use or eliminating it altogether.

Ward, Waterman, and Joint propose that rather than road rage, driver aggression should be a focus of traffic safety practitioners (4). They examined, through a series of self-report surveys, what they posit as four commonly held conceptions about road rage, namely that:

- Road rage involves an extreme emotional response.
- Road rage involves violent behavior.
- The amount of violence is related to the emotional response.
- All drivers are susceptible to it.

Ward et al conclude that “road rage” does not appear to be a distinctive phenomena. Use of the term, they argue, may obstruct improvements in traffic safety by:

- distracting attention from more significant safety problems (e.g., alcohol and drug use),
- providing the impetus to formulate dubious safety interventions in the absence of a valid theoretical framework, and
- legitimizing aggressive behavior.

Elliot comes to similar conclusions (5). Based on his examination of the nature and extent of those behaviors commonly labeled road rage he argues that the term should not be used. Among the reasons for decrying the use of road rage, he cites a 1997 report of the Crime Research Center at the University of Western Australia that suggests:

Part of the damage that labels such as road rage may cause is that they blur the boundaries between aggression and violence and allow violence in the context of driving to be seen as spontaneous and justifiable aggression rather than as criminal behavior. For this reason, this report is on driving related violence. Anger (rage) and aggression, will be treated as correlates or precursors of violence rather than as objects of primary interest.

Connell and Joint suggest that:

Part of the “cure” for road rage is that the public's perspective of the problem is restored to realistic proportions. Correspondingly, those areas of road safety that have been proven to be a significant factor in a much greater percentage of road accidents, fatigue for example, should be given greater weight. Disturbingly, there are some indications that attention on driver aggression may be attracting investment and research from other, more important areas (6).

Although the term aggressive driving is not as laden with the sensationalism that often accompanies road rage, it also is subject to a variety of definitions.

Ricardo Martinez, administrator of the National Highway Traffic Safety Administration (NHTSA) has defined aggressive driving as “driving behavior that endangers or is likely to endanger people or property” (7). NHTSA’s definition that “. . . includes a broad spectrum of driving behaviors, ranging from risky driving and escalating to dueling and violence on the road” is broad, indeed (7). Mizell, in a study conducted for the American Automobile Association (AAA) Foundation for Traffic Safety, defines aggressive driving as “an incident in which an angry or impatient motorist or passenger intentionally injures or kills another motorist, passenger, or pedestrian in response to a traffic dispute, altercation or grievance” (8). Alternatively, the State of New York suggests aggressive driving is: “operating a motor vehicle in a selfish, bold or pushy manner, without regard for the rights and safety of other users of the streets and highways” (9).

Mizell’s definition of aggressive driving is more consistent with what is more typically described, by Hohn for example, as road rage, i.e., an intentional, violent act, ranging from a physical confrontation to an assault with a motor vehicle or with a weapon, i.e., a criminal act (10). Though far from unanimous, there appears to be an emerging consensus that road rage and aggressive driving, while sharing certain underlying attributes, are characterized by fundamentally different road-user behaviors and may arise from very different driver motivations and perceptions. Consistent with the suggestions of Ward et al and Elliot, the use of “road rage,” at least in the technical community, appears to be diminishing. When the term is used, it is generally restricted to describing violent criminal acts that happen to take place within the context of the roadway.

Grey, Haworth, and Triggs in their extensive monograph addressing the role of personality, social characteristics, risk, and motivation in driver aggression, propose two definitions of aggression in driving (11):

The first (strong) definition of aggression in driving encompasses more extreme forms of aggression, including any behavior the intent of which was to cause physical and/or psychological harm or damage to oneself, other road users, or property.

The second definition of aggression generally involves less extreme behaviors and encompasses both actual aggressive behavior and aggressive-looking behavior.

The notion of “aggressive-looking” behavior is especially useful in the context of the present project. Most definitions of aggression (whether in regard to driving or other domains) require that the aggressor intends to cause harm. The second definition offered by Grey et al, on the other hand, allows inclusion of driving behaviors that encompass the concept of risk taking without necessarily invoking any intention to do harm. These behaviors are ones in which the driver may neither intend harm nor even be aware that significant risk is involved. Nonetheless the driver performs in ways that may endanger other users of the road. Included under the second definition, therefore, are acts for which the goal is not injury of a victim, but some other motive, including, for example, maintaining a high rate of speed, avoiding congested areas of a highway, or simply getting to work on time.

In addition to the difficulties of defining aggressive driving and road rage as used in the popular discourse and in the research/theoretical arenas, defining these terms has also become an important exercise in the legislative realm. Recent years have seen increased legislative activity addressing aggressive driving that directly influences traffic law enforcement. The research staff addresses the definitional efforts associated with legislative and enforcement activities in the section on reducing driver stress and aggressive driving.

2.2 DRIVER STRESS AND AGGRESSION

While reports in the popular media, and to some extent, the activities of the professional traffic safety community might lead one to believe that stress on the roadway and aggressive driving are new phenomena that have only recently received scrutiny, this is clearly not the case. As cited in an Insurance Institute for Highway Safety Status Report (12):

Back in 1915, *Engleman’s Autocraft* noted that “some automobilists abuse their rights and heedlessly run over the rights of others.” And from a 1937 textbook: “Control the desire to get ahead of the other fellow ... A good driver never permits himself to become angry. Anger frustrates good judgment.”

Despite serious definitional problems and the somewhat arbitrary use of road rage and aggressive driving recently, there exists a large body of literature addressing these issues. The review of this literature provided here does not attempt to be comprehensive. Rather, it is directed at providing an overview of some of the theoretical and empirical issues and findings that may assist in moving toward the ultimate goals of the present project. These goals are to identify the pertinent factors that increase driver impatience, irritation, and stress in the congested urban environment that may be precursors to aggressive behaviors on the road and to identify, develop and test mitigation measures; especially traffic engineering measures that can be implemented without

major infrastructure changes. In order to develop measures that have the potential to influence driver behavior, it is useful to understand some of the behavioral mechanisms and psychological characteristics that mediate such behavior.

In a 1980 review article, Bliersbach and Dellen address the psychosocial factors of driving, based largely on 2-3 hour in-depth interviews of 230 drivers commissioned by the German Federal Institute for Road Research from 1972 to 1973 (13). The purpose of the surveys was to explore drivers' "awareness of other drivers, their fears, conflicts and manners." Five driving patterns based on drivers' behaviors on the road were derived from the survey data. They can be characterized as:

- The driving pattern of the "thrill," characterized by, for example, driving at high speed to test the limits of both the car's and their own capabilities.
- The "power display" pattern. Like the "thrill," drivers who exhibit this pattern derive pleasure in displaying the capabilities of their cars. In this case, however, pleasure comes not from the risks associated with particular driving behaviors, but rather with the demonstration of power and demand for respect.
- The "self-testing" pattern is distinguished by the tendency to measure oneself against other drivers in order to confirm one's own competence. Drivers exhibiting this pattern always try to "outsmart" other drivers. Here, behaviors such as quick lane changes, or passing on the shoulder, for example, are not undertaken for the thrill or to exert power, but rather to demonstrate that one can cope with traffic better than others can.
- Drivers exhibiting a pattern of "smoothly driving along" are primarily concerned that no obstacles appear in their paths. A "peaceful, easy, and relaxed journey free of complications with other drivers" is the goal.
- The ideal of the "piloting" pattern is to cope with traffic as masterfully—and as close to the rules—as possible. Bliersbach and Dellen suggest this pattern is distinguished by the realization that one has nothing to gain over other drivers in traffic, a belief in one's own driving competence, and the perceived ability to understand other drivers' intentions.

Individuals exhibiting different patterns of driving may display very similar behaviors (including many that can be characterized as aggressive), but they do so from quite diverse motivations, personality traits, and interactive styles. Further, they tend to interpret others' driving behaviors from their own perspective.

The importance of recognizing the variety of driving patterns motorists bring to the road lies not in specification of the precise proportions of drivers who may exhibit these driving patterns, nor even in assuming that they are correctly characterized. Rather, it serves to caution us that measures taken to modify driver behaviors, including measures based on traffic engineering, are

likely to be met with very different responses by different drivers, depending on their underlying driving styles.

It appears that the long history of investigations searching for personality traits that can predict accident involvement (e.g., the now generally discarded theory of “accident proneness” that held that a relatively small number of individuals are responsible for a large proportion of crashes due to some undefined, fixed personal characteristic) has been replaced by efforts to discover driving styles and decision-making styles that can account for differential accident involvement. The concept of “differential accident involvement” differs from “accident proneness” in that it assumes individuals vary along a continuum on factors affecting their risk of crashes (14,15,16).

For example, French et al report on the development and application of a decision-making questionnaire (DMQ) and a driving style questionnaire (DSQ) (14). Analysis of the responses of more than 700 drivers, stratified by age, sex, annual mileage, and accident involvement, to both questionnaires, revealed six independent dimensions of driving style and seven dimensions of decision-making. Multiple regression analyses were then employed to model the role of decision-making style and driving style in the incidence and causation of crashes. The results of these analyses indicated that drivers under 60 years old who scored low on the decision-making dimension of “thoroughness” were at greater risk of traffic crashes and faster driving exacerbated this relationship. That is, subjects scoring both low on thoroughness and high on the driving style dimension of “speed” tended to have more crashes.

In reviewing these types of studies, Parker et al suggest that the tendency to commit driving violations, engage in fast driving, and lack thoroughness in decision-making are reliably associated with increased crash risk (17).

Representative of this type of investigation is the complex series of studies of aberrant driving behavior employing self-report questionnaires, in-car observations and structured in-person interviews reported by Reason et al (18). They determined that drivers who report a high level of violations while driving tend to be over-represented in accidents, but that there is no significant association between self-reported driving errors and accident involvement. “Violations” as used by Reason, are defined as deliberate deviations from safe driving practices. These include violations of specific traffic laws (e.g., running red lights) but also encompass behaviors such as risky passing, maneuvering without due regard for other traffic, tailgating, and giving chase to other vehicles when angry. “Errors” comprise unintentional driving mistakes such as getting into the wrong lane, braking sooner than necessary, and misjudging a crossing interval.

The studies of French and her colleagues and those of Reason and his colleagues at the University of Manchester Driver Behavior Group share many similarities in technique. They differ however, in that the Manchester group generally conducts its studies in the context of the Theory of Planned Behavior (TPB) as illustrated in Figure 1.

The three core, independent, direct predictors of behavioral intentions (willingness to commit a specific behavior) and of the observable behaviors themselves are attitudes toward a behavior, subjective norms about the behavior, and perceived control over undertaking or refraining from a behavior (19, 20). Attitudes are the individual’s evaluation of performing a particular behavior,

including the beliefs a person has about the consequences of some behavior and the perceived benefits and penalties resulting from the behavior. Subjective norms describe the perception that an individual has of other peoples' beliefs about a behavior, that is, the extent to which people important to the individual are believed to approve or disapprove a behavior. Perceived behavioral control refers to the individual's beliefs about the degree of control over the behavior, i.e., the extent to which he/she feels capable of refraining from the behavior.

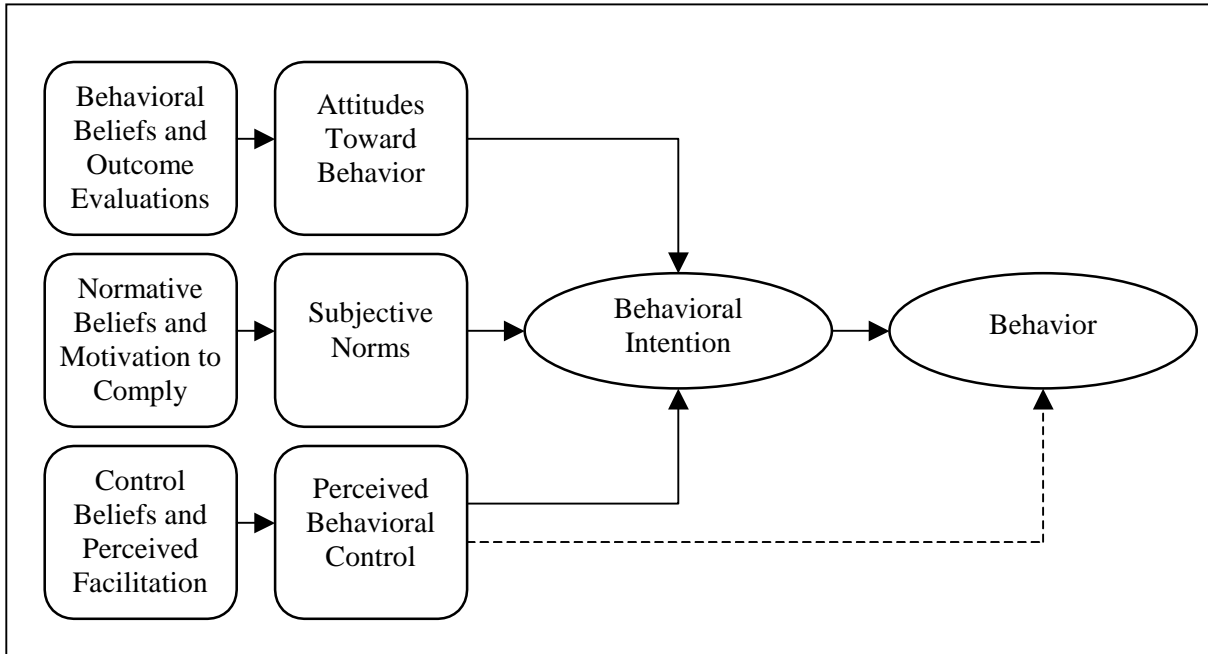


Figure 1. Theory of Planned Behavior (adapted from Ajzen-89, cited in Forward-97 [19]).

In addition to the previously noted study by Reason et al (18), the TPB is reported to successfully predict speeding, dangerous passing, close following, and lane discipline (19, 21,22, 23). The issues raised by theoretical formulations such as TPB become important when considering the types of countermeasures to unsafe behaviors that will be likely to succeed. TPB suggests that interventions that alter the perceived benefit of, for example, delaying merging to the open lane in a lane drop situation in order to maintain a faster speed longer, can be successful in effecting change in that behavior.

Among the literature investigating personality as an underlying causal factor in driver behavior, a considerable portion examines the relationship between risky driving and sensation seeking. Zuckerman, cited in Jonah, characterizes sensation seeking as “a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences and the willingness to take physical, social, legal, and financial risks for the sake of such experiences” (24). Operationally, sensation seeking is defined on the basis of scores on Zuckerman’s Sensation Seeking Scale (SSS), first published in 1964. There is at least a conceptual similarity between sensation seeking and the “thrill” driving pattern of Bliersbach and Dellen (13). Unlike the SSS, however, the thrill pattern has not been subjected to reliability and construct validity testing.

Jonah reviewed 40 studies examining the relationship between risky driving and sensation

seeking (24). Of these, only four did not report a significant positive relationship between sensation seeking and some aspect of risky driving. A majority of the studies reviewed focus on drinking and driving. Though much less frequently, other risky driving behaviors (e.g., non-use of seatbelts, speeding, lane changing, etc.) have been studied. Only the most germane to the present project, as reported and reviewed by Jonah, are noted here.

Arnett, Offer and Fine, in a 1997 study, report high school students scoring higher on a sensation seeking scale were more likely than low sensation seekers to admit to driving over 80 mph, racing other drivers, and passing in no passing zones.

In a Dutch study (1992) of 103 male drivers, Heino, van den Mollen, and Wilde found that high sensation seekers were more likely to report speeding on urban streets and highways than drivers scoring low on sensation seeking. In addition to self-reports, this study also measured following distances (headway) on a 36 km route between two cities. When free to select their own following distances, high sensation seekers chose shorter distances than low sensation seekers (1.19 seconds and 1.87 seconds, respectively). Despite allowing less headway, high sensation seekers did not perceive the risk of collision to be any greater.

In a 1989 study using a driving simulator, McMillen, Pang, and Wells-Parker measured lane changes, cars passed, and amount of time at maximum speed of 94 college students as a function of alcohol consumption, alcohol expectancy, and sensation seeking. Overall, low sensation seekers passed fewer cars and changed lanes less frequently than high sensation seekers. A significant interaction was evident between sensation seeking and alcohol expectancy. High sensation seekers who thought they had consumed alcohol passed more cars and changed lanes more often than did high sensation seekers who did not believe they had been drinking alcohol, regardless of the actual amount of alcohol consumed. Low sensation seekers who believed they had ingested alcohol took fewer risks compared to low sensation seekers who believed they had no alcohol.

Wilson and Jonah report that the thrill and adventure seeking sub-scale of the SSS combined with a measure of impulsivity was a major predictor of risky driving among drivers convicted of driving under the influence (DUI), high-risk drivers, and a sample of otherwise undefined licensed drivers.

Based on his review, Jonah concludes that it is evident that sensation seeking is moderately related to risky driving though the psychological mechanisms through which sensation seeking influences driving is unclear. The studies noted here suggest that it may be prudent to consider screening subjects for sensation seeking in the simulator studies planned to assist in the evaluation of proposed countermeasures for the present project.

Aggressive driving behaviors themselves (as will be shown in the sections on current countermeasures) may be amenable to modification through approaches that are based on educational, therapeutic, or other behavioral approaches and may be responsive to some degree of control by means of targeted enforcement programs. With some important exceptions, however, it is less likely that traffic engineering or other modifications to the driving environment will be successful in directly influencing aggressive behaviors. They may, however,

be very useful in ameliorating driver impatience, irritation, and stress. To the extent these are precursors to potentially aggressive behaviors, such measures have a reasonable chance to influence those behaviors indirectly.

Like road rage and aggressive driving, driver stress is subject to multiple definitions and interpretations. Hans Selye, an endocrinologist, first introduced the concept of “stress” in 1936 (25). In Selye’s original conception, stress described a group of physiological effects that resulted from a number of different stimuli that were noxious or aversive (26). Psychologists were quick to adopt the concept and the general consensus seems to be consistent with Cox’s view that stress “refers to a complex psychological state deriving from the person’s cognitive appraisal of their adaptation to the demands of the environment” (27). Cox argues that to evaluate stress, one needs to know:

- the demands on the individual (essentially workload),
- their individual characteristics, skills, and their ability to meet those demands,
- the constraints they are under when attempting to cope with stress, and
- the support they receive from others.

A useful way to view stress in the context of driving, consistent with the definition above, is provided by Sadalla as shown in Figure 2 (28). Being an individual psychological state, there is no absolute measure of stress or of the effect of a given stressor. The stress experienced as a function of a particular stressor will depend on the number, rate, and difficulty of the current demands on the driver when the stressor is introduced. Increase in workload can directly influence the driver’s performance, but can also serve to increase driving stress, which may in turn impact driving performance, usually negatively. The driver’s cognitive skills (or deficits), personality variables, and, Cox would add, the social support received by the driver, will affect the degree of stress experienced by the driver. It is also possible that the driver may reduce the stress experienced by changing his perception of the stressor or of himself (27).

Despite the general consensus, there is still less than unanimity on the definition of stress. The primary challenge comes from arousal theory. Weiss, cited in Robertson and Southall, for example, considers stress to be a reliable characteristic of the arousal response. As such it can be defined as a psycho-physiological change away from homeostasis, occurring in body systems, cognitions, or behaviors (29).

In addition to the theoretical implications arising from competing definitions of stress, there is also the practical matter of stress measurements. Cox and others suggest that, on theoretical grounds, there can be no direct physiological measure of stress, while arousal theorists would argue that direct physiological measures are obtainable (27). However, even those who view stress as strictly an individual psychological state will concede that physiological correlates of stress do exist and can be useful in specific, well-defined situations.

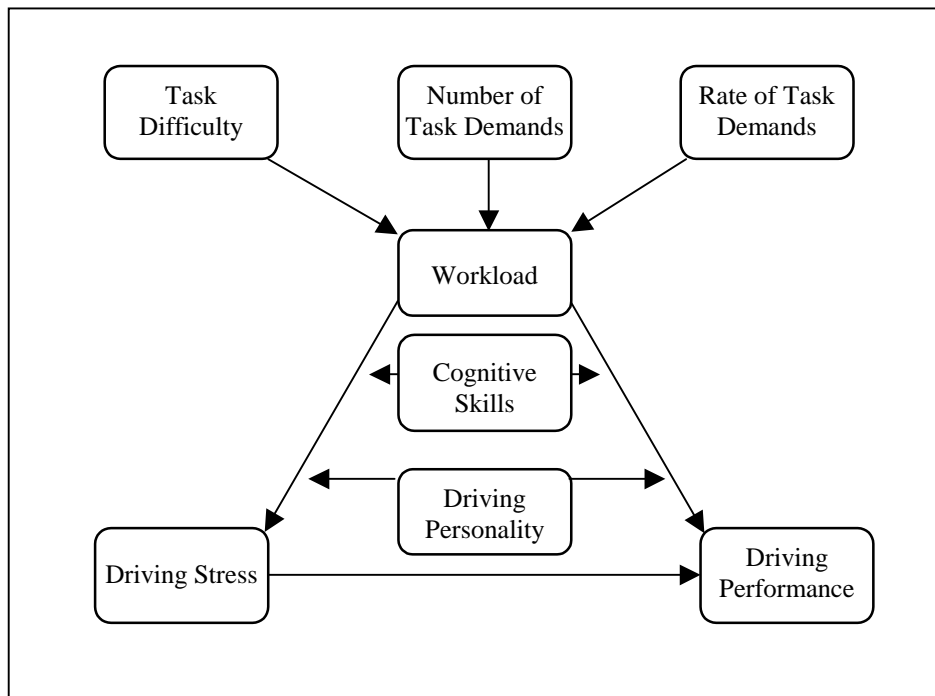


Figure 2. Relationship Between Workload, Cognitive Skills, Personality, Driving Performance, and Driving Stress (adapted from Sadalla, 1995[28]).

A variety of measures have been used as indicants of stress in empirical efforts, but their use varies widely among different investigations. Robertson and Southall report an attempt to identify physiological, psychological, or behavioral measures that would be sufficiently sensitive to the low levels of stress typically encountered in normal driving. Potential measures, for monitoring stress, selected from a review of the literature, are provided in [Table 2](#).

Table 2. Candidate Measures for Monitoring Stress.
Physiological Measures
Adrenal hormones (catecholamines: adrenalin and noradrenalin)
Heart rate (variability)
Sinus arrhythmia
Respiratory rate
Blood pressure, systolic and diastolic
Electromyography: measurement of tonus of facial muscles, trapezius
Galvanic skin response
Oculomotor activity
Psychological Measures
Self-reports of perceived mismatch between demand and driver's capacity to cope
The Stress-Arousal Checklist: defines experience of stress in terms of mood-describing adjectives
Visual Analog Scales for general driving behavior inventory
Behavioral Indices: Specific changes in observable driver behavior
Grip Strength: Measured via instrumented steering wheel rim or EMG forearm muscle activity
Blink Rate: video recording of facial activity while driving
Body posture
Source: Robertson and Southall, 1992 (29).

Combinations of candidate measures were employed in tests conducted on a simple driving simulator and in the road tests. The results of the tests conducted by Robertson and Southall in a simulator failed to produce any reliable physiological or subjective measures of the low levels of stress in which they were interested. Similarly, none of the measures employed in the on-road trials proved sensitive to the low levels of stress used in their study. They conclude that without invasive equipment that would be very difficult to use on a large number of subjects or by researchers without substantial medical knowledge and training, low levels of stress are very difficult to measure reliably. Subjective measures of stress and arousal such as provided by the Stress-Arousal Checklist may prove sensitive enough with large numbers of subjects in repeated trials. They also suggest that mean heart rate over the duration of a drive and the coefficient of variation of heart rate also be used, since such measures are easily obtained. It is possible that in situations where higher levels of stress are employed additional measures, whether employed in simulation or on the road studies, may be more useful than Robertson and Southall found them to be in under very low stress conditions.

Since at least 1988, Gulian, Matthews, and their colleagues have conducted an extensive series of investigations of driver stress (30, 31, 32, 33, 34, 35, 36, 37). These studies have been aimed both at the development and validation of the Driver Behavior Inventory as an approach for measuring driver stress and at exploring various dimensions of driver stress. Their work is based on a transactional view of psychological stress in which the outcomes of an individual's exposure to stressful situations is attributed to a person's changing cognitions about the stressful encounter. Of particular importance is the appraisal of one's personal capacity to cope with external demands and the selection of specific coping strategies. These strategies can be directed either towards changing one's own thoughts and feelings (emotion-focused coping) or towards influencing the environment (problem or task-focused coping). In this view, "the key causal factors in driver stress are the driver's appraisals of the demands of the traffic environment (including other drivers), appraisals of personal competence, and the choice of coping strategy" (35). The model employed in their studies is illustrated in Figure 3. It is particularly useful for conceptualizing the relationship between driver stress and potentially aggressive or otherwise dangerous behaviors.

