Aggressive Driver Imaging and Enforcement

Evaluation Report – Impact of Media Campaign & Effects on Safety and Productivity

Revised Draft Final Report

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SUMMARY

Aggressive driving has been recently recognized as a problem which contributes to crashes on the Nation's freeways. Aggressive driving usually involves deliberate unsafe vehicular maneuvers which threaten the safety of motorists. Speeding, following too closely, and multiple lane changes over short distances are some common indicators of aggressive driving. Early in 1997, Maryland State Police (MSP) took the initiative to explore new enforcement strategies to combat the rising trend in aggressive driving. The Aggressive Driver Imaging and Enforcement (ADIE) program of MSP is a special program to control aggressive driving on the Capital Beltway in Maryland. The program consists of a media campaign and field deployment of a prototype (ADIE) system which integrates video, speed, and distance recording technology with an interactive computer system. The integration has resulted in a new technology for targeting aggressive drivers within the traffic stream. The ADIE system is able to obtain sharp images of vehicle tag numbers. DOT numbers and vehicle path, as well as accurate record on vehicle speeds. The ADIE system is permanently installed in an enforcement vehicle and can be operated by a single trained officer. The integrated system enables field records to be saved on computer discs for later processing by an information system in the office which can be used to access motor vehicle records -- including commercial vehicles-- to identify owners of violating vehicles who would receive warnings in the mail.

The evaluation focused on determining whether the ADIE program was successful in meeting the following goals: increasing the perception of Capital Beltway motorists of the omnipresence of law enforcement, improving traffic safety, and improving the productivity of law enforcement. The strategy for program evaluation involved a 'before' and 'after' survey of Beltway motorists to assess the impact of the media campaign on motorists' attitude. The media campaign was launched in November 1997. The 'before' survey was conducted in April and May 1997. The 'after' survey was conducted in the months of March and April 1998. Field deployment of the ADIE

technology coincided with the media campaign. Data for evaluating the impact of the program on safety were traffic crashes, speed and volume provided by MSP and Maryland State Highway Administration (SHA).

The primary results of the evaluation are the following:

- The ADIE program was successful in creating the perception of the omnipresence of law enforcement on the Capital Beltway and resulted in a decline in the proportion of speeders. Speed reduction of trucks and other vehicles was used as an indicator of improved safety conditions. Speeding was recognized by MSP as a common factor in aggressive driving. Based on data from three automatic traffic recording stations, there was a significant reduction in the frequency of speeds above 60 mph in March 1998 over March 1997.
- The media campaign was successful in increasing motorists' awareness of the aggressive driving problem. Awareness percentage increased from 19% to 54%.
- The 'before' survey showed that 82% of motorists favor the use of video technology for traffic enforcement. This percentage grew to 86%, following the media campaign.
- The media campaign showed a significant increase in the percentage of motorists (41% to 48%) who believe that law enforcement is effective. However. the percentage of motorists who believe that law enforcement is effective remained less than 50%.
- The ADIE technology was successfully demonstrated as a tool for law enforcement on freeways. More than 200 warnings were sent to vehicle owners during the period, January 1998 through July 1998, which involved 163 person-hours of field patrol and office processing of ADlE files. The demonstration also revealed that, at its current state of development, the prototype equipment was not always reliable. Further enhancement would be needed to reduce the frequency of failure and to improve the accuracy in

documenting lane change maneuvers of targeted vehicles.

- Because of unresolved equipment reliability issues, the productivity evaluation is deferred and is not featured in this report. In order to conduct a fair comparison between ADIE productivity and that of traditional enforcement, number of enhancements identified by MSP must be completed.

Across the United States, motorists are increasingly accepting video technology for traffic enforcement. In spite of the potential concerns about privacy invasion, the survey of this study showed that motorists strongly favor the use of video technology. Several cities and counties in California, Virginia, Michigan, Arizona, and Maryland have already implemented 'red light cameras' and more jurisdictions are likely to adopt the concept. According to a 1995 survey by the Insurance Institute for Highway Safety, 66% of a sample of 1006 motorists favor 'red light cameras'. There is high optimism within MSP for resolving the existing reliability and efficiency problems with the ADIE equipment prototype. The strong public interest for use of video technology to promote order on freeways could be the incentive for improving the performance of the ADIE equipment prototype.

INTRODUCTION

This report summarizes the findings, procedures, and conclusions of a study to evaluate the effectiveness of a media-based awareness campaign and the use of a unique imaging technology for increasing the awareness of drivers on the Capital Beltway in Maryland of the aggressive driving problem and the need for public participation in an effort to reduce the frequency of aggressive driving events. For the purpose of this study, an 'aggressive driver' is defined as a motorist involved in vehicular maneuvers which threaten the safety of other motorists. These maneuvers include speeding, following too closely, multiple lane changes over short distances, or failing to grant right-of-way to other motorists.

With a $400,000 grant from the Federal Highway Administration (FHWA), the Maryland State Police (MSP) embarked on a program of research, development, and deployment of an innovative aggressive driver imaging and enforcement (ADIE) technology. The computerized technology of ADIE integrates a LIDAR unit for speed and distance measurements, a video camera, still camera, and an interactive computer system. Essential functional features of ADIE technology are the ability to detect and record speed, to track and provide photographic images of vehicles making aggressive maneuvers. and to provide high-resolution images of vehicle tag numbers and the DOT numbers of detected violating commercial vehicles. All data logged in the computer can be reviewed by the operating trooper while on highway patrol. Owners of vehicles in violation are issued warnings through the mail after the field data files are processed in the office. A special police vehicle (a 1996 Ford Bronco) was configured to accommodate the ADIE equipment and operating personnel. ADIE detection was conducted from various locations on the shoulder of the Capital Beltway. MSP also planned and implemented the public campaign, utilizing the media (press, TV, and radio) to make motorists aware of the dangers associated with aggressive driving and the need for motorists to control aggressive driving attitudes.

As an independent contractor for evaluating the ADIE program, Daniel Consultants Inc. (DCI). under subcontract to Science Applications International Corporation (SAIC). conducted a 'before' and 'after' survey to assess the impact of the

public awareness campaign on motorists' awareness of the aggressive driving problem. A separate study using traffic data was conducted to determine whether the ADIE technology deployment had any measurable positive impact on traffic safety.

DCI was also charged with the responsibility to determine whether the 'hi-tech' ADIE system would boost the productivity of enforcement troopers. A portion of this effort has been completed. Completion of the productivity element was deferred until all desirable enhancements are added to the ADIE system As of July 3 1, 1998 when this report was being compiled, a number of enhancements remain to be implemented. This report deals primarily with the effectiveness of the media campaign and the impact of ADIE deployments on safety. The surveys and the data collection were conducted during the period of April 1997 through April 1998.

BACKGROUND

Enforcement Challenge on the Capital Beltway

The Capital Beltway in Maryland serves a mixture of interstate, regional, and local traffic, with a weekday traffic exceeding 200,000 vehicles at various locations. Truck traffic constitutes IO- 11 percent of the total traffic on the Maryland section of the Beltway. Traffic volume is heavy throughout the day with peak recurrent congestion as a normal phenomenon during the morning and evening rush hours. As a result of high volume and traffic density, minor incidents often cause major traffic congestion. The posted speed limit is 55 m.p.h. However, speeding remains a significant aggressive behavior that reduces safety on the Capital Beltway. The 1993 accident records show 1550 reported traffic crashes. Loop detectors on the Beltway show a pattern of speed violation. In a typical 24-hour period, Maryland State Highway Administration has observed speed violations exceed 2500, in spite of the existence of traditional enforcement methods. In 1995, there were 1700 crashes of which 40% involved rear-end collisions and 12 fatalities. Traffic trends on the Capital Beltway show a steady increase in congestion. despite regional efforts to promote high occupancy modes.

Enforcement of traffic laws on high-volume freeways is challenged by the inability of the police departments to increase the number of patrol officers such that a

lasting perception of their omnipresence is established. In addition, while intensive use of traditional enforcement methods could yield safety benefits, use of those methods has been known to cause congestion and unsafe conditions, especially during peak periods of travel. The desired deterrent effect expected from enforcement patrol has declined as motorists realize that heavy traffic volume provides cover from being stopped for traffic violations. Police pursuits during heavy traffic on the Capital Beltway are often impractical and could increase the risk of accidents involving law enforcement and motorists. Moreover, some northern sections of the Beltway located in Montgomery County have no shoulders for positioning enforcement vehicles and for observing and stopping violators, The conditions created by heavy traffic and winding geometry on multi-lane freeways have stimulated interest in non-traditional and non-intrusive approaches for establishing the omnipresence of law enforcement. The ADIE program was developed in response to the enforcement dilemma posed by road and traffic conditions that limit the effectiveness of traditional enforcement strategies, while endangering the lives of police officers.

Design and Functional Features of ADIE Technology

The ADIE system was developed by engineers at the US Army Aberdeen Test Center under a partnership agreement with FHWA. SHA, and MSP. The system constitutes an assembly and integration of off-the-shelf hardware and software and placement in a mobile enforcement vehicle. Figure 1 illustrates the diverse components and their relative location in the enforcement vehicle. The primary components are the LIDAR. computer. Autosense, rear-view video camera, rear camera, and side camera. The live video camera enables the operator to view the wide field of approaching traffic. The LIDAR is used to determine accurately the location and speed of an approaching targeted vehicle. The computer utilizes distance and speed observations of the targeted vehicle to calculate when it would be broadside of the enforcement vehicle, and triggers the side camera and the Autosense. The side camera takes snapshots of the side of the targeted vehicle as well as the DOT number of commercial carriers. The Autosense measures vehicle location and speed and determines whether the vehicle detected on the