An area of interest to the current project that has received significant attention in the popular and technical literature is the relationship between traffic congestion and driver stress and behavior. Of interest are both the immediate effects in the driving environment and the potential long-term effects on health. Much of the work in this area is very speculative and appears to be directed toward supporting particular political or social agendas. There are, however, some studies of note. For example, Novaco and his colleagues at the University of California, Irvine have examined the effects of congestion since the late 1970s (38, 39, 40). Their work employs the concept of traffic "impedance." Signifying a constraint on movement and goal attainment, commuting trips can be characterized along a continuum of impedance. Both physical and subjective impedance are discussed. Physical impedance takes in to account the distance and duration of the trip, the number of roads and freeways traveled and the time of day. Subjective impedance relates to the subjective responses of drivers to their commutes. Novaco et al evaluate stress by changes in blood pressure by responses to clusters of questionnaire items in various formats. Among the findings from their work, they note:

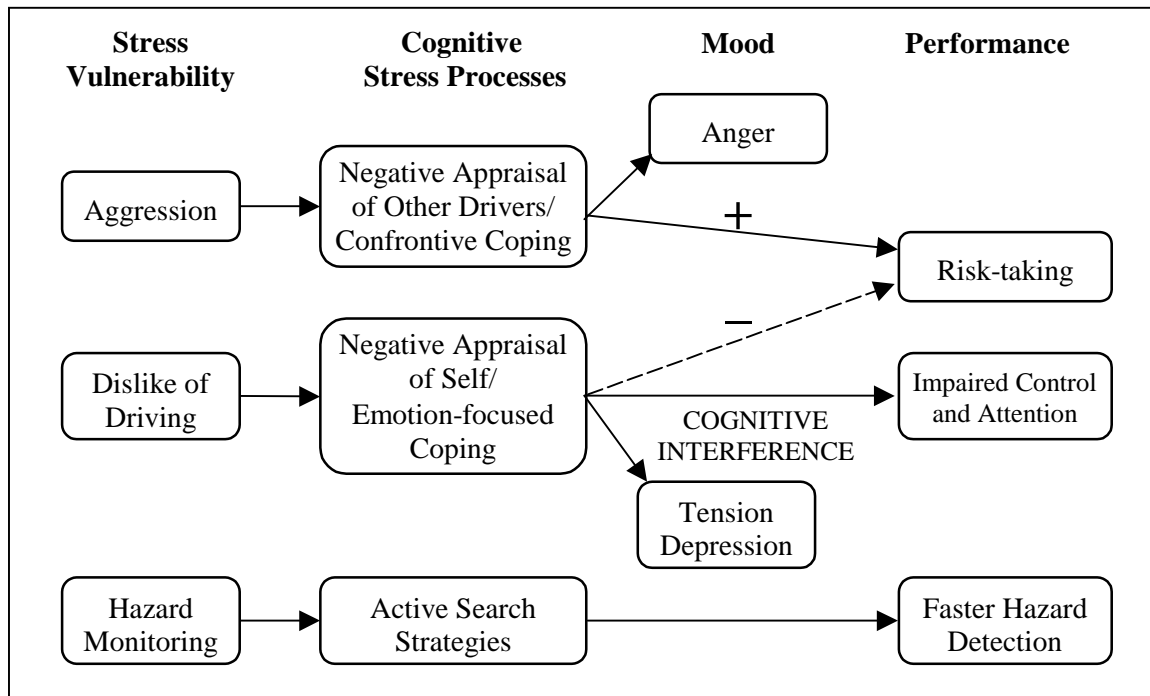


Figure 3. A Transactional Model of Driver Stress Traits and Their Effects on Cognitive Processing, Mood State, and Behavior (adapted from Matthews *et al*, 1998 [35]).

- Commuting distance is directly related to blood pressure—the longer the distance the higher the commuter’s blood pressure.
- High physical impedance is related to lower frustration tolerance, negative mood at the workplace, and absenteeism.
- Increases in negative mood (tension, nervousness, impatience, and irritability) are associated with a congested commute, but positive moods appear unaffected.

Echoing the cautions of other stress researchers, Novaco points out that the specific psychological and physiological effects of chronic exposure to traffic congestion are not obvious. Control for numerous other factors (e.g., physical characteristics, income, education, and home life, work environment) is necessary before observed stress among commuters is attributed to commuting (40).

2.3 REDUCING DRIVER STRESS AND AGGRESSIVE DRIVING

Despite difficulties in defining exactly what constitutes road rage, aggressive driving, and driver stress, and in ascertaining either their frequencies or rates of occurrence, there has been no lack of effort to develop countermeasures. Many of the same approaches that have long been employed to encourage better driving, enforce traffic laws, and design safe and efficient highways are applicable to reducing driver stress and aggression on the road. Nonetheless, a

number of new or modified approaches and programs have been targeted toward aggressive driving. Some of these are discussed in this section. Based on their underlying orientation, most of these efforts can be classified as:

- social, behavioral (including psychological and psychiatric interventions), and educational,
- enforcement and legislative activities, or
- traffic engineering/road design approaches.

Samples of the efforts and programs in each of these areas are provided here. It should be noted that there is often not a distinct dividing line between the types of approach employed. Thus, some elements of each of the general approaches may be applied in a single program.

2.3.1 Social, Behavioral, and Educational Approaches

There are many examples of government agencies, highly regarded traffic safety organizations and publications, and individuals that have provided advice on how to recognize and deal with aggressive driving or road rage in others or oneself. This advice is promulgated through books, newspaper and magazine articles, pamphlets and other public information and education materials, and entire websites.

Among the safety materials produced by the National Highway Traffic Safety Administration is a pamphlet (also available on the Internet) titled *Aggressive Driving: Help Get the Word Out* (41). Included is a self-administered test to “see if you may have developed some habits that could be adding to the aggressive driving atmosphere.

The New York State Department of Motor Vehicles website, like many others, contains in its “Safe Driving Tips” section “basic things that you can do to reduce your chances of ever becoming involved in an aggressive driving or road rage incident.” Also included are descriptions of behaviors likely to provoke aggression and tips for reducing stress (42).

The AAA Foundation for Traffic Safety distributes *Road Rage: How to Avoid Aggressive Driving* both as a full color pamphlet and on its website (43).

The National Safety Council (NSC) offers a training program for self-study or classroom use (*Driven to Extremes*) designed to help individuals recognize the symptoms of aggressive driving. NSC also sells a video “packed with information drivers need to know about maneuvering safely in today’s stressful and often dangerous driving environments. It reviews common situations that can trigger conflicts between drivers, and offers drivers practical tips for building a “Road Rage” defense ... including how to avoid becoming a victim of other drivers’ “road rage” and how to control one’s own anger while driving” (44).

The small sample above serves to indicate the types of materials and products available from a few of what might be considered ‘traditional’ traffic safety information sources.

In addition to the traditional sources of information and educational materials, recent years have seen a virtual cottage industry in aggressive driving-related books, advice, tests, surveys, and recommendations for therapeutic interventions, especially on the Internet and in the popular media. Some of these sources do provide sound advice and information based on reputable and technically solid approaches. Others appear primarily to exist for the sale or promotion of products and services. No attempt is made here to evaluate the three resources cited below. They are noted only as examples of some of what is readily available in the bookstore, on websites and through professional services; neither endorsement nor indictment is implied.

Steering Clear of Highway Madness includes identification of belief systems said to be common in varying degree to all drivers. They are noted below along with a phrase that summarizes their central theme:

- Speeder—"make good time";
- Competitor—"be No. 1";
- Passive-Aggressive—"try and make me";
- Narcissist—"they shouldn't allow it"; and
- Vigilante—"teach'em a lesson".

The author emphasizes cognitive therapy and behavioral modification techniques to foster changes in behaviors associated with aggressive driving (45).

Among the most prolific advisors offering advice, information, publications and services on the Internet are psychologists Leon James and Arnold Nerenberger. Both have massive websites that include a broad range of information and advice for recognizing and dealing with aggressive driving (46, 47).

2.3.2 Traffic Engineering and Roadway Design Approaches

Broad-based public education, individual therapeutic interventions, and targeted enforcement all have received a great deal of attention as potential means for reducing aggressive driving, while engineering and technology-based approaches have generally received less emphasis. This may be because aggressive driving is often viewed only in terms of the specific behaviors identified as being aggressive without consideration of the antecedents to such behaviors. It is those antecedents that may be most amenable to traffic engineering, road design, and other technological countermeasures.

Advocates of the development of automated highway systems suggest that the ultimate in advanced roadway design—truly automated highways—could solve all of the problems associated with driver behavior by taking the driver out of the control loop. Shladover addresses this issue in a paper summarizing the reasons he believes the development of the automated highway

system (AHS) should continue despite concerns about its feasibility and desirability. Recognizing the problems attributed to drivers in the loop, Shladover says:

Driving on freeways in major urban areas, especially during commute periods, is a stressful activity for most people. It requires both mental effort and manual dexterity, and the consequences of poor performance (either mental or physical) can be severe indeed. The normal dynamics of traffic flow in congested conditions can require very fast reactions to avoid crashes (particularly at the tail end of a shock wave). The abnormal driving behavior of “bad” drivers that drive too fast, too slow, or too aggressively (cutting off other drivers, weaving in and out of lanes, etc.) makes the problem even worse (48).

Shladover points out that, unlike vehicles dependent on human control, the performance of AHS vehicles is consistent from day to day. They neither slow down to take a closer look at incidents, nor are they affected by emotional state or chemical dependencies. Thus, many of the causes of crashes and/or poor traffic dynamics would be eliminated when vehicle control is automated. While conceptually compelling and perhaps even visionary, pursuit of the goals of fully automated systems, as posited by Shladover, obviously has little near-term impact on the problems experienced with road delay.

Other less far-reaching approaches to road design have been addressed in the literature. Retting, for example, summarizes efforts to classify urban vehicle crashes and offers a review of engineering countermeasures (49). Unfortunately, most of the countermeasures he discusses are directed at right-angle intersection-related crashes and may not be especially pertinent to the freeway-oriented emphasis of the present project. Also, except for speed-related and “ran-traffic-control crashes,” most of the crash analyses on which his work depends appear to exclude crashes involving drivers who were driving recklessly or exhibiting other behaviors that might be included under the stressful or aggressive driving rubrics.

Robertson and Ackert et al provide examples of two efforts to design and/or evaluate roadways in relation to driver stress. In a 1988 study conducted for England’s Department of Transport, Robertson attempted to determine the extent to which driver stress is used as a factor in the process of road design and appraisal (50). Based on responses to requests for information from a variety of academic transportation researchers and national transportation agencies in 16 countries, Robertson reports that there was widespread interest in incorporating knowledge about driver stress and related concepts in the road design and evaluation process. Though some concrete examples are offered (respondents from several countries cited the use of limits on some road design features, e.g., horizontal and vertical curvature that are derived in part from studies of driver stress), little definitive information was provided.

Very recently reported work by Ackert et al is promising in that it provides an approach to evaluating driver stress attributable to characteristics of the roadway (51). Shown conceptually in Figure 4, the method devised by Ackert et al has been used successfully in predicting driver stress from known roadway geometric features, lane guidance devices, and aspects of the surrounding area. Unfortunately, at the current level of development, the methods are applicable

only to rural roadways. Application to the urban area roads and highways of interest in the present project would require further, and likely more complex, development.

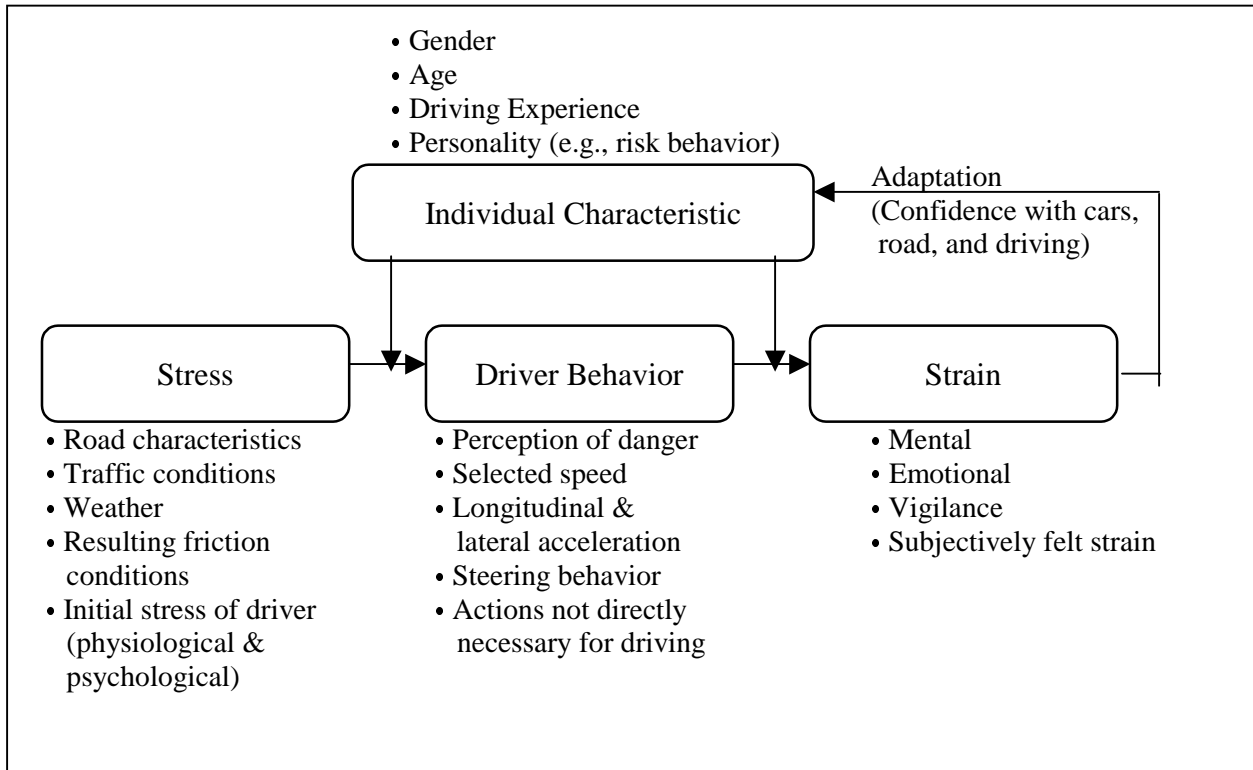


Figure 4. Concept of Driver’s Stress and Strain (adapted from Ackert, *et al* 2000 [51]).

The current lack of predictive capability does not, however, negate the usefulness of this model for conceptualizing and understanding other work. Parsons et al, for example, explored the impact of the character of the roadside environment on stress. Viewing built-up, strip-mall style roadside environments was found to slow down recovery from stressful situations. Drivers exposed to roadside nature scenes returned to baseline measures of physiological stress indicators faster. Exposure to natural roadside settings decreased the magnitude of response to a later stressful task, suggesting an “immunization effect” (52).

Design and roadway engineering approaches to reducing driver stress and aggression that require major infrastructure modifications are less germane to the present project than relatively modest traffic control techniques that have potential for ameliorating traffic flow and congestion problems. Particularly relevant is the “late merge” approach to work zone traffic control as reported by Pesti et al (53, 54). This traffic control strategy aims to reduce the length of queues that often develop when more conventional traffic control plans are implemented at freeway lane closures and traffic demand exceeds capacity. This approach is discussed in detail in Chapter 5. The issue of driver response to and acceptance of such traffic control approaches is also considered in that chapter.

2.3.3 Enforcement and Legislative Approaches

In addition to the difficulties of defining aggressive driving and road rage as used in the popular discourse and in the research/theoretical arenas, defining these terms has also become an important exercise in the legislative realm. Recent years have seen increased legislative activity addressing aggressive driving that directly influences traffic law enforcement. [Appendix A](#) provides a comprehensive review of recent legislative and enforcement activities on aggressive driving and road rage obtained during the literature review.

2.4 FOCUS GROUP AND SURVEY RESEARCH

The research team devoted a significant part of the effort in the present project to the development, planning, and execution of a series of focus groups and a telephone survey of Dallas-area commuters. Researchers reviewed a number of related efforts addressing similar issues as part of the planning for the work undertaken in this project.

Many focus groups addressing a broad spectrum of issues related to road rage and aggressive driving have been conducted in recent years. Participants in such groups, varying as a function of the groups' goals, have ranged from people with specific professional interests in the topic, e.g., law enforcement personnel, insurance executives, driver training teachers, etc., to members of the general driving public. Typical of those groups tapping the views of “special interest” populations was a group organized by the National Public Safety Learning Center in Canada (55). This group emphasized establishing a definition of road rage and its symptoms, identifying countermeasures, and recommending strategies for dealing with it. Calls for legislation and enforcement of specific driving actions, improvements in driver training, and public education and information/campaigns about driving etiquette, driving style, and traffic safety in general were some of the countermeasures discussed.

In a series of groups conducted by the Media and Injury Prevention Program at the University of Southern California, “...two thirds of drivers said they reacted to frustrating situations aggressively. Almost half admitted to deliberately braking suddenly, pulling close to the other car, or taking some other potentially dangerous step. Another third said they retaliated with a hostile gesture” (56).

Most pertinent work to the present project is a series of focus groups conducted among drivers of the Capital Beltway in the metropolitan Washington D.C. area in 1994, 1995, and 1997 (57, 58). These groups have particular relevance because they focus on the attitudes, beliefs, and perceptions of drivers, many of whom are regular commuters who drive on a high-volume freeway in a large metropolitan area.

The first two waves of the Beltway focus groups were conducted to get driver input about recommendations contained in a Washington-area safety initiative (1994) and to obtain feedback on specific public service announcements (1995). The eight groups conducted in 1997 are of particular interest. In addition to reassessing drivers' perceptions of problems experienced on the Beltway and assessing their reactions to a Washington-area enforcement program, these groups specifically explored the topic of aggressive driving. Participants in three of the 1997 groups

comprised the general population of Beltway drivers. Participants in two of the groups were selected as representative of aggressive drivers, based on their responses to a series of screening questions. Intended to measure anger, impatience, competitiveness, and vindictiveness in driving situations, the screening items were derived from a driver stress profile included in a popular book on aggressive driving (58). The remaining three groups were made up of commercial truck drivers.

In both 1994 and 1997, group participants considered driving behaviors perceived as unsafe, including excessive speed, aggressive driving, inattention, unsafe lane changing, and tailgating, to be the major causes of crashes. The major difference between the responses of 1994 and 1997 participants was a significant increase in the perception that aggressive driving is a major contributor to crashes, up from only 2 percent in 1994 to 38 percent in 1997. The authors note that the relative decrease in participants' citing congestion as a causative factor in crashes and the increase of concern with aggressive driving may be due in part to the then current concern with unsafe driving, presumably a reference to media attention. Among 1997 participants, driving conditions, including bad weather and congestion, were the second most frequently indicated area of concern with regard to accident causation, followed by roadway design and maintenance issues, trucks, and law enforcement (or lack thereof). Though not ranked highest in relation to accidents, both general drivers and truckers cite congestion as the factor most disliked about the Beltway.

Differences were evident between responses provided by the aggressive driver groups and those made up of general drivers. While both categories of participants tended to blame much of the unsafe driving observed on the "other" driver, it was reported that:

General groups expressed dismay at specific unsafe driving maneuvers that make them nervous on the Beltway—the drivers who speed, change lanes frequently, cut them off, and force their way ahead. Aggressive drivers, on the other hand, blame those who are going too slow in the passing lane, cars at the speed limit who "force" them to change lanes and weave in and out of traffic (58).

Each of the 1997 groups discussed possible solutions for the highest ranked perceived causes of crashes. Among the suggestions offered by participants to help solve problems associated with aggressive driving were:

- photo imaging aggressive drivers;
- more enforcement campaigns like "Smooth Operator;"
- more law enforcement presence on the road;
- more enforcement vehicles cruising, fewer stopped on the shoulder;
- more emphasis on unsafe driving, less on speed and minor violations; and
- tougher sanctions on repeat violators.

Countermeasures suggested for unsafe lane changing included:

- more law enforcement presence,
- “Keep Right” education and enforcement,
- public information and education on dangers of unsafe lane changes, and
- courtesy campaigns.

Numerous local, regional, and national surveys and polls, many of them web-based, addressing issues associated with road rage and aggressive driving have been conducted in recent years. Although interesting, and in many cases, glib, most of the web-based surveys suffer from fatal flaws related to sampling that negate much of their usefulness in any technical sense.¹ To their credit, many of these survey efforts do not make any claims about the statistical validity necessary for generalizing their results. Among the numerous Internet sites that include surveys related to aggressive driving are those of the American Association of Retired Persons (see their 1998 “Road Rage and Street Sense” questionnaire [59]) and the abundant online presence of Leon James, the self-styled “Dr. Driving” (60).

Several survey projects, some of which were used in developing the telephone survey conducted as part of the present project, are notable. The results of a telephone survey conducted of a proportionately representative, random sample of 1008 Canadian residents, 18 years of age and older, in 1999 and again in 2000 suggests that Canadians perceive aggressive driving to be on the rise; 73 percent of respondents felt that the incidence of aggressive driving in Canada is increasing. Further, 85 percent admitted to committing at least one act of aggressive driving. However, the behaviors respondents were least likely to characterize as aggressive were the same ones that those drivers admitted to committing on the road (61). The percentage of the sample that believed selected driving actions are aggressive is indicated in Table 3.

In 2000, 71 percent of respondents to the telephone survey believed that the primary cause of aggressive driving is stress (67% in 1999). As defined in this survey, stress includes people being in a hurry, experiencing pressure/anxiety or frustration, and/or or feeling impatient.

Twenty-one percent of the 2000 sample perceived aggressive driving to be the primary cause of most vehicle-related accidents on the roads today. Consistent with 1999, aggressive driving was second only to driver inattention and ahead of impaired driving as the primary reason for crashes.

¹ Note that a distinction should be made between “web-based surveys,” i.e., survey instruments that are completed online by self-selected visitors to publicly accessible websites and “web-reported” surveys (or other online documents), i.e., surveys that are reported, not conducted, on the web.

Table 3. Behaviors Perceived as Being Aggressive by Canadian Drivers.

Aggressive Behaviors	Percent of Sample	
	1999	2000
Tailgating	99	93
Passing on the shoulder of the road	88	87
Making rude gestures	86	87
Pulling into a someone else's parking space	80	82
Changing lanes without signaling	75	73
Flashing high beams at car in front	74	72
Drive through yellow lights turning red	69	69
Merge at last second with traffic on highway	73	66
Speeding (20 km/h or more over speed limit)	65	65
None of above	n/a	1

Source: Antonopoulos & Whelpley (61)

In September and October 1997, the Insurance Research Council (IRC) commissioned a telephone survey of the U.S. national adult population (sample size = 1000) that included a series of questions designed to gauge drivers' opinions about the apparent increase in aggressive driving. Aggressive driving was defined for this survey as "excessive speeding, rapid lane changing, tailgating, flashing lights, running a traffic sign or signal, or attempting to pull in front of another car in a reckless manner" (62). Respondents judged the extent to which eight possible contributors to aggressive driving are factors in aggressive driving behaviors. Percentages of the sample who believe each item is a "major factor," "minor factor," "not a factor," or "don't know" are provided in Table 4 (62).

Table 4. Perceptions of Contributors to Aggressive Driving.

Contributor	Major Factor (%)	Minor Factor (%)	Not a Factor (%)	Don't Know (%)
Decline in consideration for others	74	21	4	1
Traffic congestion	65	26	7	2
Others drive that way	65	28	6	1
Stress	63	29	5	3
Road construction	43	43	14	1
Longer commutes	41	39	15	5
Road design	37	43	19	1
Higher speed limits	35	34	28	2

Source: Public Attitudes Monitor Survey 1997 (62)

Interviewers also asked how frequently respondents had observed "acts of dangerous or aggressive driving." Table 5 provides the percentages of the sample who have seen each behavior "very frequently," "somewhat frequently," "not too frequently," and "not much at all".

Table 5. Frequency of Observing Dangerous or Aggressive Driving.

Driving Act	Very Frequently (%)	Frequently (%)	Not Too Frequently (%)	Not Much at All (%)
Excessive speeding	58	24	11	6
Tailgating	49	33	12	6
Drivers cutting each other off	40	35	17	8
Reckless lane changing on the highway	40	33	18	9
Driving on the shoulder at high speeds	6	13	29	50
Source: Public Attitudes Monitor Survey 1997 (62)				

NHTSA funded perhaps the most comprehensive national telephone survey in this country dealing with aggressive driving from February through April 1997. Six thousand telephone interviews were conducted among a national population sample of drivers' age 16 and older. Although a major emphasis of the survey was on speeding, A three volume report entitled *National Survey Regarding Speeding and Other Unsafe Driving Actions* provides a wealth of information about drivers' attitudes and behaviors regarding aggressive driving and related behaviors (63, 64, 65, 66).

Although most respondents (65 percent) reported no difference when asked to rate the extent to which they believed that drivers in their area were driving more or less aggressively at the time of the survey versus a year earlier, 30 percent reported that drivers were driving either a lot (13 percent) or somewhat (17 percent) more aggressively. Table 6 provides reasons given by those drivers who thought others were driving more aggressively.

Table 6. Perceived Reasons for Increased Aggressive Driving.

Reasons Cited	Percent
In a hurry/rushed/behind schedule	23
Traffic flow/increased traffic/congestion	22
Careless/inconsiderate drivers	12
Immature/young drivers	12
Higher speed limits	8
New drivers coming into area	7
Angry/frustrated/hostile drivers	7
Speeding/driving too fast	7
Fewer police officers	6
Higher stress levels/more stressed drivers	3
Overly confident drivers	3
Not sure	18
Source: Boyle et al, 1998 (65).	

Survey respondents were asked what types of unsafe driving behavior, other than driving at an unsafe speed, they encounter most frequently on urban and rural residential, non-interstate, and

interstate roadways. [Table 7](#) summarizes the responses for urban interstates, the roadways most related to the urban freeways that are of primary interest in the present project.

Table 7. Frequently Encountered Unsafe Driving Behaviors on Urban Interstate Highways.

Unsafe Behavior	Percent
Weaving in and out	30
Tailgating	17
Driver inattention	10
Unsafe lane changes	7
Cutting in front	4
Driving too slow	4
Not sure	4
Unsafe passing	3
Failing to yield	3
Drinking and driving	2
Only speeding	1
Other	9
None	7
Source: Boyle et al, 1998 (65).	

Respondents also reported their own unsafe driving behaviors. [Table 8](#) indicates the percent of the sample that admitted to each behavior, by most recent occurrence.

Sixty-two percent of all respondents reported that the behavior of another driver has been a threat to them or their passengers within the past year. Among those respondents who have felt threatened by the behavior of other drivers, the nature of the actions they perceived as threatening included that “another driver:”

- “cut very closely in front of me” (36 percent),
- “drove very closely behind me” (19 percent),
- “passed me in a dangerous manner” (15 percent),
- “cut me off at an intersection or exit” (13 percent),
- “made an obscene or threatening gesture” (5 percent),
- “wove in and out of traffic” (4 percent),
- “ran a red light” (3 percent), or
- “ignored a stop sign” (1 percent).

In the *National Survey of Speeding and Other Unsafe Driving Actions* drivers were also queried about the effectiveness of and support for various countermeasures to unsafe driving. The sample size for this portion of the survey, 3000, was half the size of the sample asked the core questions about speeding and other unsafe behaviors.

Table 8. Prevalence of Self-Reported Unsafe Driving Behaviors.

Driving Behavior	Total in Past Year (%)	Most Recent Occurrence			
		Today (%)	Past Week (%)	Past Month (%)	Past Year (%)
Entered intersection just as light turning from yellow to red	71	9	21	22	9
Drove 10 mph over speed limit on an interstate highway	60	7	16	17	20
Drove 10 mph faster than most other vehicles	56	8	14	16	18
Went 10 mph over the speed limit on a two-lane rural road	52	5	11	17	19
Slowed but didn't completely stop at a stop sign	51	11	15	12	14
Went 10 mph over the speed limit in a residential neighborhood	40	5	8	10	16
Drove through traffic switching quickly back and forth between lanes	32	2	6	8	16
Drove 20 mph over speed limit on an interstate highway	29	2	5	7	15
Drove 20 mph over the speed limit on a rural road	26	2	4	7	13
Drove through a light that was already red before entering the intersection	23	1	3	6	14
Tailgated another vehicle on a two-lane highway	23	2	3	6	12
Drove 20 mph faster than most other vehicles	21	1	3	6	10
Made an angry, insulting, or obscene gesture or comment toward another driver so that they heard or saw it	20	2	4	6	8
Cut in front of another car in order to make a turn	18	1	2	4	11
Made a U-turn where a sign said not to	16	1	2	5	8
Drove through a stop sign without slowing	15	1	3	3	7
Crossed railroad tracks when the red light was blinking	13	-	2	3	8
Passed a vehicle in a no-passing zone	10	-	1	2	7
Used the shoulder to pass in heavy traffic	10	1	2	3	5
Drove when affected by alcohol	8	-	1	2	5
Raced another driver	6	1	1	1	3

Source: Boyle et al, 1998 (65).

Respondents rated the effectiveness of nine countermeasures for reducing unsafe driving. [Table 9](#) provides the percentage of respondents indicating they believe the nine measures would be very or somewhat effective and the percentage who strongly or somewhat approve of implementing those measures.

In addition to national surveys in the U.S. and Canada, the research staff found surveys and polls focusing on local, state, or regional areas have also been conducted. The Commonwealth Poll conducted in Virginia in May 1998, for example, indicates that nearly one in five drivers in that

state admitted to aggressive driving within the month preceding the poll, and 55 percent reported that they have witnessed an incident of such behavior (67).

Table 9. Percent of National Sample Who Believe Countermeasures Effective and Approve of Implementation.

Countermeasures to Unsafe Driving	Percent Who Believe Measure Very or Somewhat Effective	Percent Who Strongly or Somewhat Approve Implementation
Assign more police to traffic	87	82
Ticket more frequently	80	83
Double/triple fines	80	77
Increase public awareness of risks	80	89
Revoke license more often	79	81
Encourage saying something to driver	73	84
Increase insurance costs	71	71
Change road design/add speed bumps	71	64
Encourage citizens to report driver	64	71
Source: Boyle et al, 1998 (66).		

2.5 STUDY OF AGGRESSIVE DRIVING BEHAVIOR ON FREEWAYS

A recent study conducted by researchers at San Diego State University (SDSU) evaluated aggressive driving and road rage behaviors on San Diego freeways (68). The California Highway Patrol (CHP) in San Diego County receives cell phone calls reporting unsafe driving incidents. SDSU researchers examined reports from the computer aided dispatch (CAD) system for all San Diego freeways during April, June, and September of 1998. There were a total of 1,987 reported incidents in the study database for this three month time period. The study offered a spatial analysis (by major freeways) of aggressive driving behavior patterns that drivers/callers reported to CHP dispatchers.

The authors categorized all of the reported incidents as speeding alone (i.e., caller reported only speeding as the offense), aggressive driving, or road rage. The authors proposed that the distinction between road rage and aggressive driving includes traffic versus criminal offense differential; therefore, the definition of these terms should in some sense address the state of mind of the perpetrator. The basic definition of road rage used for categorization was that the incident involved a state of anger or hostility directed at another driver (e.g., harassing or threatening verbally, flashing high beams or headlights, trying to run someone off the road, etc.). The authors pointed out that this condition may or may not be true of aggressive driving. The basic definition of aggressive driving used for categorization was an incident that was intentionally inconsiderate of other drivers (e.g., weaving and/or cutting, unsafe lane changes, unsafe passing, and tailgating).

SDSU staff tabulated and analyzed all of the incidents in the database and some of the significant findings included:

- Freeway drivers reported over 30 incidents each day, and, only 10 percent of people with wireless phones report such acts.
- The time period when aggressive driving, speeding, and road rage were reported most was 3 p.m. to 6 p.m. for all of the major freeways (i.e., Interstate 5, 8, 15, and 805). This finding corroborates other research (69, 70) that congestion (likely present during the PM peak period on the San Diego freeways) is a contributing factor to aggression.
- SDSU researchers determined that the number of calls was significantly greater than expected on Fridays. This increase might suggest that drivers are more prone to aggressive driving and road rage behaviors at the end of the work week.
- SDSU researchers concluded that both volume (average daily traffic) and length of the freeway section were robustly correlated with the number of phone reports per freeway.

SDSU researchers plan to use the CAD data to predict if certain sections of the freeways receive more calls than others. SDSU researchers believe the CAD data collected during this study is valuable to researchers and law enforcement and could be used in many ways, such as developing good public awareness and education campaigns. If researchers compiled similar data longitudinally for a certain number of years, then those researchers and professionals could predict trends as well as determine spatial variations in unsafe driving patterns by time of day and day of week.

CHAPTER 3

FOCUS GROUP RESULTS

3.1 FOCUS GROUPS ON DRIVING IN STRESSFUL ENVIRONMENTS

The research staff conducted a series of five focus groups designed to explore issues related to driving in stressful environments as experienced by Dallas-area commuters between March 21 and May 9, 2000. Researchers used the focus group approach to provide information that could be used in developing a telephone survey about driving in the Dallas area, and to provide a mechanism for obtaining driver input to the identification of candidate measures that may mitigate some of the stresses associated with driving in congested urban environments. Focus groups can provide information regarding attitudes, motivations, and perceptions that is difficult to acquire using other research methods. They are particularly useful because members of a focus group tend to stimulate discussion with one another, pursuing lines of thinking and offering insights individuals would not put forth independently. Although primarily intended to be exploratory and qualitative in nature, to the extent group members are representative of the target population, some generalization of the insights gained is also possible.

The group discussion emphasized those aspects of driving in the Dallas area that individuals experience as particularly irritating, frustrating, and stress-producing. Participants discussed the stresses of driving under all conditions, but primary emphasis was placed on those stresses associated with regular commuting, especially on Dallas-area freeways. In addition to discussing the irritating and stressful features of commuting, the moderator encouraged group participants to offer their insights regarding the effect of those stressors on their own driving and to offer possible approaches to ameliorating those difficulties. The moderator asked group participants to consider both behavioral stressors (typically the actions of other drivers) and stressors possibly caused by roadway design, infrastructure condition, enforcement, and traffic/transportation policy in the Dallas area. Similarly, the moderator also encouraged group members to offer any types of potentially ameliorating approaches, including behavioral, design, educational, and enforcement components.

3.2 GROUP AND PARTICIPANT CHARACTERISTICS

The first two groups, conducted over participants' lunch breaks at their place of employment, were limited to one hour in duration. The final three groups, held in the evening, each lasted from 90 minutes to two hours. A total of 40 adult (approximately 25-60 years old) Dallas-area residents, 23 males and 17 females, participated. Groups had from six to ten participants each. With a few exceptions, group participants regularly drive alone to and from work in the Dallas area in their personal vehicles. Five or six participants' car pool and most of these use high occupancy vehicle (HOV) lanes for part of their commute. None regularly use public transportation for work-related trips; however, several participants have used public transportation in the past or use it for non-work-related trips. [Table 10](#) summarizes the group participant characteristics, including the range of commute times and distances represented in each group.

Participants in the first two groups shared a common employer and those in the third group attended the same church. Research staff recruited participants in Groups 4 and 5 through a posting on the *Dallas Morning News* Internet site. The individual participants represent a wide range of occupations, encompassing skilled laborer to marketing, a variety of engineering disciplines, and technical management; however, taken as a whole, technical and professional employment are likely over represented in comparison to all Dallas area commuters.

Table 10. Summary of Focus Group Participant Characteristics.

Intra-group Affinity	Participants		One-way Commute Distance (miles)		Typical Morning Commute Time (minutes)	
	Female	Male	Min	Max	Min	Max
1. Dallas DOT employees	3	7	8	60	10	50
2. Employees of N. Dallas technology co.	4	5	Very short	27	7	90
3. Attend same church	3	3	14	35	30	60
4. Responded to Web site solicitation	3	3	Very short	40	5	70
5. Responded to Web site solicitation	4	5	Short	27	10	45

Note: Minimum and maximum commute times are for days with good weather and without significant congestion causing incidents.

3.3 SUMMARY OF FOCUS GROUP DISCUSSIONS

The moderator used the discussion guide, with minor variations for each of the five groups, to direct the participant conversation. The discussion guide is provided in [Appendix B](#). After an introductory discussion of participants’ driving and commuting experience, the moderator asked participants in each group to write down five things that irritate or aggravate them about driving in Dallas. Following this exercise, which took about five to 10 minutes, the moderator asked the groups to discuss the items they listed. [Table 11](#) provides a composite list of the issues noted by members of all of the groups. They fall into six broad categories:

- [Category 1](#): Behaviors of other drivers that are identified as irritating;
- [Category 2](#): Irritating features/aspects of Dallas area road infrastructure, design, and general traffic conditions;
- [Category 3](#): Construction zone and maintenance area specific problems;
- [Category 4](#): Enforcement and emergency response-related concerns;
- [Category 5](#): HOV lane–related items; and
- [Category 6](#): Tollway-specific issues.

In many instances, these categories are not mutually exclusive. For example, some problems noted by group participants could justifiably be categorized as both a driver behavior and an

enforcement problem or as a perceived design problem and a problem that interacts with a driver behavior issue. In fact, many of the focus group participants were quite astute in positing relationships between a design feature and driver behaviors that were viewed as aggressive, inconsiderate, or stress-producing. Although a number of the connections made between stress-producing driver behavior and design features that are perceived as inadequate may not be consistent with sound traffic and highway engineering principles, uncovering these perceptions is important in terms of gauging motorists' responses to potential engineering or other types of amelioration approaches that may be considered. Group discussion of the "irritating" aspects of driving prompted new issues that had not been noted by any of the participants in their written responses. [Table 11](#) includes these new issues.

Partly as a function of different group dynamics operating in the various groups, there tended to be somewhat different group-imposed emphases among the groups. For example, while Group 1 largely focused on driver behavior issues, Group 5 tended to address perceived roadway design and infrastructure issues. Differences among the groups are also simply a function of the degree of importance attached to different aspects of driving in Dallas by each individual. Overall, the participants required very little prompting by group moderators. Clearly, the subject of stressful driving lies close to the surface, at least among the volunteers comprising these groups.

Table 11. Irritating/Aggravating Things about Driving in Dallas.

Category 1: Driving Behaviors of Others
Tailgaters, follow too close
People who do not attend to driving task (e.g., cell phone, apply make-up)
Excessively fast drivers
Drivers who don't use turn signals/unsigned lane changes
"Rubberneckers," drivers who slow with no apparent reason
Drivers who refuse to allow others to merge
Driving on shoulders
Red light violators
Excessively slow drivers
Slow driving in left lanes
HOV lane violators
Slow drivers in HOV lanes
Improper merging from access ramps
Merging too slowly, not accelerating when entering freeway
Cutting in at last minute/last minute merges
Drivers who refuse to allow others to pass
Drivers who constantly change lanes, "dart in & out"/multiple quick lane changes
Fast lane changes in congested traffic
Excessive use of access & merge lanes for continuous driving
Cutting off to exit (crossing multiple lanes)/cut off/pull in front
Not yielding right-of-way
Not yielding at freeway on/off ramps
Cutting through median to exit
Speeding up to pass, then turning
Using passing lane, but not passing (match speed)

Table 11. Irritating/Aggravating Things about Driving in Dallas.

Not turning right on red where permitted
Angry drivers (“road rage scares me”)
Drivers who appear to believe they are more important, entitled to break laws
Apparent disregard for safety of others and self
Horn honkers
Unspecified inconsiderate, unfriendly driving/lack of courtesy/aggressive “stupid” drivers
Unskilled drivers
Uninsured drivers
Quick stops in fast traffic (don’t maintain consistent speed)
Need to be aggressive to keep up with other drivers
Competitiveness of drivers
Overly cautious drivers
Non-commuters who drive dangerously
Unsafe/polluting vehicles on freeways
Drivers of too many trucks stay in the fast lane
Trucks that drop rocks/uncovered loads
“High profile” vehicles that block others’ view
Not using lights in rain
Children not in car seats
Category 2: Infrastructure /Roadway Design/General Traffic Conditions
Too much traffic, congestion
Insufficient roadway capacity (specific roadways noted)
Too many trucks on highway
Lack of public transportation (e.g., no light rail to Plano)
Need to use freeways because of lack of surface-street alternatives
Insufficient major routes from Arlington to the North
Bad interchanges between major freeways (e.g., SH 360/I-30)
Poor freeway intersection design (e.g., Legacy-US 75, Campbell-US 75)
Access ramps too short/too close together/merge lanes too short
Ramp metering (on SH 360)
Badly timed traffic signals/lack of use of “smart” signals/short protected left turn signals
Excessively long red traffic signals
Lack of advance warning signs for lane changes/lanes that merge (inside merges)
Erroneous signs (e.g., unneeded merge signs)
Lack of lane assignment information for motorists staying on the primary roadway
Lack of other signs/markings to assist driver
Unexplained slow downs
Speed limits too low
Lack of apparent improvements in traffic/roads
Trains at crossings during peak times
Category 3: Construction/Maintenance Areas
Poor minor maintenance in general (striping, potholes, minor repairs, etc.)
Construction adds to congestion/accidents
Lack of construction/maintenance coordination among various jurisdictions
Unnecessary or excessive lane closures for construction/maintenance
Construction takes too long

Table 11. Irritating/Aggravating Things about Driving in Dallas.

Takes too long (weeks) for roads to open after construction appears complete
Construction on all available routes at same time
Construction/maintenance activities during peak times (during rush hours)
Lack of advance warning of construction/maintenance zones, incorrect signing of lane closures
Category 4: Enforcement/Emergency Response
Lack of enforcement
Emergency responders (police, fire, wreckers) causing congestion (use too much space)
Lack of traffic control measures at incidents
Not clearing wrecks/broken-down vehicles quickly (directed toward local enforcement agencies)
Incident response times too long
Lack of consistent/universal traffic regulations/laws
Category 5: HOV Lanes
HOV lanes waste of money (“social engineering”)
Lack of barriers to separate HOV and main lane traffic
Lack of control over improper HOV lane use
Inappropriate Dallas Area Rapid Transit (DART) enforcement on HOV lanes
Category 6: Tollway Specific
Congestion at toll plazas, even with toll tags
Too many entrances on tollway
Toll booths should be located on exits, not in main travel lanes
“Toll tag” lanes in outside tollway lanes—causes merge problems with slower “cash” lanes
Toll tag equipped vehicles drive too fast through tollbooths
“Yield” signs at tollbooths generally ignored
Tollway pricing policy discourages use of toll tags
Tolls still required for “paid off” sections of tollway

3.3.1 Discussion of Driver Behavior Irritants

Not surprisingly, the preponderance of responses over all groups emphasized driver behavior. Numerous comments made both in the written exercises and ensuing group discussions stressed a broad range of inappropriate and/or unsafe driver behaviors regularly observed on Dallas roadways. Tailgating and the perceived inattention of many drivers to the driving task were the most frequently noted specific behaviors that group participants found most irritating. Inattention to driving encompassed a broad range of non-driving tasks from ubiquitous cell phone use to eating and applying makeup while driving.

Participants perceived the impetus for the stress-producing/irritating/dangerous driving behaviors they observed as arising from a variety of factors including:

- increasing evidence of improper or incomplete driver education and training;
- a simple lack of courtesy, common in many areas of today’s society. Participants saw many of the cited behaviors less as intentional acts of aggression than as the result of a preoccupation by many drivers with their own interests to the exclusion of others;

- group participants believed that some of the behaviors exhibited were intentionally pursued to intimidate other drivers, taken sometimes to the level of criminal and antisocial acts of aggression;
- a lack of driving experience, particularly as it pertains to driving under crowded freeway conditions; and
- inadequate enforcement of traffic laws and regulations (often coexisting with the belief that enforcement on freeways is extremely difficult and in many cases counterproductive, i.e., enforcement itself often serves to exacerbate congestion).

3.3.2 Discussion of Roadway-Related Irritants

Group participants cited the highway infrastructure in the Dallas area as being responsible for much of the irritation and stress experienced while driving. Though differing on potential remedies, most participants agreed that there is simply too much traffic for the available capacity. Participants in all groups offered numerous examples of specific sites of congestion. Group members placed blame for a significant amount of the congestion experienced on:

- perceived poor freeway intersection design,
- badly implemented interchanges between major routes,
- excessively short merge lanes, and
- necessity to use freeways because of a lack of surface-street alternatives.

In addition to the design of roadways themselves, a recurring theme among participants was the perceived inadequacy in the roadway information/communication infrastructure. This inadequacy was evidenced by a significant number of references to:

- an overall lack of appropriate signs and other markings to assist drivers,
- erroneous and/or superfluous signing,
- lack of lane assignment signing for motorists staying on the primary roadway,
- lack of advance warning for construction and maintenance areas, and
- incorrect signing of lane closures.

The information problems expressed by many are typified by one participant who noted the failure to get information about upcoming traffic backups until it is too late to take an alternate route, or as he put it, getting stuck if information is not provided before the last “bailout route.” Participants expressed similar sentiments about insufficient lead times for upcoming exits.

3.3.3 Discussion of Construction-Related Irritants

As noted in [Table 11](#), problems related to construction and maintenance areas, particularly the extent, duration, and apparent lack of coordination among area jurisdictions, are major sources of irritation and aggravation among the participants. Most participants agreed that construction is a necessary evil; however, some felt like all available routes on their commute had some construction ongoing at the same time.

3.3.4 Discussion of Enforcement/Emergency Response Irritants

Traffic enforcement and emergency response agency activities also received their share of attention. Group members directed the majority of their comments at issues related to their responsibilities at traffic incidents. Participants cited a lack of timeliness for incident response and clearance as well as a lack of traffic control at the scene. Finally, there were a number of comments related to a general lack of enforcement presence on the urban freeway facilities in the Dallas area.

3.3.5 Discussion of HOV Lane and Tollway Irritants

Several participants expressed disfavor with Dallas-area HOV and tollway facilities. Many of the comments offered by the participants centered on policy issues concerning these facility types. HOV lane irritants ranged from them being a waste of taxpayer money to inappropriate enforcement practices that cause too much disruption of traffic during peak periods. The tollway irritants seemed to concentrate primarily on issues regarding the toll booths (resultant congestion, plaza placement, number and position of lanes, etc.).

3.3.6 Discussion of Merging-Related Irritants

In several of the groups, special emphasis was placed on traffic merging problems. Merging issues were both identified spontaneously by participants and were also identified by the research staff as being of particular interest. Several comments by participants indicated that:

- Merge lanes in Dallas are often too short.
- Freeway exits/entrances are too close together causing conflicts between entering and exiting traffic.
- Better acceleration lanes would help alleviate merging difficulties.
- Ramp metering is not viewed as an effective way to manage merging (metering was met with derision by several participants).
- Participants cited merging in areas with lane drops (particularly in construction areas where queuing situations often arise) as being particularly problematic. In some groups discussion arose spontaneously during the course of the meeting, and in others, when raised by the moderator, participants agreed virtually unanimously that difficulty with

merging is a particularly aggravating feature of driving. This problem is exemplified by the situation in which some proportion of drivers remain in the closing lane until what appears to many other motorists to be the “last minute.” Such “late merging,” whether intentional in order to maintain a higher speed and “get to the head of the line,” inadvertent (due to confusion of about which lane is closing), or forced because of unexpected congestion upstream of the lane closure, is often viewed as especially frustrating by drivers who perceive the late mergers as “not playing by the rules.” The research team calls this phenomenon “queue jumping.”

3.3.7 Participant Driving Behaviors

The moderators prompted participants to divulge if they personally ever engage in the types of rude or aggressive behaviors that were noted as being especially stress-producing and/or irritating. In some of the groups, members appeared to have some reluctance to talk openly about personal behavior that might be viewed negatively by other participants; however, there was general agreement across all groups that most people likely have engaged in inappropriate driving behavior at some level. This agreement was expressed in comments that indicated an urge to “race with” other drivers or that it was “easy to get caught up with” another driver’s observed bad behavior. Several participants did admit to tailgating in order to prevent others from changing lanes, etc., especially if the other driver had been previously observed driving in a manner considered rude or dangerous. One participant who said she has on occasion prevented another vehicle from changing lanes suggested: “...maybe next time they’ll think about getting over like everyone else did!”

Additional prompting by the moderators for participants to indicate if they ever engage in retaliatory behaviors resulted in several participants revealing that they might sometimes slow down if being tailgated, flash lights at another driver, or otherwise drive in a manner that they recognized as inappropriate. One participant suggested a rigid adherence to speed limits that implied an attempt to force others to comply.

Despite the admissions of retaliatory or other inappropriate driving behavior noted above, the expressed attitude of most group members aligned with the notion of “go with the flow” and generally “let them go.” There was some indication that restraint from retaliatory responses is in part attributable to the fear of further retaliation by the initially offending driver.

There was a lack of unanimity among participants when asked if drivers in Dallas are more aggressive than in other places and whether the irritating aspects of driving identified by group participants are unique to Dallas. While many participants indicated that they did not believe Dallas drivers are more aggressive than elsewhere, most agreed that Dallas drivers are more aggressive today than in the past, e.g., “more so than five years ago,” but are not more aggressive than in most large cities. Several groups suggested that the pace of life, especially in large cities, adds to the stress experienced in driving. One participant expressed the idea that Dallas was faster paced than Ft. Worth and that more aggressive and stressful driving was reflected in Dallas as a result.

3.3.8 Participant Ideas for Reducing Stress and Aggressive Driving

In each group, the moderator posed the question of what would help reduce the stresses of driving in Dallas. Table 12 summarizes the suggestions made by group members. As evident from the suggestions, participants generated a substantial range of ideas that would require:

- behavioral changes among drivers;
- improved roadway information;
- changes in enforcement practices;
- modifications to the physical infrastructure of Dallas roadways;
- stricter driver licensing and training procedures; and
- changes in area transportation policy, particularly as related to construction and mass transit.

**Table 12. Group-Generated Suggestions
to Ameliorate Problems Identified by Participants.**

Encourage more use of buses, mass transit to reduce congestion
Provide better incentives for car pool/mass transit use
Provide incentives for businesses to offer flex-time
Reduction needed in what is perceived as too much dependence on personal vehicles
Provide some way to encourage increased attention by drivers to driving tasks
Prohibit cell phone use, especially on high-speed roads
Fund additional speed enforcement
Increase enforcement to reduce tailgating and dangerous lane changing, etc.
Decrease enforcement during rush hours – adds to congestion
Provide better, more current information about road conditions/accidents
Implement a Web site for citizen input re: bad intersections, etc.
Improve and increase advance signing for construction and freeway exits
Improve (lengthen) acceleration lanes
Add freeway main lanes, not HOV lanes
Remove HOV occupancy restrictions, provide added capacity for all
Relocate tollway toll booths from main lanes to exits
Apply technology to “smart” signals that adapt to traffic conditions
Increase driver training
Make getting and keeping drivers license more difficult
Require periodic driver training/testing (including, but not limited to, vision testing for older drivers)
Implement better sequencing and coordination of construction projects
Conduct construction/maintenance activities at night
Restrict trucks from freeways during AM and PM peak
Increase inter-jurisdiction mass transit cooperation/coordination
Require TxDOT district engineers to drive during rush hours

The information provided by participants in the five focus groups, along with review of previous studies, proved useful to the project team in developing the survey instrument used in the telephone survey (described in [Chapter 4](#)), in concentrating the team's attention on potential public response to some of the mitigating measures that will be tested in future phases of the project, and in providing greater insight into the perceptions and opinions of the driving public.