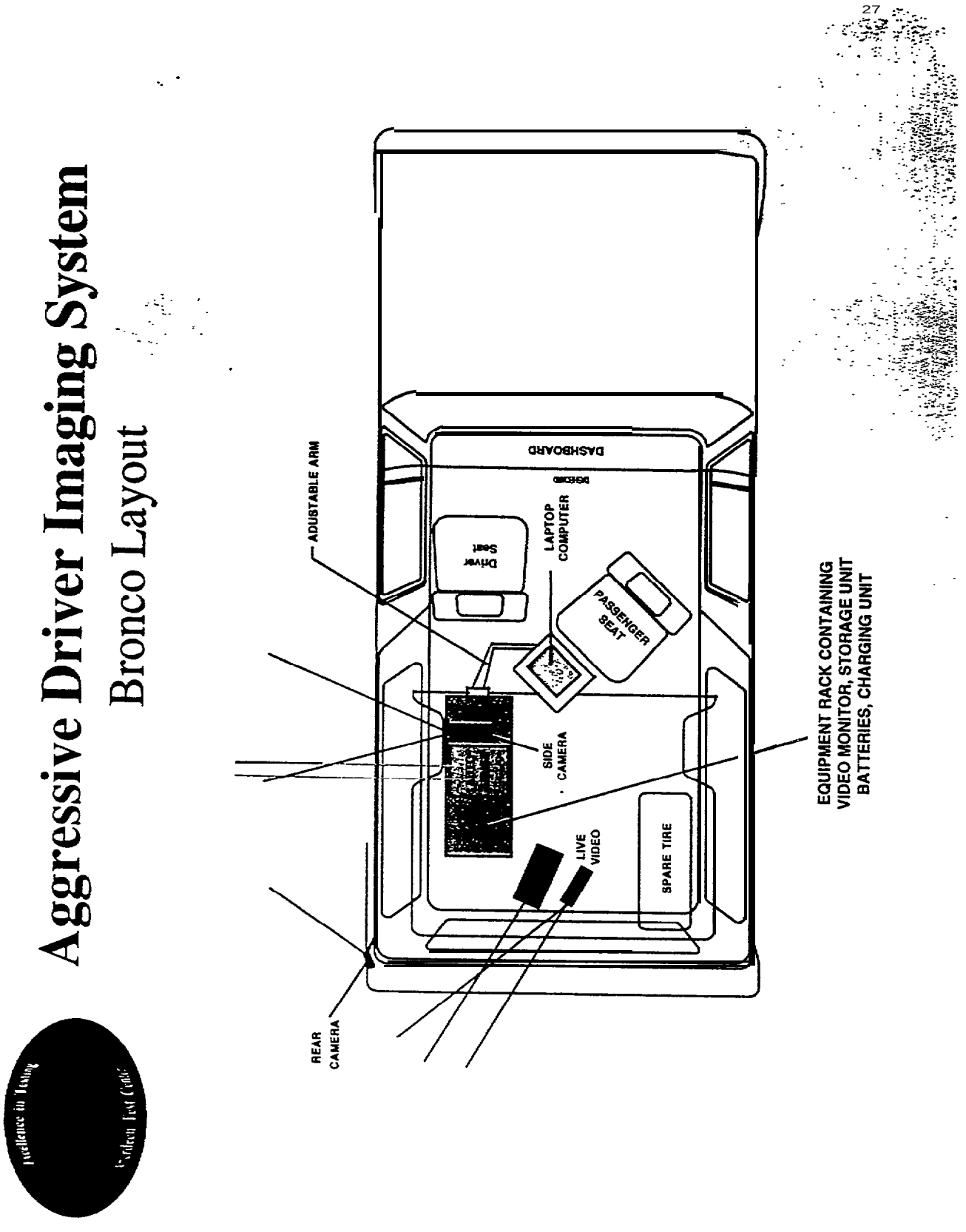


Figure 1: Layout of the Aggressive Driver Imaging System in Enforcement Vehicle

side is the same as the one targeted upstream. The Autosense also estimates the length of vehicles. The rear camera also takes snapshots of targeted vehicles. The decision to target an approaching vehicle is made by the system's operator who is also able to annotate the automated data file on each observation. The operator has the option to override the automatic mode at any time. The personal computer in the vehicle is specially configured for high-speed processing and has 2.1 gigabytes of memory and a jazz drive to facilitate the retrieval of data for processing at the office. At the office, the field data is processed and appropriate warnings are sent to the owners of the vehicles. Only warnings were mailed to vehicle owners since Maryland law does not provide for mailed citations, except for red light violations. Tag numbers are used to automatically access owner information in the files of the motor vehicle administration.

EVALUATION GOALS AND OBJECTIVES

The ADIE program evaluation basically focused on the following goals:

1. Evaluate the effectiveness of the ADIE program in increasing the perception of Capital Beltway motorists of the omnipresence of law enforcement.
2. Evaluate the effectiveness of the ADIE program in improving safety on the Capital Beltway.
3. Evaluate the effectiveness of the ADIE technology deployment in improving the productivity of law enforcement,

GOAL No. 1: Increasing Motorists' Perception of Omnipresence of Law Enforcement

As part of the ADIE program, an intensive media campaign was launched. The campaign was intended to inform the public of the characteristics of the aggressive driving problem and associated risk and to encourage motorists to curb tendencies to initiate or to reciprocate aggressive driving maneuvers. The media campaign clearly indicated that MSP will be increasing law enforcement intensity on the Capital Beltway and will be using innovative imaging technology to catch aggressive motorists. The objectives of Goal No. 1 and their respective null hypotheses are presented below:

Objective 1.1:	To assess change in the motorists' perception of the extent of the aggressive driving behavior as a result of the media campaign.
Hypothesis 1.1:	The media campaign had no effect on the extent of motorists' perception of aggressive driving as a problem
Objective 1.2:	To assess whether the media campaign would affect motorists' perception of the types and frequency of aggressive driving they observe.
Hypothesis 1.2:	The media campaign had no effect on motorists' perception of the types and frequency of aggressive driving behaviors.
Objective 1.3:	To assess motorists' awareness of the program against aggressive driving.
Hypothesis 1.3:	Motorists were not aware of the media campaign against aggressive driving.
Objective 1.4:	To assess change in motorists' perception of the effectiveness of law enforcement on the Capital Beltway.
Hypothesis 1.4:	The media campaign had no effect on the number of motorists who believe that law enforcement is effective.
Objective 1.5:	To assess the willingness of motorists to accept more effective law enforcement measures on the Capital Beltway.
Hypothesis 1.5:	Beltway motorists are not willing to accept more effective law enforcement measures.
Objective 1.6:	To assess the willingness of motorists to accept the use of video technology for law enforcement on the capital Beltway.
Hypothesis 1.6:	The media campaign had no effect on the number of motorists who are willing to accept video-based enforcement.

Data Collection for Evaluation of **Goal No. 1**

The 'before' survey for collecting data for evaluating Goal No. 1 was conducted over the period April 21 through May 21, 1997, well before the formal launching of the MSP's media campaign on November 21, 1997. The survey questionnaire in Appendix D

was mailed to 4000 motorists with addresses along the corridor of the Maryland segment of the Capital Beltway. A special effort to ensure the inclusion of truck drivers involved the distribution of survey questionnaires at the commercial vehicle inspection station located at the I-95 / I-495 Interchange in northern Prince George's County. A sample size above 700 was determined to be adequate. There were 1014 responses to the 'before' survey. The data collected for evaluating Goal No. 1 are tabulated and presented in Appendix A.

Data Analyses for Goal No.1

The data analyses utilized the Chi Square test at a 10% level of significance **to** test the null hypotheses 1.1 through 1.6 after transformation into the various contingency table formats as shown in Appendix A. Tabulated analyses are presented in Tables B. 1 through B.6 in Appendix B.

Results of Goal No. 1 Analyses

Table 1 summarizes the results of the Chi Square analyses of hypotheses 1.1 through 1.6.

Awareness of the Aggressive Driving Problem: The observed x^2 value of 9.0987 was found to be greater than the critical x^2 value 6.25 14 with a significance< 0.1. with reference to Table 1. Thus, the null hypothesis was rejected at level of significance 0.1. This indicates that the media campaign had an effect on the awareness of motorists of the aggressive driving problem. From the analysis, it could also be stated that there was a statistically significant increase in awareness of the aggressive driving problem. As shown in Figure 2, after the media campaign, there was a reduction in the percentage of motorists who believe that aggressive driving is a critical problem. More motorists believed aggressive driving to be 'not a problem' or a 'minor problem' after the media campaign.