CHAPTER 4

TELEPHONE SURVEY RESULTS

4.1 BACKGROUND

This study included a telephone survey of drivers in 431 households in Dallas from May 29 to June 7, 2000. The purpose of the survey was to assess the prevalence and driver definition of stressful conditions that may lead to aggressive driving behaviors. Additionally, the survey was intended to assess the perceived effectiveness of a set of proposed countermeasures for reducing the stress of driving.

Prior to conducting the telephone survey, the research staff conducted five focus groups in the Dallas area. As described in the previous [chapter](#), the research staff used the focus groups to gain insight, through extensive discussion with commuters, about conditions related to Dallas freeway driving that increase stress. Because these focus groups represented only a very small number of self-selected drivers, researchers used the telephone survey to substantiate the findings from the small discussion groups at a broader level and to obtain data that could be generalized to Dallas commuters as a whole.

4.2 TELEPHONE SURVEY METHODOLOGY

The research staff devised the telephone survey instrument using results from the focus group discussions and previous related national surveys. A pilot test was conducted with 10 respondents to estimate the interview time, to assure the clarity of the questions, and to gauge respondents' acceptance of the subject matter and interview format.

The Public Policy Research Institute (PPRI) at Texas A&M University administered the telephone survey. PPRI staff made calls generally between 6 p.m. and 9 p.m. on weekdays and on weekends.

The survey sample was selected from among blocks of current telephone exchanges in Dallas County using a random sampling procedure in which telephone numbers were computer generated. After the interviewer reached a residential household, randomization within the household was enhanced using the "last birthday" method. With this method, the interviewer asked to speak to the person 18 years of age or older who had the most recent birthday. PPRI used this technique to reduce the bias introduced into telephone surveys by the propensity of certain household members to answer the phone most often or the varying willingness within households to respond to surveys.

Interviewers made at least four attempts to reach a respondent at each telephone number. The refusal rate was very low—8.31 percent. Additionally, once respondents agreed to participate in the survey, their cooperation throughout the survey was phenomenally high. There were only 14

terminated interviews. This percentage is an extraordinarily low number of terminations relative to telephone surveys in general and indicates an interest in and willingness to discuss this topic.

After the initial screening question (How many days a week do you typically drive on freeways during rush hour times in Dallas?), interviewers asked respondents to answer 33 questions. The first question determined the distance of the respondent's commute. The next four questions asked the respondent to assess the driving situation in Dallas in terms of stress and to assess their own and other drivers' aggressive reactions to stress. The following 10 questions addressed driving behaviors of others and roadway conditions that raise stress levels. This set of questions was followed by one question regarding lane closures. Surveyors then asked respondents to give their opinion of the effectiveness of a list of actions that could be taken to reduce stressful driving conditions. The interview concluded with four standard demographic questions. The telephone interviews averaged approximately 10 minutes per respondent. Response frequencies were calculated for the questionnaire and they are included as [Appendix C](#).

4.3 SAMPLE CHARACTERISTICS

The sample size of 431 represents a reasonable approximation of the driving population of Dallas. This sample size is large enough to provide a confidence interval of 95 percent and a sampling error of 6 percent. In other words, in 95 of 100 such samples, statistics show that the results should differ by no more than three percentage points in either direction from what was obtained through this survey. Furthermore, the random sampling technique allows the results to be generalized to the driving population of Dallas County.

[Table 13](#) provides a description of the sample by demographic variables. The [table](#) indicates that the sample was comprised of 48.3 percent males and 51.7 percent females. The sample was largely working age (over 18 and under 65), with a reasonable distribution among major age groups. The sample was also fairly well educated, with over 45 percent having college degrees, and an additional 30 percent having some college education. With regard to race/ethnicity, the sample was somewhat under-represented by minorities as compared to the composition of the general population in Dallas County, but not to such a large extent that the results should be considered skewed disproportionately toward the majority. As evidenced in the [table](#), the sample was 63.3 percent White, 18.3 percent Black, 8.8 percent Hispanic, and 8.1 percent Other. The 1990 Census records the breakdown for Dallas County as 50 percent White, 20 percent Black, 17 percent Hispanic, and 13 percent Other. The telephone survey sample is likely to be a very close representation of the breakdown of adult commuters in terms of race/ethnicity.

As mentioned previously, the screening question was, "How many days a week do you typically drive on freeways during rush hour times in Dallas?" Interviewers thanked those who answered "none" for their time, and the interview was terminated. Just over half of the remainder (52.3 percent) said they drove during rush hour five days a week, and 13.9 percent said they were rush hour commuters seven days a week. Thirty-five percent of these commuters in Dallas County had a commute that was between 10 and 20 miles one-way. Twenty-seven percent said they drove more than 20 miles one-way, and almost 30 percent drove less than 10 miles one-way on their work commute.

Table 13. Demographic Characteristics of Telephone Survey Sample.

Gender	Percent	(n)
Male	48.3	(208)
Female	51.7	(223)
Age		
18-25	11.4	(49)
26-45	47.6	(254)
46-65	31.8	(391)
>65	8.4	(36)
Race/Ethnicity		
White	63.3	(273)
Black	18.3	(79)
Hispanic	8.8	(38)
Other	8.1	(35)
Education		
<High School	4.9	(21)
High School Grad.	17.4	(75)
Some College	30.6	(132)
College Grad.	46.6	(201)

4.4 SURVEY RESULTS—PERCEPTION OF AGGRESSIVE DRIVING

Respondents were asked to compare current driving conditions in Dallas with those of a year ago, in terms of stress. The majority of respondents (57.3 percent) characterized driving in Dallas as more stressful now than a year ago, with almost 40 percent saying it is “a lot more stressful.”

While many factors may contribute to the stress of urban driving, an often-cited major contributor is the aggressive acts of other drivers. A commonly expressed notion is that some cities are worse than others with regard to aggressive driving. Another is that the problem is growing worse every year. Over 65 percent of respondents expressed the perception that drivers are more aggressive, with approximately 35 percent specifying that Dallas drivers are “a lot more aggressive now than they were a year ago.”

Many survey respondents attributed the increased intensity of aggressive driving to other drivers. Almost half (48.5 percent) said they, themselves, drove about the same as they did a year ago. Over 30 percent said they drove less aggressively, and only 18 percent claimed they drove more aggressively compared to a year ago. In fact, a large majority of respondents in the telephone survey sample placed themselves on the bottom half of a 10-point scale of aggressive driving. A

small number (11) rated themselves 9 or 10 on the 10-point scale, with 10 being most aggressive. The majority (53.3%) rated themselves in the 3- to 5-point range.

4.4.1 Stressors—Definition and Frequency

Interviewers asked respondents to describe the one driving behavior that is most likely to raise their stress level when driving on the freeways in Dallas. The results showed that the most prevalent answer was related to some type of lane change or merging behavior. Almost one-fourth of the respondents specifically stated that “cutting people off or people cutting in” aggravated them the most. When all of the responses that describe a lane change, merge, or related activity are considered, the proportion adds up to 50.4 percent. In other words, the research staff determined that half of the driving behaviors volunteered as the most likely to raise stress were directly related to changes in lane positioning or queuing.

[Appendix C](#) lists all of the stress-raising behaviors mentioned in response to the open-ended question. Several noteworthy behaviors also mentioned included tailgating (11.1 percent), speeding (10.2 percent), use of cellular phones (3.2 percent), and driving too slow (4.5 percent). A variety of actions mentioned less often included inattention, red light running, impatience, obscene gestures and language, disregarding signs, rubbernecking, and a whole host of other infractions.

Immediately following the question about what behavior is most stressful was the question, “What one roadway condition that you encounter frequently on freeways in the Dallas area is most likely to raise the stress you feel while driving?” The most prevalent answer was construction (30.4 percent) or related to construction in some way (an additional 5.8 percent). Over 12 percent of the respondents gave a congestion-related road condition as the most stressful to them, and 8.1 percent of those surveyed chose rain or very wet roads as the primary road-related stress producer. It is noteworthy that 10.7 percent of the respondents said there were no road conditions that were stress producing for them.

After the interviewer asked the two open-ended questions discussed above, the interview returned to a fixed-choice format designed to measure the degree of stress associated with eight driving behaviors, as well as the frequency of occurrence of these behaviors. Specifically, commuters were asked to rate how stressful a list of driving situations was, on a scale from 1 to 5, where 1 was “doesn't add to the stress of driving at all” and 5 was “adds very much to the stress of driving.” [Table 14](#) provides the outside marginal and the frequency of occurrence for each of the driving situations that were presented.

Over half of the Dallas commuters surveyed said they were very much stressed when “someone repeatedly weaves in and out of freeway lanes to get through traffic.” Sixty-five percent of the sample had witnessed this type of driving behavior within the last day, and of those who had not encountered it within the last day, 75 percent had witnessed it within the last week.

Table 14. Driving Behaviors That Raise Stress Levels.

Behavior	Does Not Add to Stress Level (%)	Adds Very Much to Stress Level (%)	Encountered	
			Daily	Weekly (%)
Weaving in and out of traffic	5.1	52.7	65.2	75.3
Drivers prevent merge	4.9	50.8	27.6	40.1
Inattentive driving	5.1	47.6	59.6	58.6
Tailgating	9.7	44.8	46.6	60.2
Passing on freeway shoulder	14.2	44.3	18.8	24.9
Staying in a closing lane	8.8	39.7	53.1	67.3
Drivers block move from closing lane	8.4	37.1	36.7	50.7
Excessive speeding	15.3	31.6	73.5	74.6

Additionally, approximately 50 percent of the Dallas commuters surveyed said they were very much stressed when someone intentionally blocked them from merging or changing lanes, which had happened to 27.6 percent of the respondents within the last day and to an additional 40.1 percent during the past week.

Relative to other behaviors, the least stress-producing behavior was excessive speeding, cited by less than a third as adding very much stress. Fifteen percent of the sample said they were not bothered at all by the excessive speeding of other drivers. This behavior was also the one most frequently witnessed by respondents in the survey. The least frequently observed behavior was passing on the freeway shoulder, which also was not stressful to 14 percent of the sample.

Almost 40 percent of the drivers surveyed said other drivers who stayed in a closing lane for as long as possible before moving into the open lane added very much to their driving stress level, and over half had seen this behavior during the last day. The survey included a question designed specifically to ascertain how this population responds to lane closure situations. The question was: when you are driving on a freeway and see there is a lane closure ahead, do you usually a) move out of the closing lane as soon as possible, b) drive in the closing lane as long as possible, or c) do something in between? Very few of the drivers surveyed (3.5 percent) said they stay in the closing lane as long as possible. The majority (71.9 percent) reported they move out of the lane as soon as possible. And almost one-fourth reported they do not move out of the closing lane either right away or at the last moment, but at some point in between.

4.4.2 Countermeasures

Following the inquiry regarding stress-producing behaviors and perceptions of aggressive driving in Dallas, a concluding segment of the interview dealt with potential countermeasure approaches. The interviewer then provided respondents with a list of 14 possibilities and asked

them to give each a rating as to how effective they might be in reducing the stress of driving. [Table 15](#) summarizes the results of the countermeasure evaluation.

Table 15. Rating of Potential Countermeasure Approaches.

Countermeasure Approach	Limited or No Effectiveness (%)	Effective (%)	More or Highly Effective (%)
Run campaigns in the media that promote more courteous driving	44.1	24.6	30.0
Build more non-freeway major streets	20.5	26.5	50.8
Focus on aggressive driving in driver education and defensive driving classes	21.4	26.9	51.3
Encourage more use of public transportation	23.9	23.7	51.8
Increase enforcement targeted at aggressive driving	17.0	24.6	56.3
Improve public information for scheduled freeway lane closures	17.9	24.4	57.6
Have hotlines to report aggressive driving to the police	23.2	17.4	57.7
Improve the signs or pavement markings that advise of lane closures	14.1	23.4	62.1
Improve public information about lane closures due to crashes or breakdowns	13.7	23.2	62.8
Encourage employer-provided flexible work hours and telecommuting	17.4	16.0	66.1
Increase the length of acceleration lanes at freeway entrances to make merging easier	15.3	17.2	67.3
Add more freeway lanes at bottleneck locations	12.7	14.8	71.0
Build more freeway lanes where needed to handle traffic better	9.5	13.0	76.3
Clear accidents and other incidents faster	6.9	15.5	76.8

As indicated in the [table](#), the commuters of Dallas are not very convinced that campaigns to persuade drivers to be more courteous would be an effective way to reduce the problem. Nor are they convinced overwhelmingly that education, enforcement, or surface-street construction would be most effective in relieving stressful driving situations.

The top three countermeasure approaches, that is, those countermeasures that received the highest percentage of “more effective” and “very effective” ratings, were those solutions that would most directly impact congestion. First, clear accident and incident obstructions faster. Closely at second, build more freeway lanes where needed. Third, and akin to building more lanes in general, build more freeway lanes at bottleneck locations.

4.5 SUMMARY OF TELEPHONE SURVEY FINDINGS

A representative sample of 431 Dallas commuters readily responded to a 10-minute telephone survey on the topic of aggressive driving on Dallas freeways. These commuters agreed that driving is more stressful now than it was a year ago, and that there are more aggressive drivers now than there were a year ago. However, the majority did not consider themselves more aggressive than they were a year ago, nor did the majority rate themselves on the top half of the aggressive driver scale.

The drivers surveyed expressed particular aggravation with other drivers who change lanes excessively, “cut people off,” “cut in,” and who prevent others from merging. These types of responses dominated both the open-ended and fixed-choice prompts for stress-producing behaviors. Construction, congestion, and wet weather conditions were three of the most often-cited roadway conditions that contribute to stress.

According to Dallas commuters in this survey, the most effective measures to reduce stress are to build more freeway lanes and to clear accidents faster. The survey results revealed that respondents considered public information and education to be less effective countermeasures.

CHAPTER 5

DEVELOPMENT OF TRAFFIC ENGINEERING MITIGATION MEASURES

This chapter describes all of the potential mitigation measures for reducing the prevalence and impact of road rage/aggressive driving considered during the first year of this project. Based on the results of the literature review, focus groups, telephone surveys, and judgment of the research team, a list of potential mitigation measures was developed for consideration. Researchers considered the development of mitigation measures related to traffic engineering elements (i.e., roadway geometrics, signing and marking, work zones, etc.) as the focus of this project because those measures are under the jurisdiction of TxDOT. Most of the research on the subject of road rage/aggressive driving has concentrated on the development of education- and enforcement-related solutions. The research team also considered mitigation measures related to education and enforcement that could potentially be applied by TxDOT for the evaluation phase scheduled for the second year of the project. Researchers divided the chapter into four subsections: [education-related mitigation measures](#), [enforcement-related mitigation measures](#), [traffic engineering–related mitigation measures](#), and [recommended measures for further testing](#).

5.1 EDUCATION-RELATED MITIGATION MEASURES

The research team considered several mitigation measures related to driver education. The following subsections contain information on five of the education-related mitigation measures.

5.1.1 Dynamic Message Sign Usage

Several focus groups cited the need for improved public information of lane closures and incidents. In the Dallas/Ft. Worth (DFW) area, both TxDOT Districts have dynamic message signs (DMS) deployed along freeways. These electronic signs display messages that provide drivers with important traveler information. Sometimes the DMS display educational- and safety-related messages to promote ozone alerts, the “Drive Friendly” campaign, and the “Move-It” law. Several focus group members suggested that the DMS be used more frequently for this type of activity, especially to promote the Move-It law, because group participants felt that most motorists do not realize that a law requires them to move vehicles involved in an accident off the roadway unless there are injuries or the vehicle is not drivable. [Figure 5](#) shows an example of an actual message sequence (first message on the left followed by the message on the right) used by the TxDOT Dallas District to inform motorists of their responsibilities if involved in an accident ([71](#)). In addition to the previously mentioned messages, several group members suggested that a message designed to inform drivers that the left lane is for passing only could be beneficial.

5.1.2 Traffic Emotions Education Cards

Over 80 percent of telephone survey respondents believed enforcement targeted at aggressive drivers could be an effective mitigation measure. One such measure, identified during the literature review, was the use of traffic emotions education (TEE) cards. Dr. Leon James, a

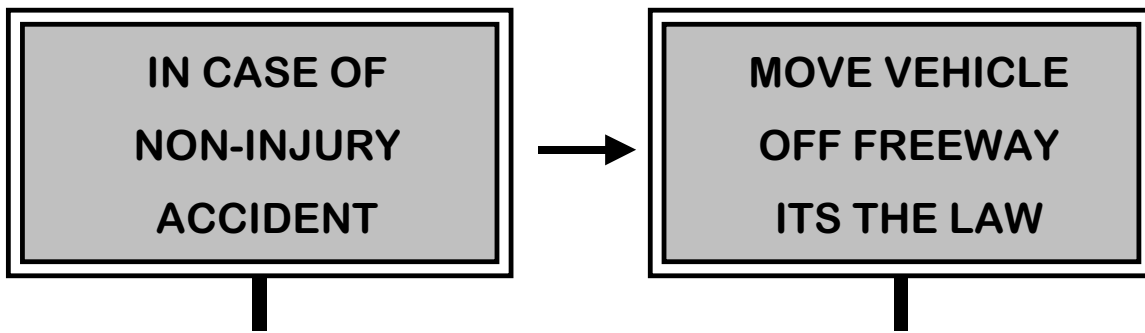


Figure 5. Example of DMS Educational Display for “Move-It” Law.

professor of Social Psychology at the University of Hawaii, is also known as Dr. Driving. He has developed a Web site that provides a wealth of information on the subjects of road rage and aggressive driving (72). One of the prominent developments by Dr. James is TEE cards. They express and promote a driving psychology approach designed to reduce the negative impacts associated with aggressive driving. The central idea of the driving psychology approach is that driving habits occur in three domains: emotions, thoughts, and sensory actions. James developed seventy-eight TEE cards to help drivers improve in all three domains. Table 16 shows a TEE card designed to test a driver’s road rage tendency.

TEE cards can be distributed in a variety of ways; however, James recommends the primary method as having a police officer provide one when a motorist is stopped for an aggressive driving–related offense. The San Antonio Police Department recently initiated a campaign, “Drive Smart, Be a Cool Operator,” in cooperation with a local insurance company, the American Institute for Public Safety, and Dr. James, to target aggressive driving on San Antonio highways with a multi-faceted program (73). The first component of the program involves traffic officers handing out TEE cards to drivers they stop in an attempt to make the drivers more aware of their driving habits.

5.1.3 Drivers Education/Defensive Driving Courses

Almost 80 percent of telephone survey participants thought that improvement could result from adding content on road rage/aggressive driving to driver education courses. Telephone survey respondents rated this measure 12th among the 14 listed in Table 15. Development of course content is not within the scope of this project; however, the research staff could inform organizations responsible for the development of these courses of key findings and results to consider adding to their curriculum.

Table 16. Example TEE Card—Test Your Road Rage Tendency.

No.4C1 Test Your Road Rage Tendency			
Instructions: Answer each question yourself and ask a passenger who knows you to fill out the back, answering about you as a driver.	on EVERY Trip	on SOME Trips	NEVER
1. I complain to myself about other drivers or the traffic.			
2. I get annoyed or irritated by some drivers.			
3. I feel frustration and anger in congested traffic.			
4. I drive like I'm in a hurry, leaving slower drivers behind.			
5. I honk at drivers who upset me.			
6. I tailgate slower drivers who refuse to move over.			
7. I yell at drivers, and if they deserve it, I give them the finger.			
8. I break speed limits.			
9. I go through red lights.			
10. I drive impaired (alcohol, medication, fatigue).			
Evaluation: 2 or more EVERY answers=Your road rage tendency is at a dangerous level. 5 or more SOME answers=You have moderate road rage. 7 or more NEVER answers=You're in control of yourself. Congratulations! Now compare your answers about yourself with the passenger's answers about you.			

5.1.4 Media Exposure

Slightly over half of the motorists surveyed believed the media could effectively promote courteous driving. The media (TV, radio, and print) has given the subject of road rage/aggressive driving a lot of coverage during the last five years. The research team believes that using local media sources to produce stories on important aspects of this research could be a good potential mitigation measure because it is low-cost and has potentially broad appeal. Media interest in this project is extensive; therefore, researchers recommend the early provision of this report to the interested parties. While not part of the formal second year of testing mitigation measures, any increased awareness of aggressive driving may create a greater willingness to obey social norms and exhibit more courtesy.

5.1.5 Public Service Announcements

Public service announcements (PSAs) are a common technique used to educate the public on issues with a broad scope. The research team believes that the development of PSAs that highlight important findings of this project is a mitigation measure worthy of consideration. It is not within the scope of this research to actually develop PSAs; however, the research staff found examples of existing PSAs on the Internet that could be modified with content related to the

research findings (74). Updating a PSA on the Move-It law would also be beneficial, based upon comments in the focus groups.

5.2 ENFORCEMENT-RELATED MITIGATION MEASURES

Since the telephone survey showed that 80 percent of respondents thought increased enforcement was an effective strategy, the research team developed several mitigation measures related to traffic enforcement. Researchers realize that none of the enforcement solutions assessed are under the jurisdiction of TxDOT; therefore, the cooperation of local and state enforcement agencies would be required for implementation. The following subsections contain information on five of the enforcement-related mitigation measures considered during this project.

5.2.1 Legal Penalties

Every state has existing DUI laws that define violations and their associated penalties. DUI violations have been decreasing and one of the primary reasons is the stiffer penalties associated with committing a violation compared to the past. Many states are now passing their first aggressive driving legislation in order to clearly define violations and their associated penalties so that enforcement can take place. The State of Texas does not yet have an aggressive driving law. The research team believes that, just as with DUI, states with laws that have penalties that are strong deterrents will have more success in reducing the problems associated with aggressive driving and road rage. The following list provides some of the legal penalties that enforcement agencies can use to deter aggressive driving:

- make aggressive driving behavior a criminal (jailable) act and not a civil infraction;
- enhance penalties for repeat violations or those that cause serious injury or death;
- points, suspension, and/or revocation of the offender's drivers license;
- impoundment or immobilization of repeat offenders vehicles;
- mandatory fines for convictions; and
- completion of educational courses related to aggressive driving and anger management.

Arizona was one of the first to pass a law for aggressive driving, in August of 1998 (75). The law states that an aggressive driving violation occurs if: 1) the motorist's driving constitutes an immediate hazard to another person or vehicle, 2) the driver is speeding, and 3) the driver also commits two or more of the following violations arising out of the same series of acts:

1. failure to obey traffic control devices,
2. overtaking and passing a vehicle on the right by driving off the pavement or main traveled portion of the road,

3. unsafe lane changes;
4. following a vehicle too close; or
5. failure to yield the right-of-way.

A person convicted of aggressive driving is guilty of a class one misdemeanor, will have six points assessed to their driver's license, and could also be fined up to \$2,500 and/or sentenced for up to six months in jail. The law allows the presiding court to order the suspension of a first-time offender's driving privileges for 30 days. Finally, the law requires a person convicted of aggressive driving to attend and successfully complete an approved training and education course designed to improve their driving habits and safety.

5.2.2 Cellular Hotlines

The proliferation of cellular phones in the United States has created the potential for motorists to report traffic problems quickly to the necessary authorities. The research team considered the establishment of a separate hotline number for motorists with cellular phones to report aggressive drivers to police as a potential mitigation measure. The telephone survey revealed that cellular hotlines were ranked as the 8th most effective countermeasure with almost 58 percent rating it as highly effective.

The Colorado State Patrol (CSP) implemented a program in 1998 for motorists in their state to report aggressive drivers (76). The CSP uses a computer at their communications center to handle motorists' phone calls. A previous media campaign used *DUI (star, 384) to report impaired drivers. With the assistance of the computer system, another cell phone number, *CSP (star, 277), was added to allow motorists to report aggressive drivers. Figure 6 shows a graphic of a CSP banner promoting the *CSP hotline. The software program was developed and delivered to the CSP free of charge by the vendor. The cellular calls to both numbers are free to the motorists because all of the wireless providers agreed to fund this service.



Figure 6. Colorado State Patrol Aggressive Driving Hotline.

The callers to *CSP are also allowed to vent their frustrations regarding other motorists. When CSP receives a call at the communications center, the dispatcher determines if the call is an urgent circumstance or if it is someone venting his or her frustrations. If it is an emergency, the dispatcher handles the call and sends the assistance that is required. The dispatcher forwards all other phone calls to the computer system that logs the complaint. The computer system can track the license plate numbers of the vehicles with the aggressive driving behavior. Once the computer database logs three complaints on the same license plate number, a letter is sent to the registered owner, advising that person of the complaints. The CSP would eventually like to send troopers to the homes of registered owners of the vehicles and issue citations based upon the complaints.

5.2.3 Selective Enforcement Techniques

Actual field enforcement of existing laws related to road rage and aggressive driving is one of the most basic mitigation measures considered during this project. The literature review conducted during this project revealed that there are a number of different selective enforcement techniques being used by police agencies throughout the United States to combat road rage and aggressive driving. Motorists that participated in the telephone survey ranked increased enforcement targeted at aggressive driving as the 10th most effective countermeasure. The following list provides a brief description of some of the more prominent selective enforcement techniques (77):

Unmarked Vehicles—the basic idea of this technique is to have unmarked police vehicles (sometimes motorcycles and aircraft) that are dedicated to enforcement of common aggressive driving behaviors (e.g., tailgating, weaving in and out of traffic, driving on the shoulder to pass, etc.). The Arizona Department of Public Safety has an aggressive driver program, *Operation Chill*, that uses the unmarked vehicle technique. Some police departments have used a technique where they enforce aggressive driving using vehicles that appear to belong to the local transportation department to catch violators.

Video Enforcement—the basic idea of this technique is using video equipment to record and document aggressive driving behavior. This technique is being applied in a variety of different ways. The Maryland State Police, in cooperation with the Federal Highway Administration, developed the ADVANCE (Aggressive Driving Video and Non-Contact Enforcement) program to identify aggressive drivers on the Capital Beltway in the Washington D.C. metropolitan area. The ADVANCE program uses a vehicle equipped with a lidar (i.e., laser radar) speed-measuring device and video cameras to capture pictures of vehicles (Figure 7). Police have used another more mainstream video enforcement technique to monitor red light running at signalized intersections. A number of police agencies are starting to use video enforcement to combat red light running. Figure 8 provides an example of output from a system used to document and capture red light runners (78).

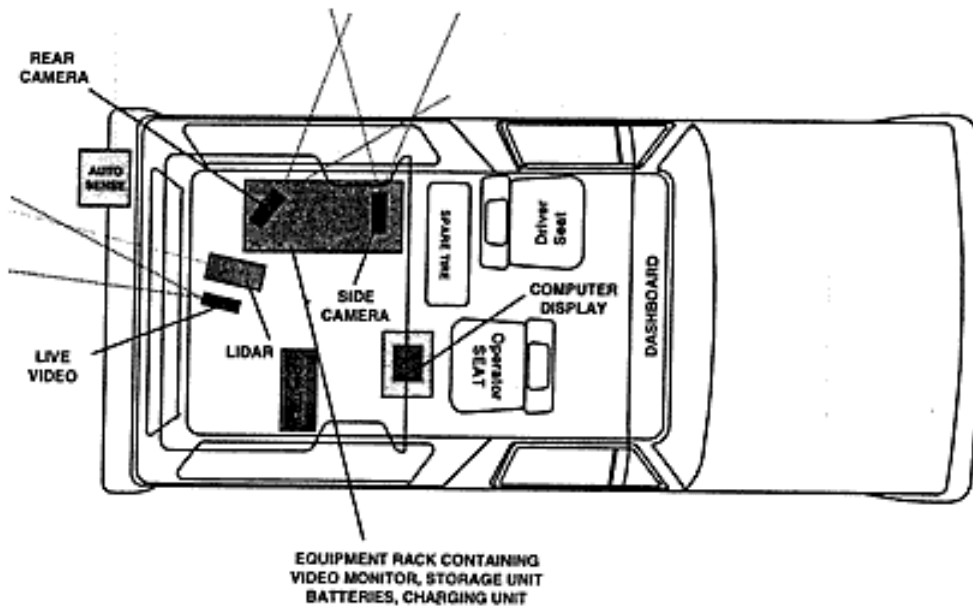


Figure 7. Schematic of ADVANCE Vehicle.

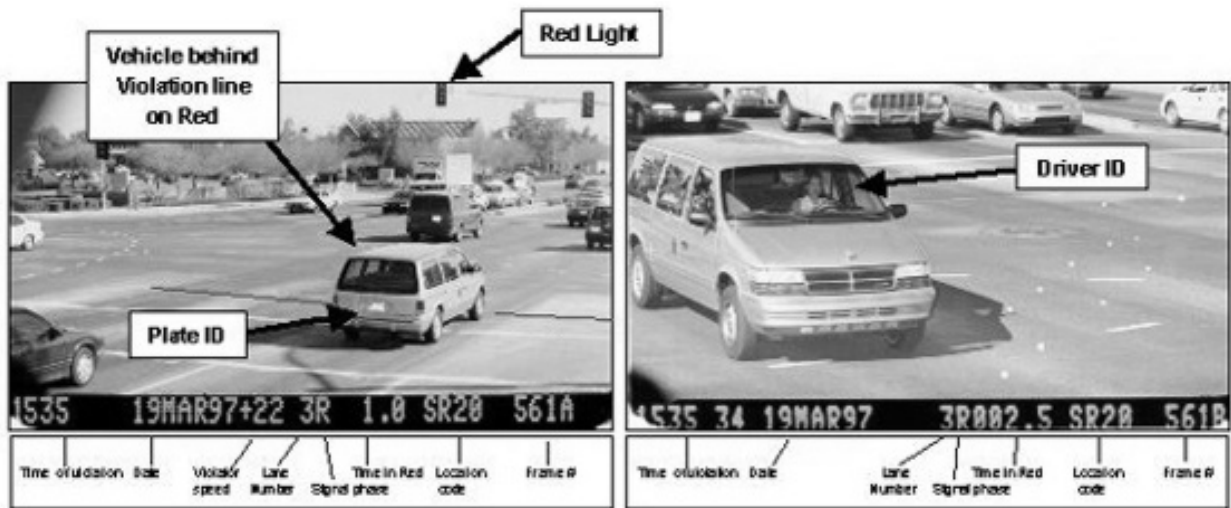


Figure 8. Example Output from Red Light Running Video Enforcement System.

Team Enforcement—the basic idea of this technique (also known by names such as wolfpack and saturation patrol) is having a team of officers dedicated to enforcement of aggressive driving violations at selected locations. The idea is to have a number of resources available at one location to enforce most of the violations observed. The Pennsylvania State Police and Albuquerque (New Mexico) Police Department are two

agencies that use this technique. This technique is popular because it is eligible for funding assistance from grant programs.

5.2.4 Expediting Incident Clearance

One of the most frustrating and stressful situations motorists face is being delayed by an incident on their route. The one mitigation measure rated most effective in the telephone survey for reducing driver stress was clearing freeway incidents sooner. Almost all survey respondents (93 percent) thought expediting incident clearance would be effective, with the vast majority (77 percent) ranking it as highly effective. There are a number of ways to improve and expedite the incident clearance process so that motorists are not delayed unnecessarily. The research team decided that the use of photogrammetry for investigation of incident scenes in the Dallas area was a good mitigation measure to consider. Photogrammetry is the measurement and processing of vital incident data (skid marks, vehicle position, etc.) from scene photographs using specially designed computer software. In theory, photogrammetry saves time over other investigation methods used at an incident scene (tape measures, total stations, etc.) because it does not take long to take photographs of the scene (Figure 9) (79). TxDOT's role in using photogrammetry to process incident scenes would be as a facilitator, leaving the actual investigation to the responding police agency. For example, the Utah Department of Transportation facilitated the use of photogrammetry by the Utah Highway Patrol by funding the purchase of equipment (i.e., digital cameras and photogrammetry software) and the necessary training using Congestion Mitigation and Air Quality funds. The opportunity for TxDOT to partner with local or state police for testing the ability to expedite clearance of incident scenes is a mitigation measure for further consideration.

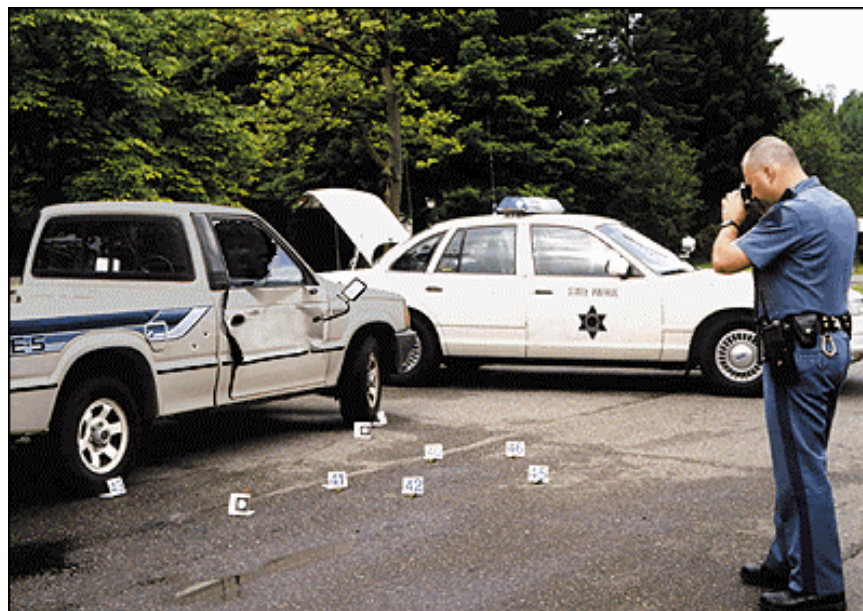


Figure 9. Using Photogrammetry for Incident Investigation.

5.3 TRAFFIC ENGINEERING–RELATED MITIGATION MEASURES

The research team considered a number of potential mitigation measures related to traffic engineering. All of the traffic engineering–related mitigation measures considered are under the jurisdiction of TxDOT, and TxDOT could implement the measures that appear feasible and effective. The following subsections contain information on all of the traffic engineering–related mitigation measures.

5.3.1 Signing, Marking, and Traffic Control Issues

The research team considered several potential mitigation measures related to signing, marking, and traffic control. One of the most prominent irritations cited by motorists in the focus groups and telephone survey was slow drivers using the left lane and causing congestion and erratic maneuvers. Other studies (80, 72) have confirmed that slow drivers are a problem throughout the country. The proposed mitigation measure for this problem is to install the “left lane for passing only” signs in an urban location. However, the research team rejected this solution because during peak hours all lanes are needed for capacity and lane changing could actually increase the congestion level. A better sign in urban areas might be “slower traffic keep right” to discourage “parking” in the left lane.

The Pennsylvania Department of Transportation (PennDOT) recently implemented a unique signing program aimed at changing motorist behavior (81). PennDOT is installing permanent signs on two sections of roadway in the Philadelphia area in order to combat the more than 250 crashes in the last five years attributed to aggressive driving (tailgating, improperly changing lanes, speeding, and other impulsive acts). This implementation is part of a statewide pilot program that is being paid for with maintenance funds from each of the state’s 11 highway districts. The new signs will have one of the following three messages displayed:

- Beware of Aggressive Drivers (Figure 10),
- Don’t Tailgate, and
- Slow Down – Save a Life.

PennDOT has not performed an evaluation on the effect these signs may have in encouraging more courteous driving.



Figure 10. Beware of Aggressive Drivers Sign.

5.3.2 Speed Trailers

Excessive speed is probably the most recognized and studied aggressive driving behavior. There are a variety of engineering-related strategies for reducing motorists' speed. The strategy considered during this project was the use of portable trailers equipped with a radar and DMS to display speeds as motorists pass a location. [Figure 11](#) shows an example of a typical speed trailer ([82](#)). However, survey respondents did not indicate that speeding by other drivers was particularly stressful to them, so this measure was not chosen for evaluation.

5.3.3 Entrance Ramp Improvements

A specific source of frustration mentioned during the focus groups was motorists having difficult merging from a freeway entrance ramp. Participants cited merging behaviors such as cutting across the gore area and other drivers trying to enter at a slow speed as being particularly frustrating. The proposed mitigation measures considered in this project are to install flexible delineators to restrict movements across gore areas and double white lines ([Figure 12](#)), install "Merge at Freeway Speeds" signs on ramps, and increase the length of acceleration lanes to facilitate smoother merging at problem locations (rated as the 4th most effective countermeasure by telephone survey participants). At times, motorists' need a full auxiliary lane to handle the traffic volume, which is often a strategy used at bottleneck locations, as mentioned above. One example of such a location that the research team could evaluate for reduction in driver stress is the northbound entrance ramp from Interstate 30 to Loop 12, where restriping to provide an auxiliary lane will be completed during the fall of 2000.



Figure 11. Example Speed Trailer.



Figure 12. Flexible Delineators for Restricting Movements across Ramp Gore Areas.

5.3.4 Improved Construction Scheduling

Construction is often viewed as a necessary evil in the quest for progress. Construction will likely always be part of the commute to work. The focus group and telephone survey discovered that work zones are a significant source of irritation and stress. Survey respondents reported that construction was the most stressful roadway-related irritant. Researchers believe that scheduling is one of the elements of construction that might be improved. A popular suggestion from the focus groups was to perform more construction at night and on weekends. The research team considered this mitigation measure for further evaluation because construction typically has less impact (delay and subsequent frustration) during nights and weekends. TxDOT is due to let the contract for the IH635/US75 interchange in 2001. The contract will encourage the contractor to work 24 hours a day all seven days of the week. Researchers believe that reasonable driver feedback regarding this measure could be obtained on the *Dallas Morning News* (DMN) website.

5.3.5 Improved Public Information

The statement “information is power” is probably true when considering traveler information. A motorist who has accurate and timely information about travel conditions is empowered and can make better and safer choices. Having this information might also help a motorist avoid the stress and frustration associated with driving in congested conditions. A number of intelligent transportation systems technologies are designed to provide accurate and timely information to motorists. DMS, lane control signals, highway advisory radio, in-vehicle navigation devices, and other technologies provide drivers with helpful information on their commutes. Nonrecurrent congestion is more likely to produce stress and frustration because it is often unexpected. Because of this unexpectedness, the research team is considering the improvement of public information about incidents (6th ranked countermeasure in the survey) and scheduled freeway lane closures (9th ranked countermeasure in the survey) as mitigation measures for further study. TxDOT has 57 cameras and 14 DMS already deployed on Dallas freeways, with a website where motorists can obtain information of this kind. However, this website is in its infancy, and the research staff believes an evaluation would probably not be appropriate for this project.

5.3.6 Bottleneck Improvements

The focus groups and telephone interviews generally revealed that motorists experience irritation and stress under congested travel conditions. Congestion is classified as either recurrent (occurs on a regular basis) or nonrecurrent (occurs as a result of an incident). Recurrent congestion is caused by demand exceeding capacity, in some cases as a result of a bottleneck. Walters et al define a bottleneck as a short section of freeway where demand exceeds the capacity in one or more lanes, resulting in congestion upstream and free-flow conditions downstream (83). Walters et al suggest that in many cases the bottleneck constriction can be removed through a relatively low-cost improvement to the short section of freeway within existing right-of-way. This improvement would perhaps only require conversion of a shoulder to a driving lane with slight narrowing of mainlanes from 12 feet to 11 feet. Based on the telephone survey results, the addition of lanes at bottleneck locations is generally viewed as an effective solution. This feedback caused the research team to view improvements at bottleneck locations as a mitigation measure to consider for further evaluation. Respondents ranked this countermeasure as the 3rd most effective in the telephone survey, with 71 percent rating it as highly effective. Figure 13 provides an example of a typical bottleneck location with the roadway lane configuration before and after improvements were implemented. In this example, the bottleneck improvement consisted of converting a shoulder to an auxiliary lane for approximately 600 feet and narrowing the lanes to 11 feet by restriping. Researchers might test this mitigation measure in two ways: reduction in congestion (speed increase for constant volume) and reduction in driver stress as subjectively reported by drivers on the DMN website.

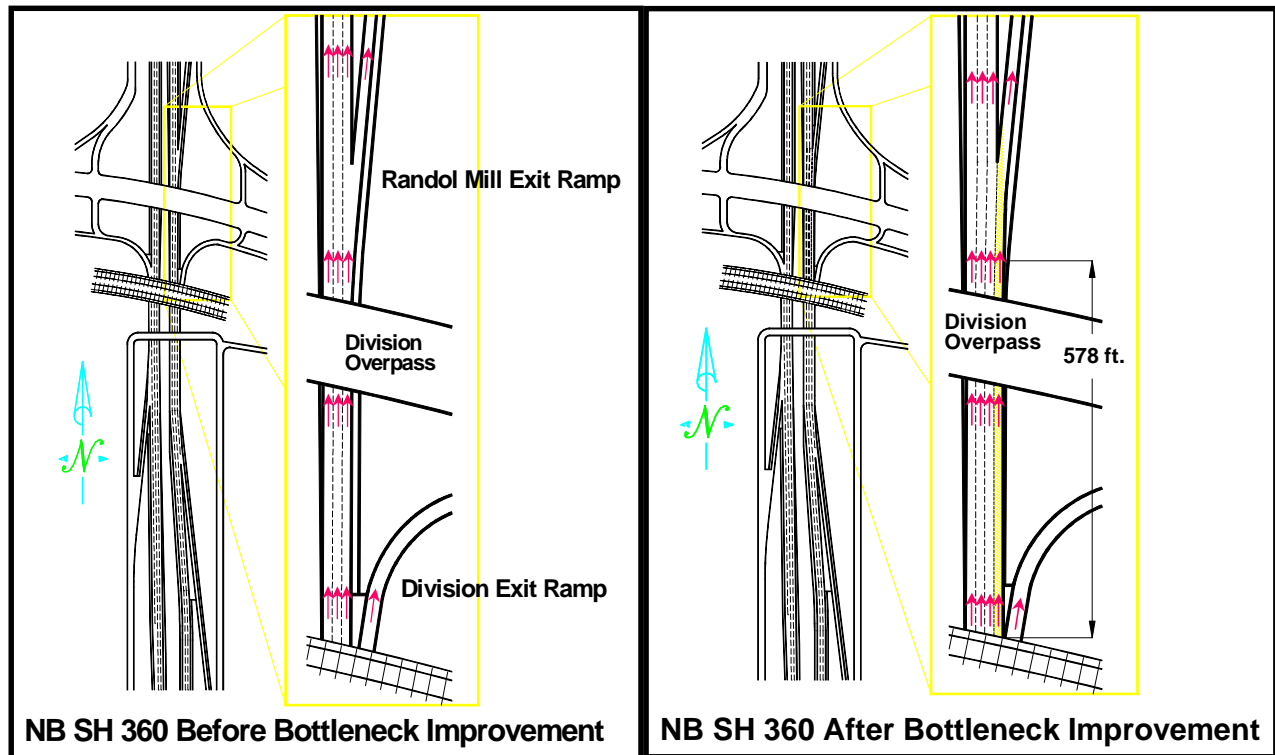


Figure 13. Example Before and After Bottleneck Improvement.

5.3.7 Innovative Merging Strategies

The focus groups and telephone surveys determined that the majority of participants in this project experience frustration at lane closures. The telephone survey revealed that 50 percent of the driving behaviors volunteered as the most likely to raise stress were directly related to lane positioning or queuing. Respondents indicated that a source of specific frustration was when drivers in the open lane in advance of a lane closure are passed by drivers remaining in the closed lane and merging into the open lane ahead of them, often at the last possible second. The research team identifies this behavior, where drivers in a closing lane bypass drivers in an open lane, as queue jumping. The literature review determined that there are a number of different strategies being used, primarily at work zones, to mitigate the frustration (and potentially aggressive driving and road rage) experienced by drivers.

Late Merge Traffic Control Concept. The late merge is a traffic control concept developed by PennDOT for use in rural work zones (53). Typical traffic control plans work well during most hours of the day; however, when traffic demand exceeds capacity of the work zone, problems occur, which is what prompted the development of the late merge strategy. The objectives of the late merge concept are to reduce the queue length by 50 percent, decrease potential for accidents at the tail of the queue, and lessen driver anxiety and frustration. Figure 14 shows a typical layout for the late merge traffic control plan on a rural four-lane interstate highway. Researchers from the University of Nebraska-Lincoln conducted field studies to evaluate the late merge concept. Field personnel collected volume, lane distribution, queue length, vehicle type, and speed data to assess the effectiveness of the strategy. The following list provides some of the major findings of the evaluation:

- Speed profiles showed that both passenger cars and trucks drove faster in the left lane (i.e., the lane being dropped) versus the right lane.
- The concept did not work as effectively as hoped based on the lane distribution data obtained during both free-flow and congested flow periods.
- Researchers observed that when a breakdown situation where the length of queue exceeded 2 miles during the field study, the lane distribution was close to 50/50 (i.e., vehicles behaved according to the late merge concept).
- A large portion of the motorists did not follow the directions given by the traffic signs and truck drivers were especially reluctant to remain in the closed lane.
- A common case observed during congested periods was that of two trucks blocking both lanes by traveling side-by-side at the same, generally very slow, speed.
- Still, an independent study conducted by a consulting firm in Pennsylvania (84) determined that the late merge strategy increased the capacity of the work zone by as much as 15 percent.

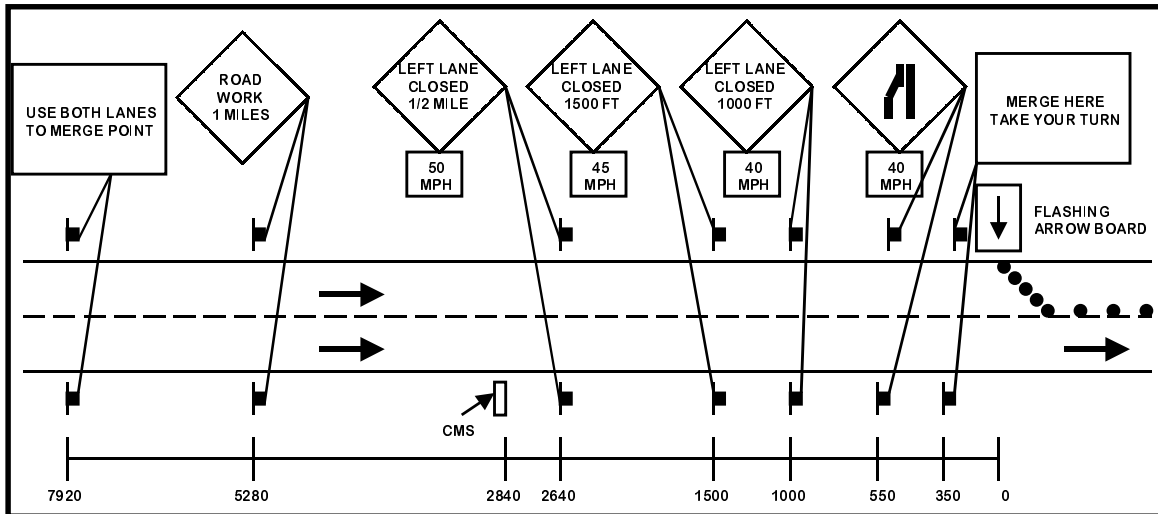


Figure 14. Late Merge Traffic Control Plan.

Another component of the evaluation was surveys of drivers who had traversed one of the field sites (54). The surveys revealed that late merge detractors said that “drivers don’t follow instructions,” “does not prevent drivers from cutting in front of them,” “signs were confusing,” and “having one merge point increases congestion.” Late merge proponents said that “not having to worry about changing lanes” and “being able to use either lane to pass slower vehicles” were benefits. The study results, especially the increased capacity of merging operations, caused this project’s research team to consider the late merge strategy as a mitigation measure for further evaluation. The research staff believes that signing can be improved, and variation could be tested in the driving environment simulator (DESi) at TTI.

Zippering Traffic Control Concept. Zippering is a traffic control concept developed by researchers at Delft University in the Netherlands (85). Delft researchers conducted focus groups with motorists in Rotterdam, a congested region, to discuss problems with freeway operations. Participants indicated that they often had difficulty at lane drops. The Department of Transport wanted to influence lane changing at lane drops and therefore requested a study. The basic strategy of zippering is to reduce queue extent, improve queue discharge rate by concentrating lane changing closer to the lane drop, and to increase the frequency of the zippering maneuver. Zippering means that each driver does not change lanes until a fixed distance from the lane drop, immediately behind the follower of their original leader. The research hypothesis was that traffic flow would be more efficient and safer when the prevalence of zippering was high.

Figure 15 is a representation of the four phases in the mandatory lane changing process at a lane drop and the five types of lane changing maneuvers used by researchers during the evaluation. The signing used to promote zippering at the test site is shown in Figure 16. Field personnel placed a set of signs 1 km upstream of the lane drop to warn the motorist which lane is dropping (phase 1—look for gap). Another sign, positioned 650m prior to the lane drop adjacent to the closing lane, tells the motorist to begin to “Zip in 300m” (phase 2—adjusting speed). The final set of signs is placed 300m before the lane drop (phase 3—merging). The sign adjacent to the lane

being dropped includes the instruction to “Zip Here.” Delft researchers designed the sign adjacent to the lane being continued to say “Allow Drivers to Zip” (phase 4—adjusting following distance). Preliminary results from the evaluation of sites with the zipping traffic control configuration have indicated that neither objective (i.e., reduced queue length and improved queue discharge rate) was achieved by the promotion of zipping. The University of Delft plans further research on this concept. Feedback from approximately 400 drivers revealed that 50 percent understood the signs and almost everyone (97 percent) expected zipping to improve throughput. This positive feedback caused the Delft research team to view the zipping concept as a mitigation measure to consider for further evaluation.

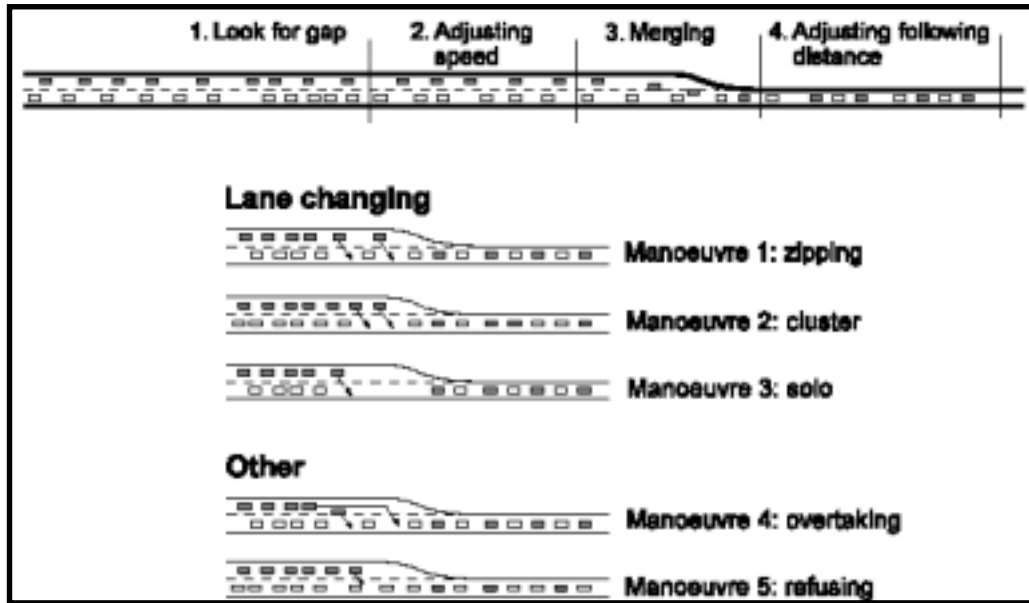


Figure 15. Lane Changing Phases and Maneuvers at a Lane Drop.