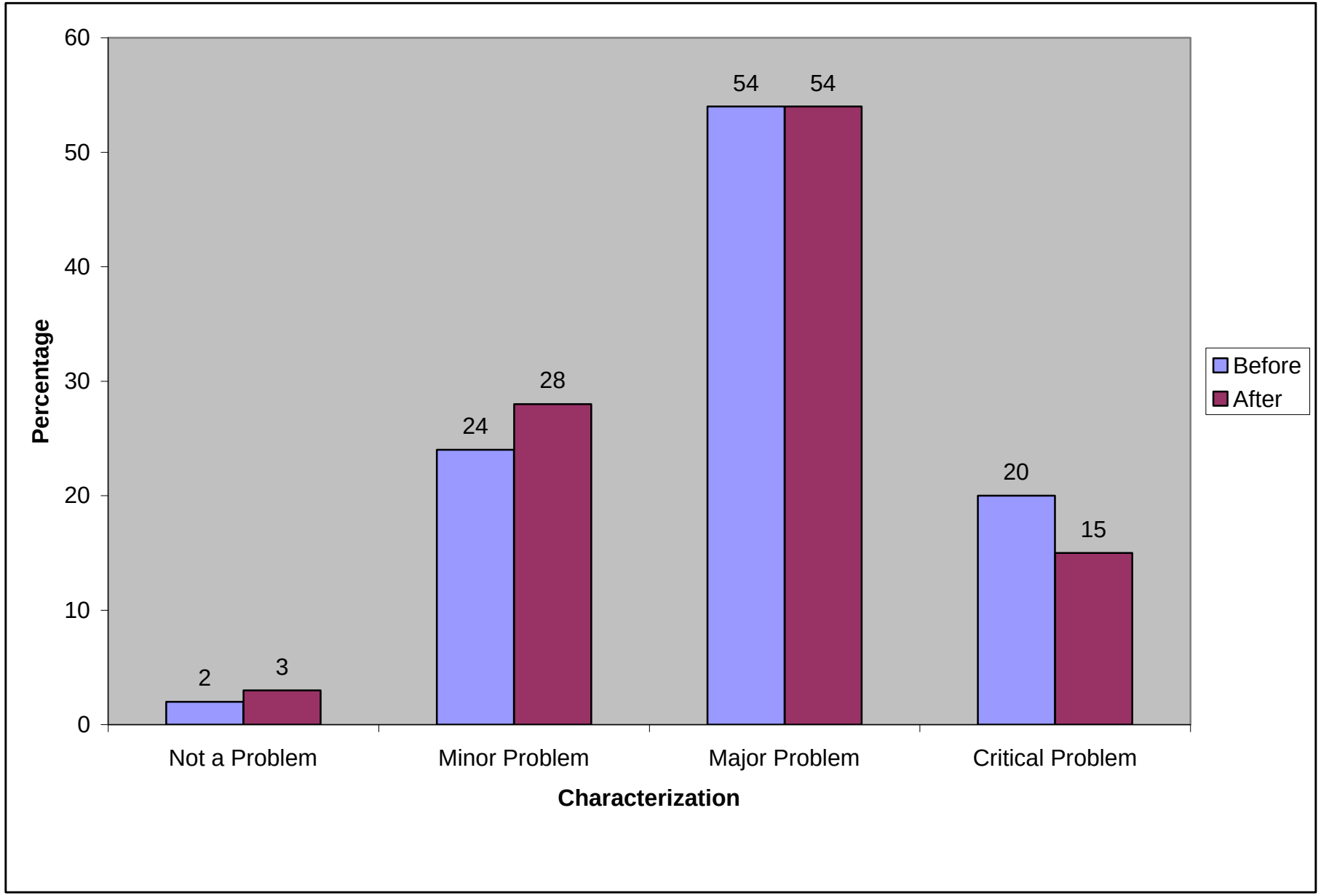
Perception of Aggressive Driving Frequency: With an observed x^2 value of 3.849,

Table 1: Results of the Analyses

NULL HYPOTHESES	OBSERVED x^2	CRITICAL x^2	SIG. OF P-VALUE	NULL HYPOTHESES DECISIONS
1.1: The media campaign had no effect on motorists perception of aggressive driving as a problem	9.0987	6.25 14	0.028	REJECTED
1.2: The media campaign had no effect on motorists' perception of types and frequency aggressive driving behaviors	3.849	6.2514	0.278	ACCEPTED
1.3: Motorists were not aware of the media campaign against aggressive driving	x9.234	4.605 1	0.00	REJECTED
1.4: Media campaign had no effect on number of motorists who believe that law enforcement is effective	8.371	6.25 14	0.03	REJECTED
1.5: Beltway motorists are willing to accept more effective law enforcement measures.	0.1192	2.7055	0.7299	ACCEPTED
1.6: Media campaign had no effect on number of motorists who are willing to accept video-based enforcement.	3. 1895	2.7055	0.07411	REJECTED
2.3: ADIE program had no effect on operating speeds of traffic on Capital Beltway.	98.456	4.605 1	0.00	REJECTED

Criterion: Reject H_0 if OBSERVED x^2 > CRITICAL x^2 ; (a= 0.1).

Figure 2: Motorist's Perception of the Serious of the Aggressive Driving Problem



which is less than the critical x^2 value of 6.2514, with reference to Table 1, the null hypothesis was accepted. This shows that the media campaign had no significant effect on how motorists perceive the aggressive driving problem. Figure 3 shows that the distribution of aggressive driving patterns observed by motorists experience minimal change after the media campaign.

Motorists' Awareness of Media Campaign: The observed x^2 value of 89.234 was found to be greater than the critical x^2 of 4.6051 with significance < 0.1, with reference to Table 1. Thus, the null hypothesis was rejected at level of significance 0.1. This indicates that the media campaign had a statistically significant effect on the number of motorists who became knowledgeable about an aggressive driving problem. Figure 4 shows an increase in awareness from 19% to 54% and a reduction in non-awareness from 81% to 45% respectively for the 'before' and 'after' conditions. It could be stated that, although the campaign created a greater awareness of the aggressive driving programs, motorists, however, were unable to associate the aggressive driving program with efforts of MSP.