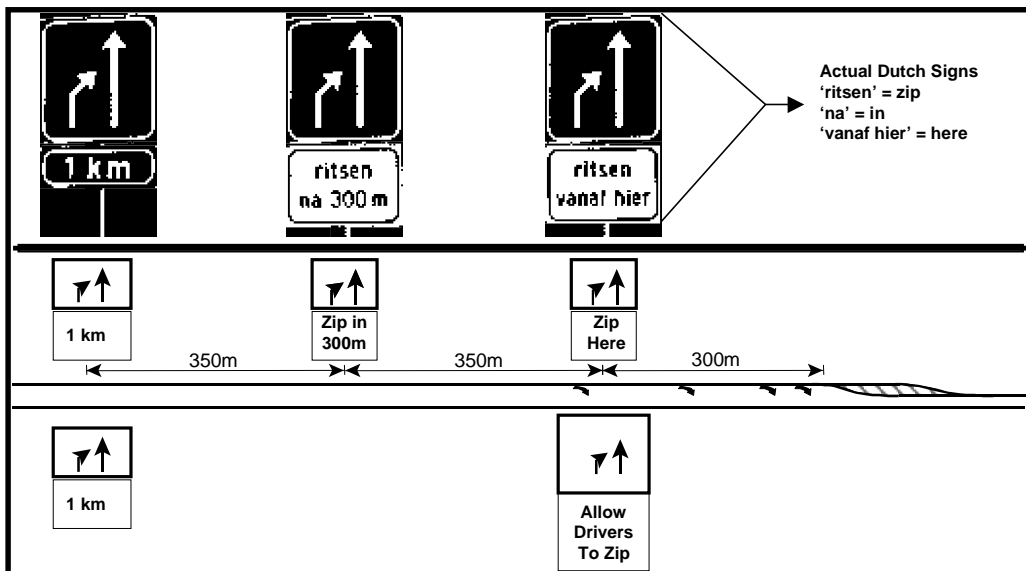


Figure 16. Zipping Traffic Control Plan.

Static and Dynamic Merge Enforcement System. The Michigan Department of Transportation (MDOT) recently implemented and is testing new merge enforcement systems (86). MDOT and the Michigan State Police have established five test locations for enforcement of proper merging. MDOT engineers designed the systems to reduce aggressive lane changes by encouraging drivers to switch lanes before the discontinued lane tapers. Both of the systems being deployed in Michigan have basically the opposite strategy of the late merge and zipping traffic control concepts.

MDOT has placed “Do Not Pass” signs in the lane that will be closed ahead. MDOT plans to test different two systems, one “static” and one “dynamic.” In the static system, the “Do Not Pass” signs are always in place and in effect. In the dynamic system, automated detectors sense traffic slowdowns. As traffic slows, the sensors will trigger a chain reaction and activate an earlier sign that begins flashing a “Do Not Pass” warning. In the dynamic system, the “Do Not Pass” signs are in effect only when the attached lights are flashing. The initial sign will always have its lights flashing. Once the lights are flashing, motorists continuing to drive and pass vehicles in adjacent lanes will be ticketed, facing fines of up to \$200. The research team added the static and dynamic merge enforcement systems to the list of mitigation measures to consider for further evaluation; however, obtaining the higher level of enforcement required may make this concept infeasible for testing during this project.

5.4 RECOMMENDED MEASURES FOR FURTHER TESTING

The final process undertaken by the research team was the selection of the most promising mitigation measures for inclusion in the second year evaluation and testing. Because of the limited budget and scope, the research team decided that only three mitigation measures would be selected for further evaluation. The research team considered all of the [educational-](#), [enforcement-](#), and [traffic engineering-](#)related mitigation measures described previously in this chapter. The research team selected the following mitigation measures:

5.4.1 Mitigation Measure #1—Innovative Merge Strategies

Merging difficulties accounted for over half of the of the number one volunteered stress-producers, and a majority (62.1 percent) of telephone survey respondents rated improving signs and pavement markings in advance of lanes closures as a highly effective countermeasure. These results prompted the research team to select the evaluation of an innovative merge strategy in an urban location as a mitigation measure for the second year of this research. Researchers plan to evaluate a merge strategy similar to the late merge traffic control concept in the DESi laboratory setting and at one or more field sites in the Dallas area. The DESi is comprised of four components: a full-size 1995 Saturn SL automobile, four computers, three projection units, and a projection screen (87). [Figure 17](#) shows a rendering of the simulator. The DESi is designed to allow participants to “drive” a real vehicle through realistic computer-generated driving environments while controlling acceleration, braking, and steering—exactly like they would in the real world. In this case, researchers will use the DESi to evaluate different signing combinations and strategies for optimizing merging in advance of lane drops. This simulation will provide the research team with invaluable feedback prior to field implementation.

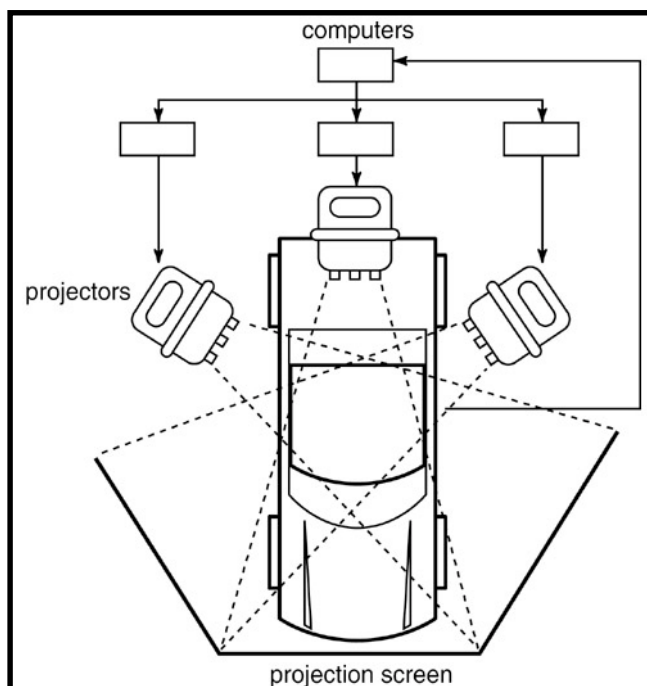


Figure 17. TTI Driving Simulator.

5.4.2 Mitigation Measure #2—Bottleneck Improvements

The research team felt that evaluating the benefits of bottleneck improvements for mitigating aggressive driving had merits for further evaluation and testing. The telephone survey confirmed that this countermeasure approach is one of the most effective in the eyes of motorists that regularly commute. TxDOT personnel plan to let contracts funding several bottleneck improvement projects in late 2000 or early 2001 in the Dallas area. TTI staff will evaluate several locations by performing traditional before and after studies (i.e., collect travel times, volumes, and accidents to measure benefits for reduced delay and improved safety) and also some before and after Internet surveys of commuters. The research team will conduct the Internet surveys to assess the perceived benefits to motorists in terms of reduction in stress/irritation and aggressive driving behaviors (queue jumping, passing on the shoulder, etc.) while traversing the bottleneck freeway section. As a control measure, the research team may also conduct surveys for bottleneck locations where no improvements are planned.

5.4.3 Mitigation Measure #3—Using Photogrammetry to Expedite Incident Clearance

The final mitigation measure selected by the research team for inclusion in the second year is the use of photogrammetry for expediting incident clearance. Telephone survey participants indicated that clearing accidents and other incidents faster was the most effective countermeasure. The Dallas County Sheriff is currently in the process of training their officers to use photogrammetry for incident investigation in lieu of other methods (primarily total stations). Research staff will coordinate with the Dallas County Sheriff to collect before and after

clearance time data. Researchers will use this information to assess whether or not photogrammetry reduces the overall time, particularly time spent on the investigation portion of incident clearance.

REFERENCES

1. Lexis-Nexis Academic Universe. [Online]. Available: <http://web.lexis-nexis.com/>.
2. Fumento, M. (1998, August). Road rage vs. reality. *The Atlantic Monthly*, 282(2), 12-17.
3. Aggressive driving, part 1: Scope of the problem (1999, January). Session 074-A at the 79th Annual Meeting of the Transportation Research Board, Washington D.C.
4. Ward, N., Waterman, M. and Joint, M. (1998). Rage and violence of driver aggression. In *Behavioural Research in Road Safety VIII*. University of Leeds, Department of School Psychology.
5. Elliott, B. J. (1999, May). *Road rage—Media hype or serious road safety issue?* Presented at Third National Conference on Injury Prevention & Control, May 9-12, 1999. Brisbane, Australia. [Online]. Available: <http://drivers.com/behavior/roadrage/elliott.html>.
6. Connell, D. and Joint, M. (1996, November). Driver aggression. In *Aggressive driving: Three studies*. (pp 24-36). Washington, D.C.: AAA Foundation for Traffic Safety. (Available from AAA Foundation for Traffic Safety, 1440 New York Ave, NW, Washington, DC 20005).
7. Martinez, R. (1997, July 17). *Statement of the Honorable Ricardo Martinez, M.D. Administrator National Highway Traffic Safety Administration before the Subcommittee on Surface Transportation Committee on Transportation and Infrastructure U.S. House of Representatives*. [Online]. Available: <http://www.house.gov/transportation/surface/sthearin/ist717/martinez.htm>.
8. Mizell, L. (1997). Aggressive driving. In *Aggressive Driving: Three Studies*. (pp 3-16). Washington, D.C.: AAA Foundation for Traffic Safety. (Available from AAA Foundation for Traffic Safety, 1440 New York Ave, NW, Washington, D.C. 20005).
9. New York State Police (nd). *Aggressive Driving Enforcement*. [Online]. Available: <http://www.troopers.state.ny.us/traf/trafindex.html>.
10. Hohn, R. L. (1998, January). Aggressive driving/road rage: They aren't the same! Arizona Department of Public Safety Tips. [Online]. Available: <http://www.dps.state.az.us/highwaypatrol/aggressivedrivers/aggressivedriversandrr.htm>.
11. Grey, E., Haworth, N., and Triggs, T. (1989, March). *Driver aggression: The role of personality, social characteristics, risk and motivation*. (CR 81) Canberra, Australia: Department of Transport and Communications, Federal Office of Road Safety.
12. Insurance Institute for Highway Safety (1998). Road rage. *Status report* 33(10) 1ff.
13. Bliersbach, G. and Dellen, R. G. (1980). Interaction conflicts and interaction patterns in traffic situations. *International Review Of Applied Psychology*, 29, 475-489.
14. French, D. J., West, R. J., Elander, J., and Wilding, J. M. (1993). Decision making styles, driving style and self-reported involvement in road traffic accidents. *Ergonomics*, 36(6), 627-643.
15. West, R., French, D., Kemp, R., and Elander, J. (1993). Direct observation of driving, self-reports of driver behaviour, and accident involvement. *Ergonomics*, 36(5), 557-567.

16. Elander, J., West, R., and French, D. (1993). Behavioral correlates of individual differences in road-traffic crash risk: An examination of methods and findings. *Psychological Bulletin*, 113(2), 279-294.
17. Parker, D., West, R., Stradling, S., and Manstead, A. (1995). Behavioral characteristics and involvement in different types of traffic accidents. *Accident Analysis and Prevention*, 27(4), 571-581.
18. Reason, J. T., Manstead, A. S. R., Stradling, S.G., Parker, D., and Baxter, J. S. (1991). The social and cognitive determinants of aberrant driving behaviour (Transport and Road Research Laboratory/Contractor Report 253). Crowthorne, Berkshire, U.K.: Department of Transport, Transport and Road Research Laboratory.
19. Forward, S. E. (1997). Measuring driver attitudes using the theory of planned behavior. In T. Rothengatter, and Carbonell-Vaya, E. (Eds.) *Traffic and transport psychology: Theory and application*. (pp 353-366). New York: Elsevier Science, Ltd.
20. Stradling, S. G. and Parker, D. (1997). Extending the theory of planned behavior: The role of personal norm, instrumental beliefs and affective beliefs in predicting driving violations. In T. Rothengatter, and Carbonell-Vaya, E. (Eds.) *Traffic and transport psychology: Theory and application*. (pp 367-374). New York: Elsevier Science, Ltd.
21. Parker, D. (1990). *Intentions to violate*. In Grayson, G. B. and Lester, J. F. (Eds.) Behavioral research in road safety. Proceedings of a seminar held at Nottingham University. (pp.118-130).
22. Parker, D., Manstead, A., Stradling, S., Reason, J. and Baxter, J. (1992). Intention to commit driving violations: An application of the theory of planned behaviour. *Journal of Applied Psychology* 77(1), 94-100.
23. Parker, D., Manstead, A., Stradling, S., and Reason, J. (1992). Determinates of intention to commit driving violations. *Accident Analysis and Prevention*, 24, 117-131.
24. Jonah, B. A. (1997). Sensation seeking and risky driving: A review and synthesis of the literature. *Accident Analysis and Prevention* 29(5), 651-665.
25. Appley, M.H. and Trumbull, R. (1967). On the concept of psychological stress. In Appley, M.H. and Trumbull, R. (Eds.) *Psychological stress: Issues in research*. (pp 1-13). New York: Appleton-Century-Crofts.
26. Robertson, S. A. (1987, February). *Literature review on driver stress*. (Report No. TSU/Ref-364) London: Department of Transport, Transport Study Unit.
27. Cox, T. (1985). The nature and measurement of stress. *Ergonomics*, 28(8), 1155-1163.
28. Sadalla, E. (1995, June). *Investigate the effects of driving stress on health*. (Report No. FHWA-AZ-95-421) Phoenix, AZ: Arizona Department of Transportation (Available from the National Technical Information Service, Springfield, VA 22161)
29. Robertson, J., and Southall, D. (1992). *Methods for monitoring driver stress*. (Transport and Road Research Laboratory/Contractor Report 303). Crowthorne, Berkshire, U.K.: Department of Transport, Transport and Road Research Laboratory.

30. Gulian, E., Glendon, I. Matthews, G., Davies, R. and Debney, L. (1988) Exploration of driver stress using self-reported data. In *Road user behavior: Theory and research*. (pp. 342-347). Wolfeboro, NH: Van Gorcum.
31. Gulian, E., Matthews, G., Glendon, A. I., Davies, D. R., and Debney, L.M. (1989). Dimensions of driver stress. *Ergonomics*, 32(6), 585-692.
32. Glendon, A. I., Dorn, L., Matthews, G., Gulian, E., Davies, D. R. and Debney, L. M. (1993). Reliability of the driving behaviour inventory. *Ergonomics*, 36(6), 719-726.
33. Matthews, G., Dorn, L., Hoyes, T. W., Glendon, A. I., Davies, D. R., and Taylor, R. G. (1993, September). *Driver stress and simulated driving: Studies of risk taking and attention*. In Behavioural research in road safety III. *Proceeding of a seminar at the University of Kent*. 1-10.
34. Matthews, G. (1996). Individual differences in driver stress and performance. In *Proceedings of the Human Factors and Ergonomics Society 40th Annual Meeting* (pp.579-583). Santa Monica, CA: Human Factors and Ergonomics Society.
35. Matthews, G.; Desmond, P. A.; Joyner, L, Carcary, B.; and K.Gilliland (1997). A comprehensive questionnaire measure of driver stress and affect. In T. Rothengatter, and E. Carbonell-Vaya, E (Eds.) *Traffic and transport psychology: Theory and application* (pp 317-324). New York: Elsevier Science, Ltd.
36. Matthews, G., Dorn, L., Hoyes, T. W., Davies, D. R., Glendon, A. I. and Taylor, R. G. (1998) Driver stress and performance on a driving simulator. *Human Factors*, 40(1), 136-149.
37. Matthews, G., Joyner, L. A. and Newman, R. (1999). Age and gender differences in stress responses during simulated driving. In *Proceedings of the Human Factors and Ergonomics Society 43rd Annual Meeting* (pp.1007-1011). Santa Monica, CA: Human Factors and Ergonomics Society.
38. Stokols, D., Novaco, R. N., Stokols, J. and Campbell, J. (1978). Traffic congestion, type A behavior, and stress. *Journal of Applied Psychology*, 63, 467-480.
39. Novaco, R. W., Stokols, D., and Milanese, L. (1989, October). Objective and subjective dimensions of travel impedance as determinants of commuting stress. *American Journal of Community Psychology*.
40. Novaco, R. W. (1992). Commuter stress. *Access*, 1992, (1), 29-31.
41. U.S. Department of Transportation (1997, April). *Help get the word out*. Publication DOT HS 808 556 Washington, D.C.: Author.
42. NYS Governor's Traffic Safety Committee. (1999). *Aggressive Driving Topic Index and Overview* [Online]. Available: <http://www.nysgtsc.state.ny.us/aggr-ndx.htm#top> [1999, March 3].
43. Road rage: How to avoid aggressive driving. (1997). (Available from AAA Foundation 1440 New York Ave, NW, Washington, DC 20005).
44. National Safety Council. [Online]. Available: <http://www.nsc.org/>.

45. Larson, J. A. (1996). *Steering clear of highway madness: A driver's guide to curbing stress and strain*. Wilsonville, OR: Book Partners.
46. Leon James. [Online]. Available: <http://www.aloha.net/~dyc/>.
47. Arnold Nerenberg. [Online]. Available: <http://www.drnerenberg.com/roadrage.htm>
48. Shladover, S. E. (1998). Why we should develop a truly automated highway system. Preprint Number 980641 presented at the 77th Annual Meeting of the Transportation Research Board, Washington D.C.
49. Retting, R. A. (1996). Urban motor vehicle crashes and potential countermeasures. *Transportation Quarterly*, 50(3), 19-31.
50. Robertson, S. A. (1988). *Overseas use of driver stress in the process of road design* (Report No: TSU/Ref-415) London: Department of Transport, Transport Study Unit. (Available from the National Technical Information Service, Springfield, VA 22161).
51. Ackert, H., Weisse, J., Kretschmer, B and Landau, K. Method for evaluation of driver stress resulting from road characteristics. (2000, July). In *Proceedings of the IEA 2000/HFES 2000 Congress* (Volume 3 pp. 243-256).
52. Parsons, R. Tassinary, L. G. , Ulrich, R. S., Hebl, M. R. and Grossman-Alexander, M. (1998). The view from the road: Implications for stress recovery and immunization. *Journal of Environmental Psychology*, 18, 113-140.
53. Pesti, G. , Jessen, D. R., Byrd, P. S, and McCoy, P. T. (1999). Driver survey of the late merge work zone control strategy. Paper presented at the 78th Annual Meeting of the Transportation Research Board, Washington D.C.
54. Byrd, P. S, Pesti, G., Jessen, D. R., and McCoy, P. T. (1999). Traffic flow characteristics of the late merge work zone control strategy. Paper presented at the 78th Annual Meeting of the Transportation Research Board, Washington D.C.
55. *Why it's important to define road rage*. (1999, May 14). [Online]. Available: <http://drivers.com/behavior/roadrage/defining.html>.
56. Vest, J., Cohen, W., and Tharp, M. (1997, June). *Road rage USA*. U.S. News Online. [Online]. Available: <http://www.usnews.com/usnews/issue/970602/2driv.htm>.
57. U.S. Department of Transportation, National Highway Traffic Safety Administration (1998). *Aggressive drivers view traffic differently capital beltway focus groups finds*. Traffic Tech Number 175. Washington D.C.: Author.
58. Preusser Research Group (1998). Capital Beltway update: Beltway user focus groups. Interim Report Contract No. DTNH22-97-D-05018. Washington, D.C.: U.S. Department of Transportation, National Highway Traffic Safety Administration.
59. January 1998-Questionnaire Results - Road Rage and Street Sense. [Online]. Available: <http://www.aarp.org/ampie/res198.html>. Original survey: "Road Rage and Street Sense." [Online]. Available: <http://www.aarp.org/ampie/home.html>.
60. James L. and Nahl, D. (1999), "Driver Personality Survey." [Online]. Available: <http://www.aloha.net/~dyc/surveys/survey3/personality.html> [5-20-00].

61. Antonopoulos M. and Whelpley, J. (2000, June). "Aggressive driving survey." [Online]. Available:
http://www.thenewsteel.org/news/documents/show_arc_press.cfm?press_id=340.
62. Public Attitudes Monitor Survey 1997. Conducted by Roper Starch Worldwide for Insurance Research Council. [Online]. Available: through Lexis-Nexis Academic Universe
<http://web.lexis-nexis.com/>.
63. U.S. Department of Transportation, National Highway Traffic Safety Administration (1999). *Speeding and aggressive driving documented in national telephone survey*. Traffic Tech Number 186. Washington, D.C.: Author.
64. Boyle, J., Dienstfy, M. A., and Sothoron, A. (1998a). *Nationwide survey regarding speeding and other unsafe driving action, Volume I: Methodology*. Final Report to the National Highway Traffic Safety Administration, contract No. DTNH22-95-C-05096. Washington, D.C.: U.S. Department of Transportation.
65. Boyle, J., Dienstfy, M. A., and Sothoron, A. (1998b). *Nationwide survey regarding speeding and other unsafe driving action, Volume II: Driver attitudes & behavior*. Final Report to the National Highway Traffic Safety Administration, contract No. DTNH22-95-C-05096. Washington, D.C.: U.S. Department of Transportation.
66. Boyle, J., Dienstfy, M. A., and Sothoron, A. (1998c). *Nationwide survey regarding speeding and other unsafe driving action, Volume III: Countermeasures*. Final Report to the National Highway Traffic Safety Administration, contract No. DTNH22-95-C-05096.
67. The Commonwealth Poll (1998, May). [Online]. Available: <http://www.vcu.edu/srl/press/cpoll40a.htm>.
68. Sarkar, S., Martineau, A., Emami, M., Khatib, M., and Wallace, K. Spatial and temporal analyses of the variations in aggressive driving and road rage behaviors observed and reported on San Diego freeways. Preprint for presentation at the 80th Transportation Research Board Annual Meeting, January 2001.
69. Shinar, D. (1998). Aggressive Driving: The contribution of the drivers and the situation. *Transportation Research*, Part F, pp. 137-160.
70. Dollard, J., Doob, L.W., Miller, N.P., Mowrer, O.H., and Sears, R.R. Frustration and aggression. New Haven, Connecticut: Yale University Press, 1939.
71. Dallas/Fort Worth Intelligent Transportation Systems Home Page. [Online]. Available: <http://dfwtraffic.dot.state.tx.us/>.
72. Dr. Driving's Road Rage and Aggressive Driving Prevention Home Page. [Online]. Available: <http://www.aloha.net/~dyc/index.html>.
73. San Antonio Police Department Drive Smart Campaign Home Page. [Online]. Available: <http://www.ci.sat.tx.us/sapd/aggressive.htm>.
74. AAA Foundation for Traffic Safety Home Page: Road Rage Public Service Announcements. [Online]. Available: <http://www.aaafoundation.org/multimedia/RealAud.htm>.
75. Arizona Department of Public Safety Home Page: Press Release Announcing a New Law for Aggressive Drivers—August 20, 1998. [Online]. Available: <http://www.dps.state.az.us/>.

76. Colorado State Police Home Page: Press Release Announcing the Star CSP Program—June 19, 1998. [Online]. Available: http://www.state.co.us/gov_dir/cdps/csp.htm.
77. National Highway Traffic Safety Administration Home Page: Aggressive Driving Enforcement—Strategies for Implementing Best Practices. [Online]. Available: <http://www.nhtsa.dot.gov/people/injury/enforce/aggressdrivers/aggenforce/index.html>.
78. American Traffic Systems Home Page. [Online]. Available: <http://www.atstraffic.com/>.
79. DeChant Consulting Services Home Page: Forensic and Industrial Close Range Photogrammetry. [Online]. Available: <http://www.jps.net/measure/>.
80. Americans Attitudes Toward Aggressive Driving: National Survey Results, The Steel Alliance Home Page. [Online]. Available: <http://www.thenewsteel.org/>.
81. Downs, J. *Steering clear of road rage—Signs to warn drivers of high-risk highways*. Philadelphia Inquirer, Section A, page 1, October 6, 2000. [Online]. Available: http://web.philly.com/content/inquirer/2000/10/06/front_page/SSIGN06.htm.
82. RU2System Home Page: Radar Speed Signs and Trailers. [Online]. Available: <http://www.ru2systems.com/>.
83. Walters, C.H. et. al. *Methodology for assessing the feasibility of bottleneck removal*. Research Report 1232-17, Texas Transportation Institute, Texas A&M University, College Station, Texas, November 1992.
84. *Freeway construction work zone safety enhancement report*. Orth-Rodgers & Associates, Inc., 230 South Broad Street, Philadelphia, Pennsylvania, 1995.
85. Dijker, T. and Bovy, P. *Influencing lane changing at lane drops*. Preprint presented at the 78th Transportation Research Board Annual Meeting, January 1999.
86. Michigan Department of Transportation Home Page: September 12, 2000 Press Release. [Online]. Available: <http://www.mdot.state.mi.us/communications/press/files/09-14AA.htm>.
87. *TTI steps into the real world of simulation*. Texas Transportation Researcher, Volume 35, Number 1, 1999.
88. U.S. Department of Transportation, National Highway Traffic Safety Administration and Federal Highway Administration (1999, May). *Summary report: Aggressive driving and the law-A symposium*. [Online]. Available: <http://www.nhtsa.dot.gov/people/injury/aggressive/Symposium/>.
89. Goehring, J. B. (2000, January). *Aggressive driving: Background and overview report*. [Online]. Available: <http://www.ncsl.org/programs/esnr/aggrdriv.htm - law>.
90. U.S. Department of Transportation, National Highway Traffic Safety Administration (1998, August). *Strategies for aggressive driver enforcement*. Washington, D.C.: Author.
91. U.S. Department of Transportation, National Highway Traffic Safety Administration (n.d.) *Aggressive driver programs* in Traffic law enforcement packet, Campaign Safe and Sober. [Online]. Available: <http://www.nhtsa.dot.gov/people/outreach/safesobr/16qp/adprograms.html>.