Effectiveness of Law Enforcement on the Capital Beltway: The observed x^2 value of 8.373 was found to be greater than the critical x^2value of 6.25 14, with reference to Table 1, with significance < 0.1. Thus, the null hypothesis was rejected at level of significance 0.1. This is interpreted to mean that the media campaign had a statistically significant effect on the number of motorists who believe that the law enforcement is effective. There was a general increase in proportions in the various categories of positive effectiveness of law enforcement after the media campaign. Figure 5 shows the percent distribution of motorists' belief regarding effectiveness. It should be noted that the percentage of motorists claiming the program to be very effective or somewhat effective rose from 5% to 7% and from 36% to 41% respectively. Thus, a greater number of motorists believed that law enforcement is effective after the media campaign.

Need for More Effective Measures in Enforcement: From Table 1, the observed x^2

Figure 5: Motorist' Assessment of the Effectivieness of Law enforcement on teh Captial Beltway

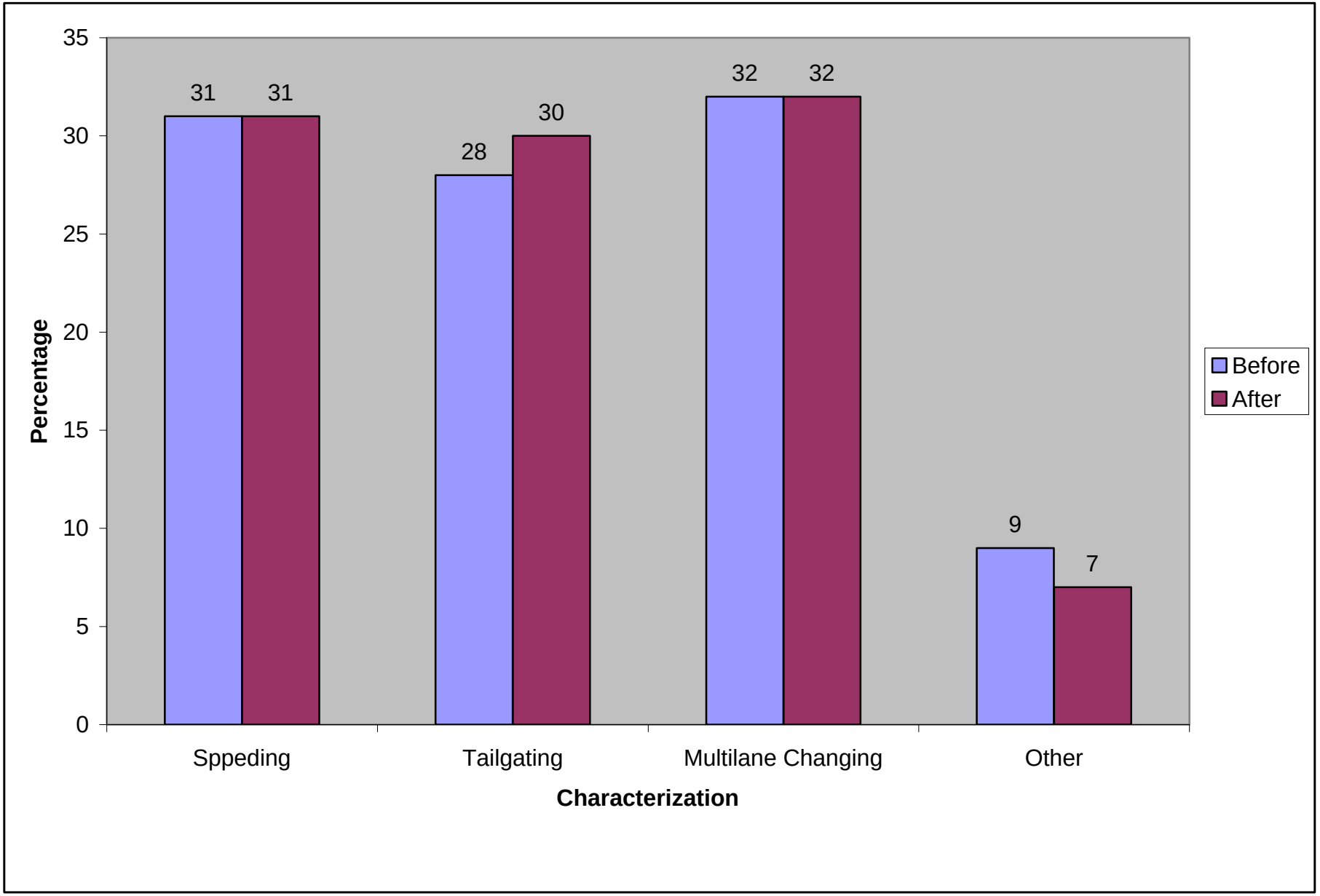


Figure 4: Motorist' Awareness of Aggressive Driving Programs

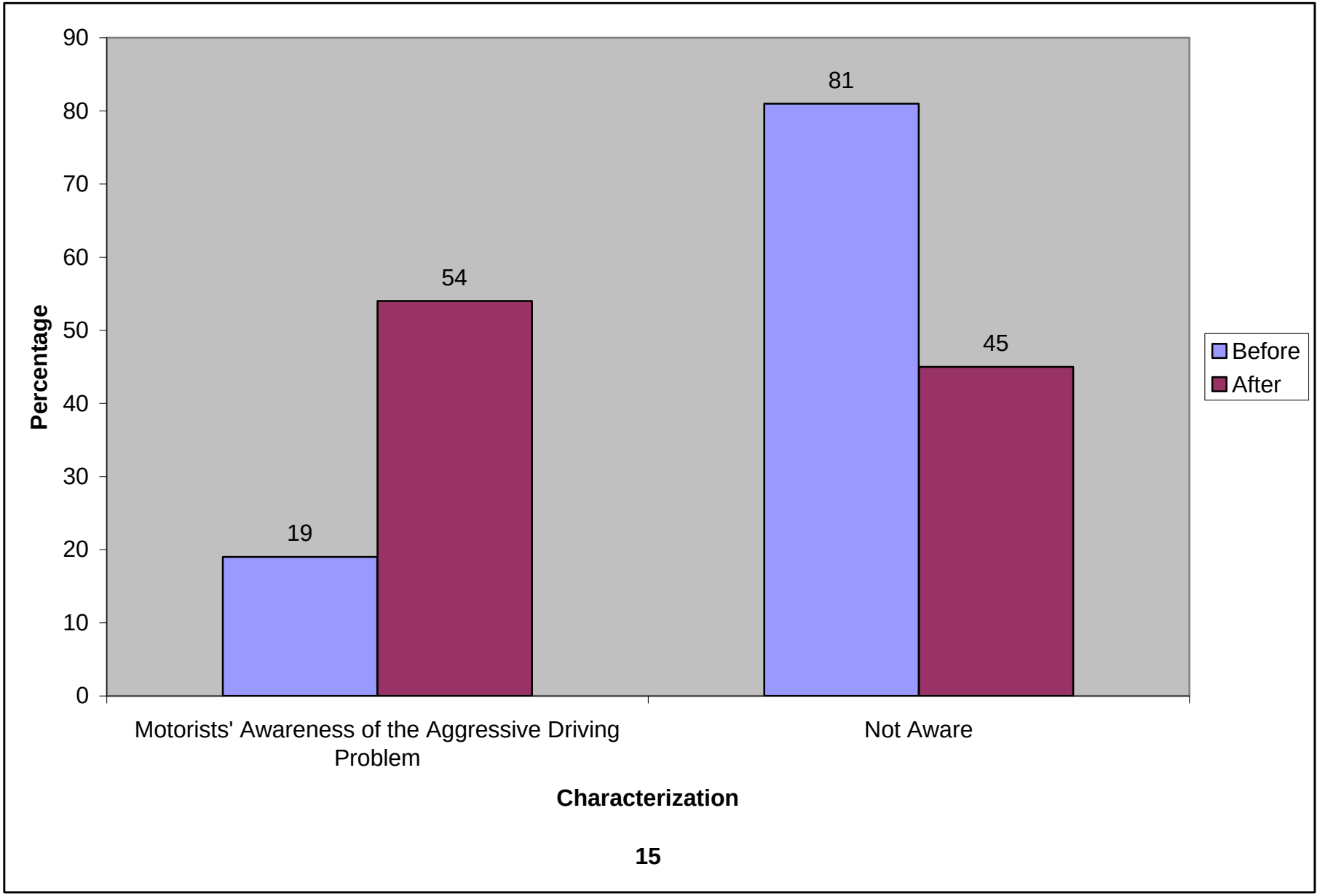
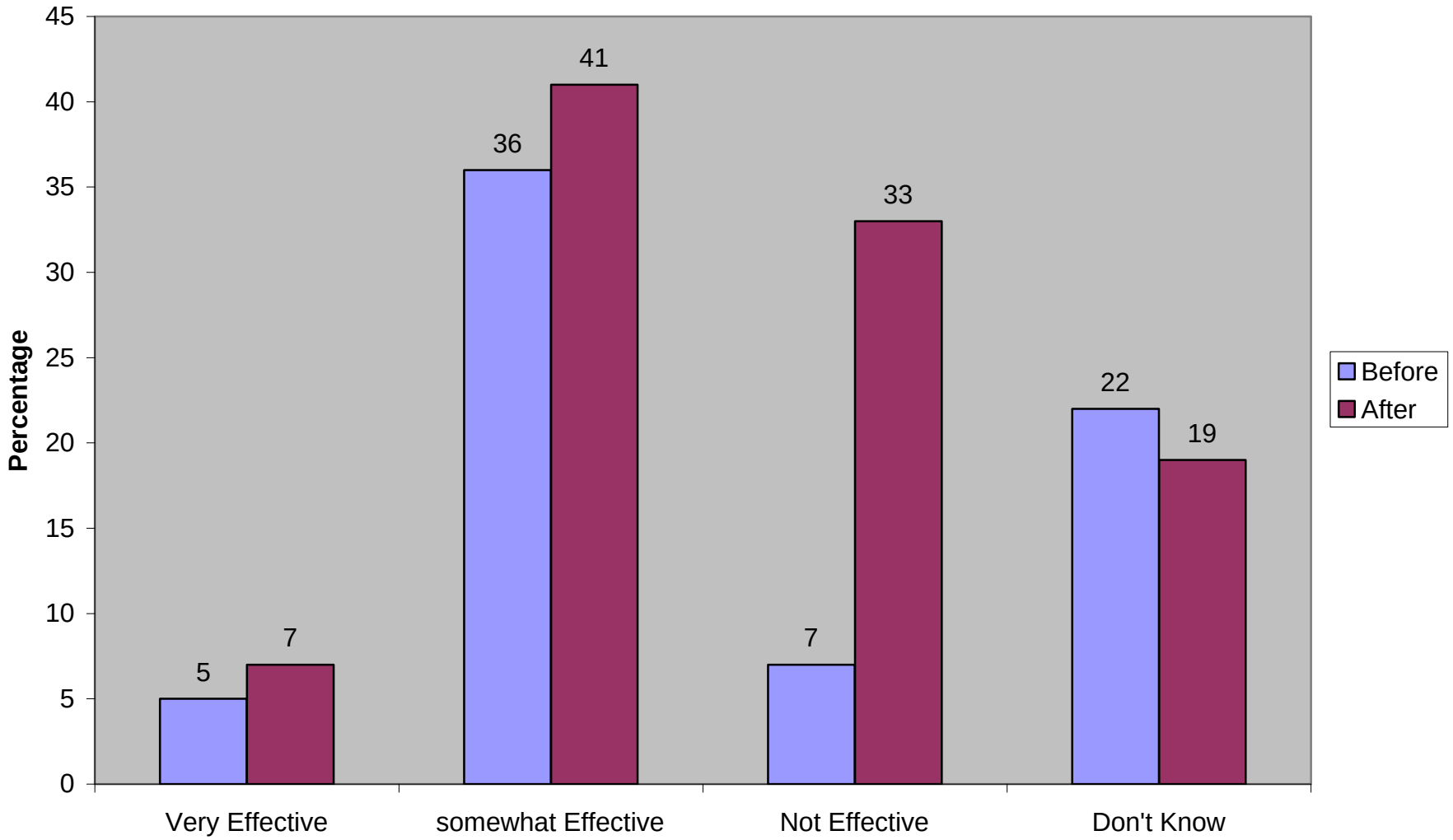