92. Fleck, J. and Smith, B. (1999, March). *Can we make red light runners stop? Red light photo enforcement in San Francisco, California*. [Online]. Available: <http://safety.fhwa.dot.gov/fourthlevel/pdf/fleck.pdf>.
93. Daniel Consultants, Inc. (1998, September). *Aggressive driver imaging and enforcement. Evaluation report—Impact of media campaign & effects on safety and productivity*. (Revised draft final report prepared for Science Applications International Corporation, McLean, VA 22102-3305).
94. Hendricks, B. (2000, April). Cops target “aggressive drivers.” *San Antonio Express-News*, April 4, 2000, 1B.
95. Text of Nevada 70th State Legislature Bill AB457 (1999) Nevada State Legislature web site. [Online]. Available: <http://www.leg.state.nv.us/70th/Bills/SEARCH/70query.htm>.
96. Synopsis of an act to amend title 21 of the Delaware Code relating to aggressive driving. (1999). Delaware General Assembly website. [Online]. Available: <http://www.legis.state.de.us/Legislature.nsf/?Opendatabase>.
97. The NHTSA legislative tracking application (2000). [Online]. Available: <http://www.nhtsa.dot.gov/ncsl/>.

APPENDIX A: SUMMARY OF AGGRESSIVE DRIVING ENFORCEMENT AND LEGISLATIVE ACTIVITIES

In January 1999 the National Highway Traffic Safety Administration and the Federal Highway Administration jointly sponsored an “Aggressive Driving and the Law” symposium (88). The goal of the symposium, attended by public safety, adjudication, and legal representatives, was to develop action steps toward solving the problem of aggressive driving. Breakout sessions and subsequent recommendations for action addressed aggressive driving from six perspectives:

- statutory approaches,
- applied technology,
- charging decisions,
- sentencing strategies,
- community leadership, and
- enforcement strategies.

The statutory breakout group recommended that “most states should consider an aggressive driving law, if only for its social aspects...” and should examine existing laws with an eye toward “...combining offenses to derive a unique aggressive driving charge as something separate and distinct.” In enacting aggressive driving statutes, the group recommended that:

- Conviction for an aggressive driving violation should involve a significant number of points and/or a minimum license suspension.
- Enhanced penalties should accompany repeat violations or those involving serious injury or death.
- The states and federal government should pass enabling legislation to permit use of advanced technology for enforcement.
- All states should implement public information and driver education programs on aggressive driving, to be taken during pre-license driver education classes and again prior to license reinstatement. Initial driver training programs should include aggressive driving and rage management training.
- Steps should be taken to have the National Committee on Uniform Traffic Laws and Ordinances (NCUTLO)—publisher of the Uniform Vehicle Code—develop a model provision pertaining to aggressive driving for consideration by the states.

- An analysis should be prepared and distributed of each state's statutes, both misdemeanor and felony, that are available to deal with aggressive driving. These statistics should be compiled and made available to other states.

Unanimity was not evidenced among the recommendations of the various groups concerning statutory actions. The "charging decisions" group did not believe that new statutes were needed to deal with aggressive driving violations because such violations are typically already covered by reckless driving laws. In those states where legislative action is needed, the aggressive driving behavior should be added to the reckless driving statute. This group suggested that written guidelines be developed for use by prosecutors and law enforcement personnel in charging and disposing of aggressive driving cases. It is also interesting to note that the NCUTLO apparently does not share the opinion that states should enact new aggressive driving laws. An overview of aggressive driving issued by the National Conference of State Legislatures reports that the NCUTLO:

... recently adopted a policy stating that although aggressive driving is a serious problem, new laws are not needed to address it. NCUTLO advocates for the strong and consistent enforcement of existing traffic laws. Where a driver violates multiple traffic laws, they should be charged with each offense (89).

Other matters considered by participants in the *Aggressive Driving and the Law Symposium* on which consensus was not reached, either within or among the breakout groups, included the issue of whether punishment for aggressive driving behaviors should be accomplished through civil or criminal penalties. The "charging decisions" group believed aggressive driving behavior should be a criminal (jailable) act and not a civil infraction. The members reasoned that if handled as a civil case, "it is too easy for aggressive driving cases to slip through the cracks." The "sentencing strategies" group was split over the civil versus criminal question, noting that treating such offenses as criminal will:

- clog the court system with jury trials;
- require appointment of public defenders. This will impact county and city budgets;
and
- impose a criminal conviction on the offender.

The "enforcement strategies" group of the symposium emphasized the need for other parts of government to work in conjunction with enforcement and recommended encouraging the provision of federal funds for programs at the state level. Other recommendations from this group included:

- Encourage citizen involvement through cellular phone use and one nationwide, standardized number.
- Use red light cameras as a means of extending the capabilities of law enforcement.

- Encourage multi-jurisdictional enforcement efforts between agencies.
- Make federal grant money available to jurisdictions that encourage legislation permitting the use of technology to fight aggressive driving.
- Encourage the use of computer technology in officers' cars to give them access to driver's license histories and a database listing of previous vehicle stops.
- Use variable message signs to advise the motoring public of congestion, delays, crashes, etc., as well as detours and alternate routes.
- Encourage policymakers to take the position of making aggressive driving a priority issue. This push must start at the top and be encouraged—within law enforcement itself.
- Provide federal funds in the form of local grants to support innovative initiatives submitted by law enforcement entities.
- Mandate training for criminal justice practitioners about the technology that is being used to fight aggressive driving; e.g., radar, laser, auto sensing.
- Educate the public about situations that precipitate aggressive driving behavior and encourage appropriate responses.

Much of the discussion and many of the recommendations regarding enforcement issues that emanated from the symposium are consistent with the views and recommendations offered by NHTSA in materials it makes available to law enforcement agent agencies, including, for example, its 1998 guide *Strategies for Aggressive Driver Enforcement* (90).

A significant effort has been undertaken in recent years to reduce the presumed increase in aggressing driving through targeted traffic enforcement programs. Although a majority of these programs predates both the *Aggressive Driving and the Law Symposium* and some of NHTSA's aggressive driver-specific guidance, many implement essentially the same ideas and strategies. For example, many are federally funded, have a public information and education component and encourage citizen involvement, employ unconventional technology or deployment strategies, and/or take advantage of multi-jurisdictional cooperative agreements. Information about these kinds of efforts is available from several sources. Except where additional information or commentary is specifically noted and referenced, the examples of enforcement activities provided below are quoted verbatim from the summary of aggressive driver programs included in NHTSA's traffic law enforcement packet "Campaign Safe and Sober" (91).

Arizona

The Arizona Department of Public Safety aggressive driver program is the longest running in the country. It focuses both on enforcement and a strong media campaign. Unmarked cars, motorcycles, and marked patrol cars are used. Aggressive driver patrols are scheduled each week throughout the State. There is a zero tolerance policy for aggressive driver violations.

Additional information: Goehring reports that this program emphasizes especially “egregious driving behavior such as speeding 20 to 30 mph over the limit, erratic lane changes, and tailgating” (89).

California

California has the longest running aggressive driving media program in the country. The program also uses enforcement patrols. The program, known as Smooth Operator, was started in 1988 to deal with increasing traffic congestion in the major metropolitan areas. This program is no longer being conducted; however, the public information and education materials are still available.

Additional information: A red light photo enforcement program was instituted in the City and County of San Francisco in October 1996. A report evaluating the program indicates that the pilot program has issued nearly 10,000 citations. Court records indicate payment rates for citations issued from photo enforcement are comparable to those issued by officers in the field. A reduction of more than 40 percent in the frequency of violations at photo-enforced locations was observed six months into the pilot. A significant decrease in the number of collisions caused by red light violators citywide is reported as a result of San Francisco’s combined efforts to combat red light running (92).

Colorado

Colorado started its aggressive driver program in late 1997. The state has an extensive media program as well as a proactive enforcement program. The program, known as Aggressive Drivers Are Public Threats (ADAPT), is a statewide program and uses unmarked cars, motorcycles, and aircraft for enforcement. There is considerable public support for the enforcement effort. The Douglas County Sheriff’s Office is also heavily involved in aggressive driver enforcement along with the Colorado State Patrol and other agencies south of Denver.

Additional information: Goehring notes that the program focuses on congested Denver-area highways and includes “an extensive media program and interagency enforcement efforts.” A cell phone number is also provided for the public to report aggressive drivers (89).

Connecticut

This program started in 1997 and uses unmarked cars to identify violators and marked patrol units to take enforcement action. There is a separate 911 system for cellular phone users to report aggressive drivers. Calls to this hotline are routed directly to State Police operators.

Delaware

Delaware started its program known as “Take It Easy” on July 4, 1997. It utilizes marked and unmarked vehicles as well as some nontraditional vehicles such as Chevrolet S-10 Blazers. Any time unmarked vehicles are used, marked patrol units must make the traffic stop. They have also developed a strong media campaign with radio PSAs.

District of Columbia

The Washington, D.C., Metropolitan Police Department is a participating agency in the Smooth Operator program in the metropolitan area. Aggressive driving enforcement continues as part of the department’s regular traffic enforcement.

Florida

St. Petersburg Police Department has developed a program, “Where’s Jockers,” that is a very effective enforcement tool. The program utilizes all types of city equipment from mowers to bucket trucks to detect aggressive drivers. Officer Jockers dresses like a city worker and uses a radar unit to detect violators or observe red light or stop sign violations. He then identifies the violators to officer patrol vehicles in the area who take the enforcement action. Recently, the Sheriff’s Department and Florida Highway Patrol became involved in the program.

Illinois

The Illinois State Police kicked off a statewide aggressive driver campaign on December 19, 1997. The program is the responsibility of each District Commander and is tailored to the individual district. The district utilizes a variety of enforcement tactics including enforcement teams, catch cars, targeted patrols, air operations, covert operations, and speed enforcement.

Indiana

The Indiana State Police began targeting flagrant traffic violators in 1988. That vigorous traffic enforcement targeted the same drivers as current aggressive driving programs: the major difference is the lack of a name. Officers use unmarked, nontraditional law enforcement vehicles and aircraft to detect the aggressive driver. They also use vehicles that appear to belong to the Department of Transportation for enforcement purposes in construction zones.

Maryland

Maryland State Police is a major participant in the Smooth Operator program conducted in the Washington, D.C., metropolitan area. The Maryland State Police aggressive driver program, known as Aggressive Driver Video and Non-Contact Enforcement (ADVANCE), uses digital video cameras coupled with lidar to identify and record aggressive drivers and other violators on the Washington Capital Beltway. This enforcement effort utilizes PSAs. Letters and photographs of the violation are sent to offending drivers. The effectiveness of this program, which started in November 1997, will be measured by before/after opinion polls of the motoring public.

Additional information: The evaluation of the Aggressive Driver Imaging and Enforcement Program (ADIE), referred to above as “ADVANCE”, was designed to determine if the program met the goals of increasing the perception of law enforcement presence and improving both traffic safety and enforcement productivity. The results of the evaluation suggest:

- the perception of enforcement on the target roadway increased,
- the frequency of speeds more than 60 mph decreased,
- the media campaign that was a part of the program increased drivers’ awareness of “the aggressive driving problem,”
- favorable opinion of video enforcement increased from 82 to 85 percent following the media campaign,
- while still less than half, the percentage of motorists who believe law enforcement is effective increased from 41 to 48 percent, and

- although the ADIE technology resulted in more than 200 warnings sent to vehicle owners during the seven-month evaluation period, the prototype equipment was not always reliable (93).

Massachusetts

This program, known as the Drunk, Drugged, and Dangerous Program, began on September 12, 1997, with a large media campaign. The program utilizes a sergeant and three troopers assigned full time to the unit. They drive video-equipped, unmarked cars to conduct the enforcement effort. They also have fostered a good working relationship with the prosecutor's office, Department of Motor Vehicles, and the courts.

Additional information: Goehring indicates that the traffic violations targeted are those that are considered aggressive but do not meet the criteria for the "operating to endanger" law. Also, an "Immediate Threat Form" can be issued that is forwarded to the Registry of Motor Vehicles and may result in a 30-day license suspension (89).

Missouri

The Missouri program utilizes traffic crash and fatality data to select targeted areas. The State Highway Safety Office coordinates the media aspect of the program while the police agencies around the state coordinate the enforcement aspect of the program. The Highway Patrol uses aircraft, unmarked patrol cars, and non-conventional vehicles to detect aggressive drivers. It also involves local law enforcement agencies and sheriff's departments in the enforcement efforts.

New Jersey

New Jersey started its program when it was determined that 63 percent of fatal crashes were the result of violations attributed to aggressive drivers. The multi-agency enforcement program utilizes semi-marked patrol cars as well as unconventional vehicles.

New Mexico

The City of Albuquerque developed a program known as Safe Streets. It utilizes intensive traffic enforcement to reduce violent felony crimes in targeted areas while targeting the aggressive driver. The program identifies high crash locations and areas of high violent felony crimes.

New York

The New York state program started during the July 4, 1997, holiday weekend with a pilot enforcement and education initiative designed to curb aggressive driving. The pilot was successful and has now been expanded to numerous local agencies, sheriff's departments, and the State Police. It uses non-conventional vehicles and unmarked cars for enforcement. Some of the vehicles are equipped with video cameras.

Additional information: The non-conventional police vehicles used include "Slick Roof" cars. Though marked, these cars are not equipped with traditional roof-mounted lighting. Goehring also notes that "road rage vans" are employed for recording driving incidents. The incidents are communicated to troopers in marked cars who make the traffic stop (89).

Ohio

The Ohio State Highway Patrol kicked off its statewide aggressive driver program, known as Targeting Reckless and Intimidating Aggressive Drivers (TRIAD), on July 4, 1997. The aviation division in Columbus is responsible for the administration of TRIAD. It utilizes 13 aircraft and ground units from the Highway Patrol and other local agency vehicles to pursue violators.

Pennsylvania

The Pennsylvania State Police program is known as Ticket the Aggressive Driver. It uses unmarked cars, aircraft, and Department of Transportation vehicles. In some cases, officers in civilian clothes are used to call in violations to other officers in marked units for enforcement action.

Rhode Island

On August 29, 1997, the Rhode Island State Police kicked off its aggressive driver program. The program was started as a result of a 54 percent increase in fatal crashes. Many of the fatal crashes were the result of traffic violations usually attributed to aggressive drivers. Along with a large media campaign, the program utilizes four unmarked cars that are dedicated to the aggressive driving detail.

South Carolina

In early 1997, the Greer Police Department began an extensive education program for both the citizens of the community and the officers. The program is known as Targeting the Aggressive Driver. Its primary purpose is to make everyone aware of the importance of obeying traffic laws and reducing crashes. In addition, an enforcement program was implemented to supplement the education portion. The overall result has been a 22 percent decrease in crashes in the first seven months of the campaign compared with the same period in 1996.

Texas

In the latter half of 1997, the cities of Arlington and Fort Worth began targeting aggressive drivers as a means of reducing crashes and associated injuries. Patrol officers were encouraged to become more involved in traffic enforcement with an increased emphasis on aggressive driving. The team concept of enforcement with marked patrol cars and motorcycles was utilized. A call-in program was developed for citizens to report aggressive drivers. The calls are screened and letters are sent to violators by the police department seeking voluntary compliance with traffic laws. In more serious cases, the traffic unit conducts a follow-up investigation.

Other information: In April 2000, the San Antonio Police Department instituted a “Drive Smart— Be a Cool Operator” aggressive driving enforcement program. An unmarked patrol car is included in the enforcement. In addition to ticketing aggressive driving violators (following too closely, weaving, unsignaled lane changes, etc.) officers also distribute written checklists that tell drivers what actions constitute aggressive driving and appropriate responses (94).

Utah

The Utah Highway Patrol has started an aggressive driver enforcement program in Salt Lake City as a result of the extensive construction project underway on I-15 through the city. Due to massive congestion on the freeway caused by the construction, the Highway Patrol has started

using unmarked cars and other non-conventional police vehicles to patrol for aggressive drivers. A training program has also been developed and is taught by public information officers throughout the State on request.

Virginia

Law enforcement agencies throughout northern Virginia are participants in the Washington, D.C., metropolitan area program known as Smooth Operator. Enforcement efforts against aggressive drivers continue as part of the regular traffic patrol enforcement by troopers.

Washington

The Washington State Patrol started its aggressive driving program on Memorial Day weekend, 1998. A squad was selected to work the aggressive drivers and two unmarked cars and motorcycles were assigned to target flagrant violators. Officers in the unmarked cars spot the aggressive drivers and the motorcycle officers make the stops and take the appropriate enforcement action. The squad is supervised by a motor sergeant with the troopers being rotated on a three-month interval. The initial squad is focusing primarily on the freeway system around Seattle.

Washington Beltway Program

The Smooth Operator program, coordinated by the Fairfax County (Virginia) Police Department, is a multi-agency enforcement and education effort directed toward aggressive drivers throughout the Washington, D.C., metropolitan area. The program utilizes coordinated enforcement waves to deter aggressive drivers and reduce crashes. There are a total of 15 agencies involved in the enforcement project.

Wisconsin

As reported by Goehring, the Milwaukee Police Department initiated a NHTSA-funded law enforcement demonstration project in October 1998. The program is designed to demonstrate and evaluate an innovative enforcement and public information and education program to reduce aggressive driving. It also collects data on aggressive driving enforcement actions, identifies legislative, prosecutorial or judicial needs, and documents methods to obtain citizen support for the project (89).

Program Assessment

With a few exceptions, notably with respect to automated enforcement, the approaches noted above did not require new statutory authorization or enabling legislation. As suggested in the previous discussion of legislative issues, there appears to be a lack of consensus on the need for new laws addressing aggressive driving. Trish Roberts of the National Association of Governors' Highway Safety Representatives suggests that two questions should precede proposals for new legislation:

- Are existing traffic laws being enforced and adequately adjudicated?
- Are aggressive driving laws needed, or are existing laws sufficient?

The number of bills introduced in recent years suggests that at least some lawmakers would answer the former question in the negative and the later in the affirmative.

Jan Goehring of the National Conference of State Legislatures has been summarizing state legislative activity on aggressive driving since at least 1997 (89). In that year, Maryland and Virginia were the only two states in which legislation was introduced to establish specific penalties for aggressive driving offenses. None passed. Goehring reports that in 1998 nine states introduced a total of 26 aggressive driving bills. Thirty-one such bills were introduced in 15 states in 1999.

In May of 1998, Arizona became the first state with a law creating a specific offense called aggressive driving. The offense of aggressive driving occurs when a driver speeds and commits two or more listed offenses that include failing to obey a traffic control device (including a prohibition against driving over the “gore” area entering or exiting a highway), driving recklessly, passing a vehicle on the right by traveling off the pavement, changing lanes erratically, following too closely, and failing to yield right-of-way. The person’s driving must be an immediate hazard to another person or vehicle. The law classifies aggressive driving as a class one misdemeanor. In addition to other penalties, it requires drivers convicted of the offense to attend driver training and education and allows for the suspension of the driver’s license for 30 days. If, within 24 months, a driver is convicted a second time, the person is guilty of a class one misdemeanor and his or her license will be revoked for one year in addition to other penalties (89).

In May 1999, the governor of Nevada signed into law AB 457 that defines the crime of aggressive driving in that state. Similar to Arizona’s law, it defines the misdemeanor of aggressive driving as committing a speeding violation, two or more of the following traffic offenses in the course of one mile (see list below), and creating an immediate hazard to another vehicle or another person:

- failing to obey an official traffic-control device,
- overtaking and passing another vehicle upon the right by driving off the paved portion of the highway,
- improper or unsafe driving upon a highway that has marked lanes for traffic,
- following another vehicle too closely, and
- failing to yield the right of way.

Penalties include the requirement to attend traffic safety courses and a possible 30-day license suspension. For a second or subsequent offense within two years, the offender’s license shall be revoked for a period of one year (95).

Delaware became the third state to enact a law creating an aggressive driving offense, in July 1999. Similar to the other two, under the Delaware statute individuals convicted of three or more

specified offenses as a result of a single incident are guilty of aggressive driving. The synopsis of the act on Delaware's legislative website states:

“Aggressive driving” has become a significant public safety concern in recent years. According to the Delaware State Police and Office of Highway Safety, aggressive driving has been a contributing factor in 67 percent of the 42 fatal crashes that have occurred in Delaware since January 1, 1999. NHTSA estimates that aggressive drivers cause two-thirds of fatal crashes, and one-third of all crashes, nationwide. Current law does not define aggressive driving. This legislation creates a new offense called aggressive driving which will be based on the combination of unsafe and unlawful driving actions that demonstrate a disregard for safety. Specifically, the bill defines aggressive driving in terms of existing Title 21 offenses such as failure to yield, unsafe lane change, disregarding of a traffic control device, failure to stop, following too closely, passing on a shoulder, and speeding. Individuals convicted of three or more of these offenses as the result of a single incident would be guilty of aggressive driving and would be subject to increased penalties. Offenders would also be required to attend a class designed to modify aggressive driving behaviors. Individuals convicted of a second or subsequent offense within three years would be subject to suspension of driving privileges for a period of thirty days (96).

Aggressive driving legislative proposals introduced or considered in 1999 and 2000 state legislative sessions are summarized in Tables 17 and 18, respectively (97).

Table 17. Summary of Status of 1999 State Legislature Bills Addressing Aggressive Driving.

State	Bill Number	Description	Status
Connecticut	SB 920	Permits the Commissioner of Motor Vehicles to require a driver with multiple moving violations to attend a course to control aggressive driving.	Jan. 25, 1999: Introduced. March 1, 1999: Drafted by Committee. April 19, 1999: Failed Joint Favorable Deadline.
Delaware	HB 364	Establishes the offense of aggressive driving. Provides that individuals convicted of three or more specified offenses as a result of a single incident are guilty of aggressive driving. Requires offenders to attend behavior modification course and license suspension for repeat offenders.	June 22, 1999: Introduced. July 22, 1999: Signed by Governor.
Florida	SB 2390	Defines the crime of aggressive driving and establishes penalties.	Mar. 2, 1999: Introduced. Mar. 16, 1999: To Senate Committee on Transportation. April 30, 1999: Died in Committee.
Hawaii	HB 1535	Establishes the offense of aggressive driving and sets penalties.	Jan. 28, 1999: Introduced. Feb. 5, 1999: Referred to House Committee on Transportation.
Hawaii	SB 1206	Creates the offense of aggressive driving; imposes penalties similar to Driving Under the Influence.	Jan. 26, 1999: Introduced. Feb. 2, 1999: To Senate Committee on Transportation.
Hawaii	SB 1390	Establishes the offense of aggressive driving; sets penalties.	Jan. 26, 1999: Introduced. Feb. 3, 1999: Senate Committee on Transportation and Intergovernmental Affairs.
Illinois	HB 2233	Defines the crime of road rage and allows the Secretary of State to revoke the driver's license of a person convicted of road rage or aggravated road rage.	Feb. 19, 1999: Introduced and referred to House Committee on Rules. Feb. 26, 1999: Referred to House Committee on Transportation and Motor Vehicles. March 3, 1999: In House, placed on Short Debate Calendar, second reading. March 26, 1999: Rereferred to House Rules Committee.
Kansas	SB 49	Regulates traffic; concerns aggressive driving.	January 14, 1999: Introduced. January 15, 1999: Referred to Senate Committee on Judiciary.
Massachusetts	HB 3159	Defines the crime of aggressive driving. The offenses of speeding, weaving and switching lanes without signal, and making obscene gestures make up the crime of aggressive driving.	Jan. 6, 1999: Introduced and referred to Committee on Public Safety. July 6, 1999: Combined with study order H4489.

Table 17. Summary of Status of 1999 State Legislature Bills Addressing Aggressive Driving.