Figure 5: Motorists' Assessment of the Effectiveness of Law enforcement on the Capital Beltway



value of 0.1192 was found to be less than the critical x^2 value of 2.7055, with significance > 0.1. Thus, the null hypothesis would be accepted at level of significance 0.1. This can be interpreted to mean that the media campaign had no effect on the proportion of drivers who claim to need more effective measures of enforcement. The proportion of motorists who expressed need for more effective measures remained at 91% as indicated in Figure 6 during the 'before' and 'after' studies.

Acceptability of Video Technology for Law Enforcement: The observed x^2 value of 3.1895 was found to be greater than the critical x^2 value of 2.7055, with reference to Table 1, with significance < 0.1. Thus, the hypothesis was rejected at level of significance 0.1. Thus the media campaign had a statistically significant effect on the number of drivers who are willing to accept video-based law enforcement methods. The proportion of motorists who are willing to accept video-based law enforcement methods grew from 82% in the 'before' survey to 86% after the media campaign (Refer to Figure 7).

Goal No. 2: Improving Highway Safety with the ADIE Program

The evaluation of Goal No. 2 was aimed at assessing the impact of the ADIE program on highway safety based on traditional measures such as speed change and vehicle crashes. The reasoning is that the ADIE program could result in driver behavioral modification which could be indicated by lower operating speeds and fewer crashes. The study team, however. recognized that conclusive results would not be possible because of the random nature of crashes and the unavailability of sufficiently long study period (one-two years) to collect an adequate sample for the 'before' and 'after' periods. Thus, the confidence in the analysis involving accidents is not strong. The objectives and null hypotheses associated with Goal No. 2 are the following:

Objective 2.1:	To assess the ability of the ADIE program to reduce the frequency of crashes on the Capital Beltway in Prince George's County.
Hypothesis 2.1:	The ADIE program had no effect on crashes on the Capital

Figure 6: Proportion of Motorists Interested in More Efective Enforcement Measures