Maryland	SB 710	Prohibits aggressive driving and sets out penalties.	Feb. 22, 1999: Introduced. March 22, 1999: Referred to House Committee on Commerce and Government Matters. Session adjourned April 12, 1999, bill died.
Michigan	SB 287	Relates to traffic control; regards violations; establishes aggressive driving as a civil infraction.	Feb. 9, 1999: Introduced. March 10, 1999: In Senate, read third time.
Michigan	HB 4279	Relates to traffic control and aggressive driving; prohibits and provides penalties.	Feb. 16, 1999: Introduced and referred to House Committee on Criminal Law and Corrections.
New Hampshire	LSR 2024	Regarding road rage.	Sept. 22, 1999: Introduced.
Nevada	AB 457	Defines the crime of aggressive driving.	March 10, 1999: Introduced and referred to Assembly Committee on Transportation. April 15, 1999: Referred to Senate Committee on Transportation. May 24, 1999: To Governor. May 28, 1999: Signed by Governor.
New York	AB 16	Enacts the aggressive driving awareness act; provides that the governors' traffic safety committee with cooperation from the departments of motor vehicles, transportation, the division of state police and thruway authority shall design and implement a public education campaign to educate motorists with regard to the dangers associated with aggressive driving; requires other agencies and authorities to cooperate therewith.	December 30, 1998: Introduced and referred to Assembly Committee on Transportation.
New York	SB 643	Defines and establishes the crime of aggressive driving, requires aggressive driving prevention instruction to be included in pre-licensing courses for drivers.	January 4, 1999: Introduced and referred to Senate Committee on CODES. April 9, 1999: Amended in Senate Committee on CODES. April 14, 1999: From Senate Committee on CODES. June 17, 1999: To Senate Committee on Rules.
New York	SB 84	Requires that pre-licensing and defensive driving courses devote a minimum of 15 minutes to road rage awareness. Directs commissioner of motor vehicles to establish road rage curriculum; defines the term "road rage."	January 6, 1999: Introduced and referred to Senate Committee on Transportation. March 30, 1999: Amended on the Senate Floor. June 1, 1999: To Assembly Committee on Transportation.
New York	AB 1920	Creates and defines the new crime of aggressive driving as a class E felony; establishes a minimum one year sentence when court imposes alternative definite sentence.	January 19, 1999: Introduced and referred to Assembly Committee on CODES.

Table 17. Summary of Status of 1999 State Legislature Bills Addressing Aggressive Driving.

New York	AB 2129	Authorizes the Department of Motor Vehicles, in consultation with the American Automobile Association, to study the effects of driver training programs on driving practices, versus the incidence of traffic violations, traffic accidents, and road rage; requires reporting to the governor and the legislature.	January 21, 1999: Introduced and referred to Assembly Committee on Transportation.
New York	SB 1515	Creates and defines the new crime of aggressive driving as a class E felony; establishes minimum one year sentence when court imposes alternative definite sentence.	January 25, 1999: Introduced and referred to Senate Committee on CODES.
New York	SB 2786	Directs the Superintendent of State Police to establish the Stop Aggressive Vehicular Encounters Program within the Division of State Police and other police departments and law enforcement agencies to provide for aggressive, concentrated and collaborative enforcement of certain provisions of the Vehicle and Traffic Law.	Feb. 18, 1999: Introduced and referred to Senate Committee on Finance.
New York	AB 2317	Creates crime of aggressive driving as a class E felony, defining it as recklessly creating a substantial risk of serious physical injury to another person, displaying a deadly weapon, or placing another person in reasonable fear of physical injury, serious physical injury or death; requires an educational component on aggressive driving in prelicensing courses.	Jan. 25, 1999: Introduced and referred to Assembly Committee on Transportation.
New York	AB 2373	Creates crimes of criminally aggressive driving in the third, second and first degrees. Requires pre-licensing education, provides for suspension or revocation of drivers' licenses for violations, prohibits the issuance of restricted licenses to persons convicted of criminally aggressive driving.	Jan. 25, 1999: Introduced and referred to Assembly Committee on Transportation.
New York	AB 5187	Requires that pre-licensing and defensive driving courses devote a minimum of fifteen minutes to road rage awareness, defines the term road rage.	Feb. 23, 1999: Introduced. April 6, 1999: Amended in Assembly Committee on Transportation.
New York	SB 5505	Defines the crime of aggressive driving and establishes penalties. Requires prelicensing education regarding aggressive driving and for license suspension and revocation.	April 21, 1999: Introduced. June 16, 1999: To Assembly Committee on Codes.

Table 17. Summary of Status of 1999 State Legislature Bills Addressing Aggressive Driving.

Oregon	HB 2836	Creates offense of aggressive driving; punishes by maximum fine of a specified amount, maximum term of imprisonment of six months, or both.	Feb. 19, 1999: Introduced and referred to House Committee on Judiciary Criminal Law. Session adjourned June 30, 1999, bill died.
Oregon	SB 607	Creates the offense of aggressive driving; punishes by maximum fine, maximum term of imprisonment or both.	Feb. 15, 1999: Introduced and referred to Senate Committee on Judiciary. Session adjourned June 30, 1999, bill died.
Rhode Island	HB 5974	Establishes the offense of “aggressive driving” and would provide penalties for committing such offense.	Feb. 2, 1999: Introduced and referred to House Committee on Judiciary. April 8, 1999: Transferred to House Committee on Finance.
Rhode Island	HB 5809	Defines aggressive driving; provides for penalty of a specified amount and 30 hours of community service and license suspension.	Feb. 2, 1999: Introduced and referred to House Committee on Judiciary.
Rhode Island	SB 327	Establishes the offense of aggressive driving and provides penalties for committing such offense.	Feb. 3, 1999: Introduced and referred to Senate Committee on Judiciary.
Utah	HB 22	Relates to motor vehicles; amends certain reckless driving penalties; requires completion of a defensive driving course that includes education on the effects of aggressive and reckless driving in certain circumstances.	December 22, 1998: Prefiled. January 18, 1999: Introduced. January 19, 1999: Failed to Pass House.
Virginia	HB 895	Defines aggressive driving; makes it a misdemeanor punishable by a fine of \$200 to \$2500 and confinement in jail for one month to one year.	January 26, 1998: Introduced. June 18, 1998: Regular session adjourned. Bill carried over to 1999 session. Dec. 17, 1998: Died in Committee.
Virginia	SB 546	Provides that anyone who engages in “aggressive driving” shall be guilty of a Class 1 misdemeanor, including a mandatory, minimum fine of \$250 not subject to suspension by the court; defined as committing any two or more of the following violations in a single act or series of acts in close proximity to another motor vehicle: an unsafe lane change, following too closely, failure to yield to an overtaking vehicle, speeding, and racing.	January 26, 1998: Introduced. June 18, 1998: Regular session adjourned April 23, 1998, bill carried over to 1999 Regular Session.
Washington	SB 5291	Creates the crime of aggressive driving to combat road rage.	January 18, 1999: Introduced January 19, 1999: Referred to Senate Committee on Judiciary. March 12, 1999: Passed Senate, sent to House. March 16, 1999: To House Committee on Criminal Justice and Corrections.

Source: NHTSA legislative tracking application (97).

Table 18. Summary of Status of 2000 State Legislature Bills Addressing Aggressive Driving.

State	Bill Number	Description	Status
Connecticut	SB 476	Requires those convicted of multiple moving violations to attend a course designed to help control aggressive driving.	Feb. 23, 2000: Introduced and referred to Joint Committee on Judiciary. 4/5/00: Referred to Joint Committee on Transportation. 5/3/00: Session adjourned, no action on bill after 4/5/00.
Delaware	HJR 13	Creates a toll-free hot line for reporting incidents of road rage.	Jan. 2000: Remains in House Committee on Public Safety.
Florida	HB 373	Defines the offense of aggressive careless driving.	Dec. 8, 1999: To House Interim Committee on Criminal Justice. 2/21/00: In House Interim Committee on Transportation, temporarily deferred. 3/22/00: Amended in House Committee on Judiciary. 4/11/00: Passed with amendment from House Committee on Law Enforcement and Crime Prevention. 5/5/00: Died in Committee.
Florida	SB 732	Defines the offense of aggressive careless driving.	Dec. 8, 1999: Prefiled. 4/17/00: In Senate Committee on Transportation: NOT considered. 5/5/00: Died in Committee.
Hawaii	HB 1535	Defines the offense of aggressive driving and establishes penalties for such offense.	Aug. 1999: Carried over to 2000 session.
Hawaii	SB 1206	Establishes the offense of aggressive driving and imposes penalties similar to those for DUI. Includes suspension of license and mandatory attendance at an anger mgmt. or traffic safety course.	Aug. 1999: Carried over to 2000 session.
Hawaii	SB 1390	Creates the offense of aggressive driving and establishes penalties.	Aug. 1999: Carried over to 2000 session. 2/17/00: Passed out of Senate Committee on Transportation and Intergovernmental Affairs. 3/3/00: Second reading in House. 3/15/00: Passed House Committee on Transportation.
Iowa	SB 2058	Establishes the crime of aggressive driving.	Feb. 1, 2000: Referred to Senate Committee on Transportation. 4/18/00: Session adjourned, no action on bill after 2/1/00.
Illinois	HB 2233	Defines and establishes the offense of road rage.	Jan. 2000: Remains in House Committee on Rules.

Table 18. Summary of Status of 2000 State Legislature Bills Addressing Aggressive Driving.

Kansas	SB 49	Establishes offense of aggressive driving.	July 1999: Carried over to 2000 session. 4/10/00: Session adjourned, bill died in Committee.
Massachusetts	HB 4489	Combines several bills together, including HB 3159, concerning aggressive driving. Authorizes the Committee on Public Safety to conduct a study regarding this issue and other traffic safety issues.	Jan. 2000: Remains in Committee on Public Safety.
Maryland	SB 217	Defines the crime of aggressive driving and establishes penalties.	Jan. 25, 2000: Referred to Senate Committee on Judicial Proceedings. 2/18/00: Referred to House Committee on Commerce and Gov't Affairs. 3/10/00: Reassigned to House Committee on Judiciary. 4/10/00: Died in Committee.
Maryland	HB 1234	Defines the offense aggressive driving, specifies penalties.	Feb. 11, 2000: Referred to House Judiciary Committee. 3/25/00: Died in Committee.
Maryland	HB 417	Defines the crime of homicide by aggressive driving for a person who commits two or more specified violations in connection with a single traffic incident that results in the death of another person.	2/3/00: Introduced. 3/23/00: Referred to Senate Committee on Judicial Proceedings. 4/5/00: Senate refused to concur with House amendments. To Conference Committee.
Michigan	HB 4279	Defines aggressive driving and provides penalties for such offense.	Jan. 2000: Remains in House Committee on Criminal Law and Corrections.
Michigan	SB 287	Establishes the civil infraction of aggressive driving.	Jan. 2000: Remains in Senate after third reading.
Missouri	SB 799	Concerning the offense of aggressive driving.	Jan. 10, 2000: Introduced. Jan. 24, 2000: Referred to Senate Committee on Civil and Criminal Jurisprudence.
Missouri	HB 2122	Concerning aggressive driving.	3/9/00: Introduced. 3/13/00: Second reading in House. 3/30/00: To House Committee on Criminal Law.
New Hampshire	HB 1529	Regarding road rage.	9-22-99: Introduced. Dec. 1999: Referred to House Committee on Criminal Justice and Public Safety. 2/24/00: Failed to pass House.
New York	AB 1920	Establishes the crime of aggressive driving and establishes a one year minimum sentence.	Jan. 5, 2000: Referred to Assembly Committee on Codes.
New York	AB 2317	Establishes the crime of aggressive driving.	Jan. 5, 2000: Referred to Assembly Committee on Codes.
New York	AB 2373	Establishes the crime of aggressive driving in the third, second and first degrees.	Jan. 5, 2000: Referred to Assembly Committee on Transportation.

Table 18. Summary of Status of 2000 State Legislature Bills Addressing Aggressive Driving.

New York	SB 643	Creates the class E felony of aggressive driving. Requires aggressive driving prevention instruction to be included in drivers ed courses.	1/6/99: Introduced. 1/5/00: Recommitted to Senate Committee on Codes.
New York	AB 5187	Requires driver's education courses to devote at least 15 minutes covering road rage awareness.	Jan. 5, 2000: Referred to Assembly Committee on Transportation. 3/22/00: Amended in Assembly Committee on Transportation.
New York	SB 1515	Establishes the crime of aggressive driving.	Jan. 5, 2000: Referred to Senate Committee on Codes.
New York	SB 2786	Establishes the Stop Aggressive Vehicular Encounters Program.	Jan. 5, 2000: Referred to Senate Committee on Finance.
New York	SB 5505	Establishes the offense of aggressive driving in the third, second, and first degrees.	Jan. 5, 2000: Recommitted to Senate Committee on Codes.
Oklahoma	HB 1920	Prohibits aggressive driving and establishes a definition of the crime aggressive driving.	Jan. 6, 2000: Prefiled. Jan. 21,2000: To House Committee on Public Safety. 4/5/00: Passed Senate, to House for concurrence. 4/12/00: Conference Committee, House names conferees. 4/26/00: To Conference Committee. 5/4/00: Conference Committee report submitted. 5/23/00: To Second Conference Committee.
Oklahoma	SB 856	Relates to aggressive driving.	Jan. 14, 2000: Prefiled.
Rhode Island	HB 7214	Defines crime of aggressive driving.	2/2/00: Introduced and referred to Joint Committee on Highway Safety. 5/24/00: Passed as amended from Joint Committee on Highway Safety. 6/6/00: Passed from House, sent to Senate. 6/7/00: Held on Senate desk. 7/13/00: Signed by Governor.
Rhode Island	HB 7677	Establishes crime of aggressive driving.	2/3/00: Introduced and referred to House Committee on Judiciary. 4/4/00: Committee failed to recommend passage.
South Carolina	HB 4612	Defines crime of aggressive driving and establishes penalties.	2/15/00: Introduced and referred to House Committee on Judiciary.
Washington	SB 5291	Requires license suspension when a person is convicted of aggressive driving.	July 1999: Carried over to 2000 session. 3/10/00: Returned to Senate Rules Committee for third reading. No action after 3/10.
Source: NHTSA legislative tracking application (97).			

APPENDIX B: FOCUS GROUP DISCUSSION GUIDE FOR DRIVING IN STRESSFUL ENVIRONMENTS

I. Introductory Remarks

- A. Welcome
- B. Introductions

II. Driving Experience

- A. How long have you been driving?
- B. What type of vehicle do you drive most often?
- C. What type of driving do you do most often (on what type of roadways and typical duration)?
- D. Describe your work commute. Do you regularly drive in rush hour traffic?

III. Driving Stressors

- A. Write down five irritating things about driving in Dallas. Read and discuss lists.
- B. Which type of road is most stressful for you—freeway, highway, local major streets, local minor streets? Explain.
- C. What increases your stress level while driving?

Prompts:

- Other drivers' behaviors (describe)
- Inadequate signing or marking
- Construction or maintenance zones
- Everyday congestion
- Unexpected congestion
- Other roadway conditions (describe)
- Within car environment (i.e., kids, other passengers)
- Other personal conditions

IV. Reactions to Driving Stressors

- A. Are there occasions when stress has built to a point in which you have driven aggressively? What situations prompted this behavior? How often do you drive aggressively?
- B. Describe your aggressive driving behavior.
- C. Have you seen other drivers driving aggressively?
- D. Describe their aggressive driving behavior.
- E. How do you react to other aggressive drivers?
- F. Do you think people in Dallas drive more aggressively than in other cities? Why?

V. Recommendations for Improvements

- A. Can you think of anything that would lessen stressful driving conditions in Dallas?
- B. Are there specific improvements to roadway conditions that you think would provide remedies?
- C. Responses to suggestions and recommendations.

APPENDIX C: TELEPHONE SURVEY QUESTIONS AND RESPONSE FREQUENCIES²

1. How many days a week do you typically drive on freeways during rush hour times in Dallas? (N=431)

Responses	Percentage
1	7.4
2	7.6
3	8.3
4	4.2
5	52.3
6	6.0
7	13.9

2. About how many miles do you normally drive, one-way, to work on a typical day?

None	6.3
Less than 5 miles	8.4
5-10 miles	20.9
11-20 miles	35.3
>20 miles	27.1
Don't know	2.1

3. Compared to a year ago, would you say that driving in Dallas is now:

A lot more stressful	39.7
Somewhat more stressful	17.6
About the same	27.1
Somewhat less stressful	6.7
A lot less stressful	5.6
Don't know	3.2

4. Compared to a year ago, would you say that other drivers in Dallas are now:

A lot more aggressive	35.3
Somewhat more aggressive	30.2
About the same	28.1
Somewhat less aggressive	2.3
A lot less aggressive	1.6
Don't know	2.6

5. Compared to a year ago, would you say that you, yourself, are now:

A lot more aggressive driver	6.3
A somewhat more aggressive driver	11.8
About the same	48.5
A somewhat less aggressive driver	16.0
A lot less aggressive driver	14.8
Don't know	2.6

² Question wording is abbreviated for some questions and some response categories have been collapsed. Introductions, instructions, and transitions have been omitted.

6. Concerning your own driving behavior, on a scale from 1 to 10, with 1 being not at all aggressive and 10 being the most aggressive, in general, how would you rate yourself as a driver?

1	11.1
2	10.4
3	18.8
4	12.5
5	22.0
6	10.2
7	7.2
8	4.4
9	0.9
10	1.6
Don't know	0.9

7. What one driving behavior that you observe frequently in the Dallas area is most likely to raise the stress you feel while driving?

<u>Responses with 2 or more frequency</u>	<u>Percent</u>
Cutting people off/cutting in	23.9
Weaving or frequent lane changes/changing multiple lanes at once	13.4
Tailgating/following too close	11.2
Speeding	10.2
Going too slow/slow in the left lane/not getting up to speed	4.5
No signal when changing lanes	3.7
Not letting you merge or change lanes/speeding up to block lane change	3.7
Cell phones	3.2
Not using blinkers	2.8
Honking horn/yelling/cursing/obscene gestures/impatient drivers/road rage	2.0
Lack of courtesy/rude drivers/disregard for other drivers	1.7
Driving on median or shoulder/passing on shoulder	1.4
Accidents/rubbernecking/anything that can cause a wreck	1.4
Late merges/last minute exits/bad merging at entrance and exits	1.4
Traffic/congestion	1.2
Not paying attention/putting on makeup or fixing hair	0.9
Bad lane changes	0.9
Running red lights	0.7
Slamming on brakes/excessive braking	0.7
Not yielding the right-of-way	0.7
Going to front of the line when lane closed/queue jumping	0.7
18-wheelers/trucks	0.5
Disregarding signs	0.5
People who do crossovers	0.5
Traffic on 635	0.5
None	1.6
Don't know	1.4

8. What one roadway condition that you encounter frequently on freeways in the Dallas area is most likely to raise the stress you feel while driving?

<u>Responses with 2 or more frequency</u>	<u>Percent</u>
Construction	31.1
Traffic/congestion	8.4
Wet roads/rain	8.1
Traffic congestion	5.6
Potholes/bumpy roads/poor pavement conditions, etc.	5.4
Lane closures/width transitions	5.3
Accidents/breakdowns	3.2
I635	2.1
Merging lanes/merging traffic	1.1
Entrance/exit ramps	1.0
I35	0.9
Debris on the highway	0.7
Poor exit markings	0.5
I30	0.5
Workers on the side of the road	0.5
Poor/non-existent shoulders	0.5
Barricades/partitions/barriers	0.5
None	10.7
Don't know	4.9

9. How stressful is it when someone tailgates you on the freeway?

1 Doesn't add to the stress of driving at all	9.7
2	9.0
3	15.5
4	20.0
5 Adds very much to the stress of driving	44.8
Don't know	0.4

Has this happened to you within the last day?

Yes	46.6
No	52.4
Don't know	0.9

Has this happened to you within the last week?

Yes	60.2
No	38.5
Don't know	1.3

10. How stressful is it when someone drives excessively fast, say 20 mph over the speed limit?

1 Doesn't add to the stress of driving at all	15.3
2	17.2
3	19.7
4	16.2
5 Adds very much to the stress of driving	31.6

	Have you seen this within the last day?	
	Yes	73.5
	No	26.5
	Have you seen this within the last week?	
	Yes	74.6
	No	25.4
11.	How stressful is it when someone repeatedly weaves in and out of freeway lanes to get through traffic?	
	1 Doesn't add to the stress of driving at all	5.1
	2	6.0
	3	16.9
	4	19.0
	5 Adds very much to the stress of driving	52.7
	Don't know	0.2
	Have you seen this within the last day?	
	Yes	65.2
	No	34.8
	Don't know	
	Have you seen this within the last week?	
	Yes	75.3
	No	24.0
	Don't know	0.7
12.	How stressful is it when drivers stay in a lane that will be closing soon for as long as possible before moving into the open lane?	
	1 Doesn't add to the stress of driving at all	8.8
	2	12.5
	3	21.3
	4	17.2
	5 Adds very much to the stress of driving	39.7
	Don't know	0.5
	Have you seen this within the last day?	
	Yes	53.1
	No	46.2
	Don't know	0.7
	Have you seen this within the last week?	
	Yes	67.3
	No	31.2
	Don't know	1.5

13. How stressful is it when other drivers won't let you in when you try to move out of a lane that is closing?

1 Doesn't add to the stress of driving at all	8.4
2	8.6
3	23.7
4	21.8
5 Adds very much to the stress of driving	37.1
Don't know	0.5

Have you seen this within the last day?

Yes	36.7
No	63.1
Don't know	0.2

Have you seen this within the last week?

Yes	50.7
No	49.3

14. How stressful is it when another driver obviously is not paying enough attention to their driving?

1 Doesn't add to the stress of driving at all	5.1
2	7.4
3	14.4
4	25.1
5 Adds very much to the stress of driving	47.6
Don't know	0.5

Have you seen this within the last day?

Yes	59.6
No	40.4

Have you seen this within the last week?

Yes	58.6
No	40.2
Don't know	1.1

15. How stressful is it when someone intentionally blocks you from merging or changing lanes?

1 Doesn't add to the stress of driving at all	4.9
2	6.3
3	17.6
4	19.5
5 Adds very much to the stress of driving	50.8
Don't know	0.9

Has this happened to you within the last day?

Yes	27.6
No	72.4

	Has this happened to you within the last week?	
	Yes	40.1
	No	59.6
	Don't know	0.3
16.	How stressful is it when someone uses the shoulder on a freeway to pass?	
	1 Doesn't add to the stress of driving at all	14.2
	2	10.7
	3	17.2
	4	12.5
	5 Adds very much to the stress of driving	44.3
	Don't know	1.2
	Have you seen this within the last day?	
	Yes	18.8
	No	81.2
	Have you seen this within the last week?	
	Yes	24.9
	No	74.6
	Don't know	0.6
17.	When you are driving on a freeway and see there is a lane closure ahead, do you usually:	
	Move out of the closing lane as soon as possible	71.9
	Drive in the closing lane as long as possible	3.5
	Something in between	24.4
	Don't know	0.2
18.	Increase enforcement targeted at aggressive driving.	
	Not at all effective	6.3
	Only somewhat effective	10.7
	Effective	24.6
	More effective	20.6
	Very effective	35.7
	Don't know	2.1
19.	Run campaigns in the media that promote more courteous driving.	
	Not at all effective	20.9
	Only somewhat effective	23.2
	Effective	24.6
	More effective	11.4
	Very effective	18.6
	Don't know	1.4

20.	Focus on aggressive driving in driver education and defensive driving classes.	
	Not at all effective	7.2
	Only somewhat effective	14.2
	Effective	26.9
	More effective	21.1
	Very effective	30.2
	Don't know	0.2
21.	Have hotlines to report aggressive driving to the police.	
	Not at all effective	11.4
	Only somewhat effective	11.8
	Effective	17.4
	More effective	20.6
	Very effective	37.1
	Don't know	1.6
22.	Add more freeway lanes at bottleneck locations.	
	Not at all effective	6.0
	Only somewhat effective	6.7
	Effective	14.8
	More effective	20.4
	Very effective	50.6
	Don't know	1.4
23.	Build more freeway lanes where needed to handle traffic better.	
	Not at all effective	4.9
	Only somewhat effective	4.6
	Effective	13.0
	More effective	21.1
	Very effective	55.2
	Don't know	1.2
24.	Increase the length of acceleration lanes at freeway entrances to make merging easier.	
	Not at all effective	8.1
	Only somewhat effective	7.2
	Effective	17.2
	More effective	26.0
	Very effective	41.3
	Don't know	0.2
25.	Improve public information about scheduled freeway lane closures.	
	Not at all effective	7.0
	Only somewhat effective	10.9
	Effective	24.4
	More effective	21.6
	Very effective	36.0
	Don't know	0.2

26.	Improve public information about lane closures due to crashes or breakdowns.	
	Not at all effective	4.9
	Only somewhat effective	8.8
	Effective	23.2
	More effective	22.7
	Very effective	40.1
	Don't know	0.2
27.	Clear accidents and other incidents faster.	
	Not at all effective	6.9
	Only somewhat effective	4.6
	Effective	15.5
	More effective	21.6
	Very effective	55.2
	Don't know	0.7
28.	Improve the signs or pavement markings that tell you lanes are going to end.	
	Not at all effective	4.4
	Only somewhat effective	9.7
	Effective	23.4
	More effective	20.6
	Very effective	41.5
	Don't know	0.2
29.	Build more non-freeway major streets.	
	Not at all effective	7.0
	Only somewhat effective	13.5
	Effective	26.5
	More effective	21.3
	Very effective	29.5
	Don't know	2.3
30.	Encourage more employers to allow workers to have flexible working hours or to work at home.	
	Not at all effective	7.2
	Only somewhat effective	10.2
	Effective	16.0
	More effective	19.5
	Very effective	46.6
	Don't know	0.5
31.	Encourage more use of public transportation.	
	Not at all effective	11.1
	Only somewhat effective	12.8
	Effective	23.7
	More effective	18.6
	Very effective	33.2
	Don't know	0.7