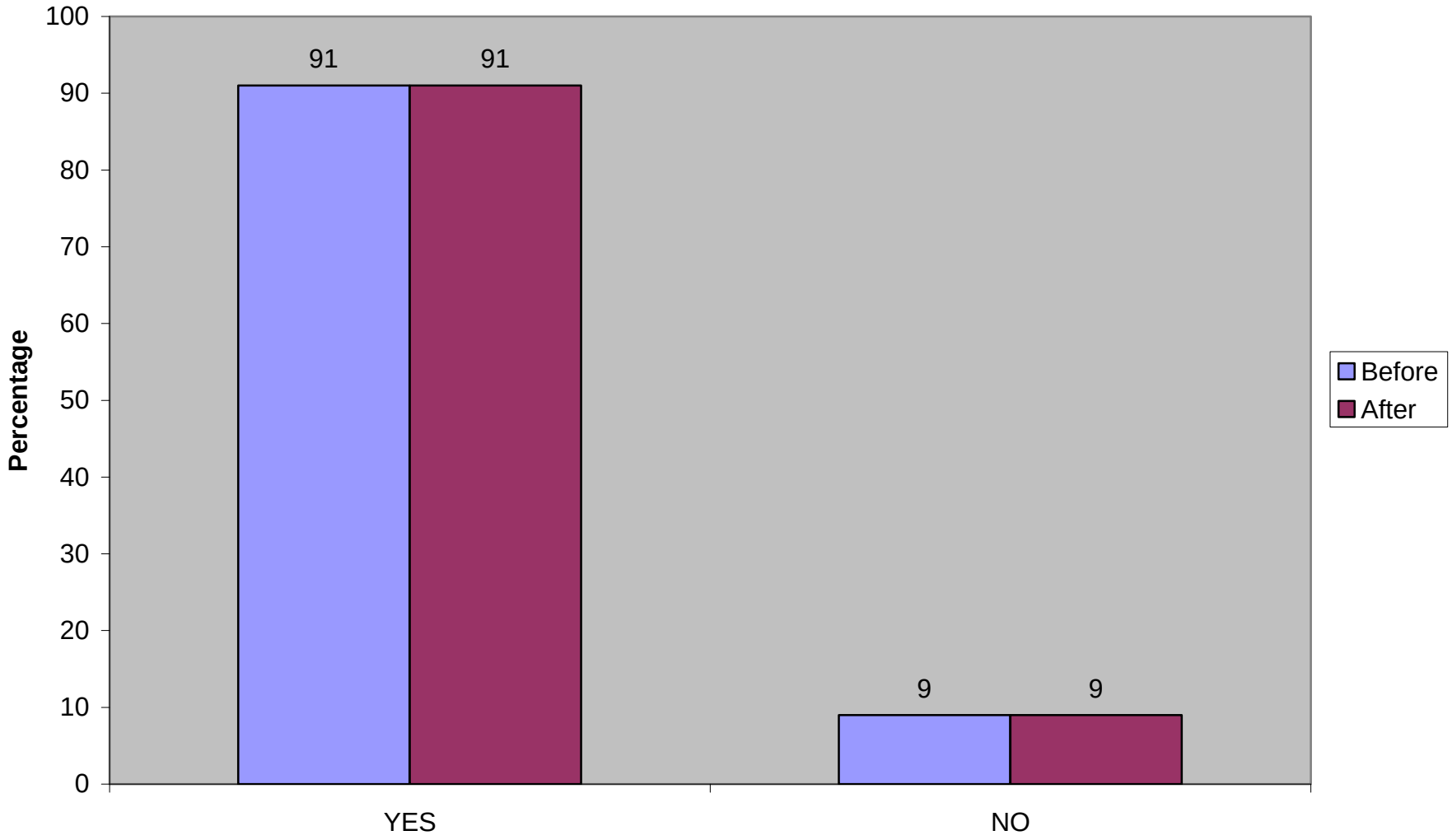
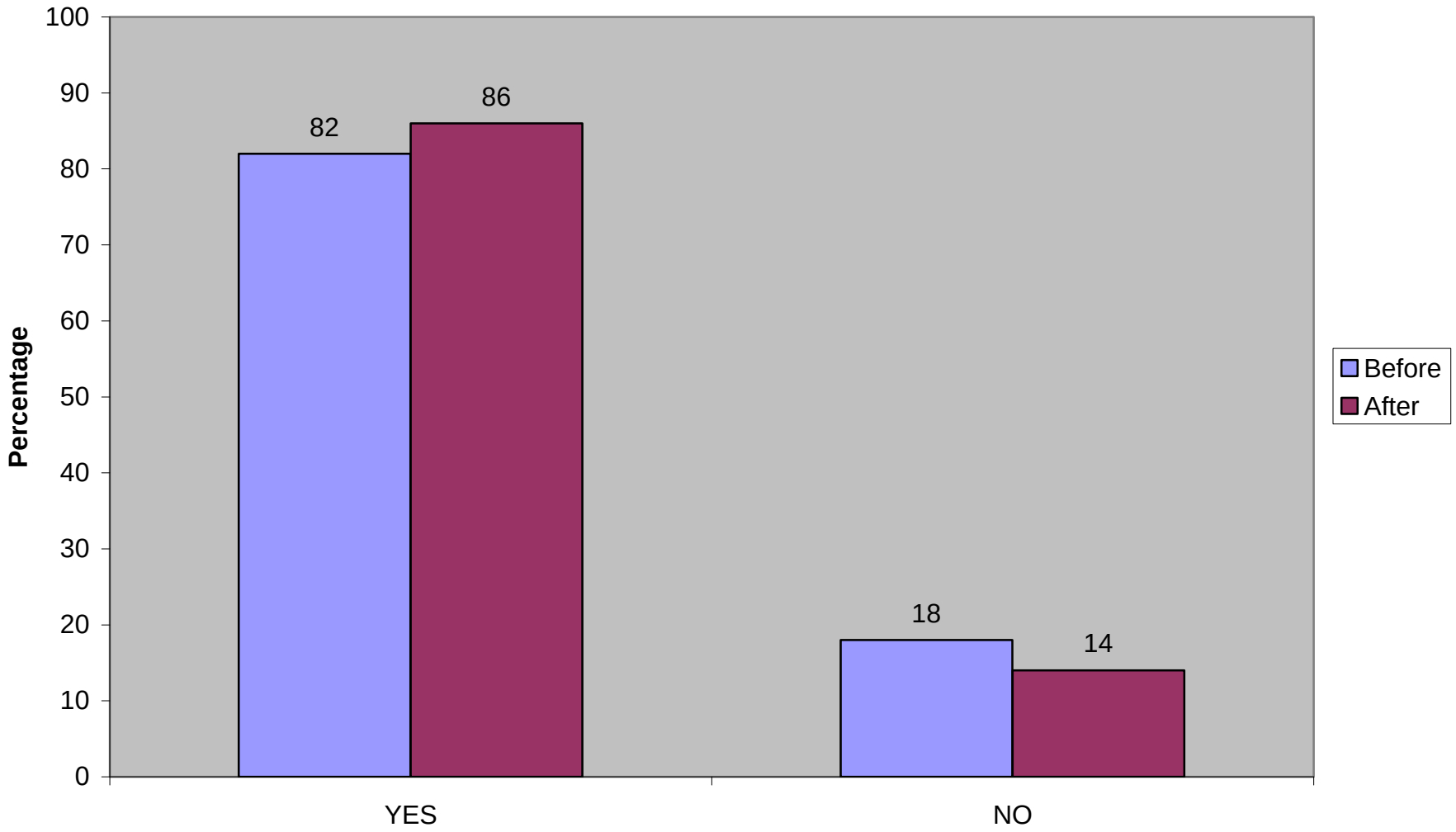


Figure 7: Motorists' Willingness to Accept Video Technology for Law Enforcement



Beltway in Prince George's County.

Objective 2.2: Assess the ability of the ADIE program to reduce the frequency of crashes in Montgomery County .

Hypothesis 2.2: The ADIE program had no effect on crashes on the Capital Beltway in Montgomery County.

Objective 2.3: To assess the ability of the ADIE program to lower the speed of motorists.

Hypothesis 2.3: The ADIE program had no effect on the operating speed of traffic on the Capital Beltway.

Data Collection for Goal No. 2 Evaluation

The evaluation team relied on average daily traffic (ADT) volume data compiled by SHA for the month of Marchl997. This constituted the 'before' ADT. The 'after' ADT covered March 1998. The ADTs of three automatic traffic recording stations (ATR) ranged from 120,000 vpd to 216,000 vpd. SHA also provided records of speeding over 60 mph. Both speed and volume data were obtained from SHA's traffic database for locations on the Capital Beltway. The speed data were for the month of March 1997 and 1998. The data collected for the evaluating Goal No.2 are presented in Appendix A-2.

Data Analysis for Goal No.2

An examination of the reduced data shows a pattern of increased accident rates during the 'after' period. In Prince George's County, the 'before' and 'after' accident rates were 0.62 and 0.74 accidents per hundred million vehicle miles, respectively. In Montgomery County the 'before' and 'after' accident rates were 0.48 and 1.00 respectively. See Figures 8 and 9. Given the numerous causal factors that could result in the increase of accident rates, it might well be that those factors dominate any reduction in rates which could be derived from the ADIE program. A statistical analysis of the accident data was not conducted due to short horizons used in collecting the data.

Comparison of speed profiles is a well-established method for evaluating

Figure 8: Vehicle Crashes Per 100 Million Vehicle Miles on I-495 in Prince George's County

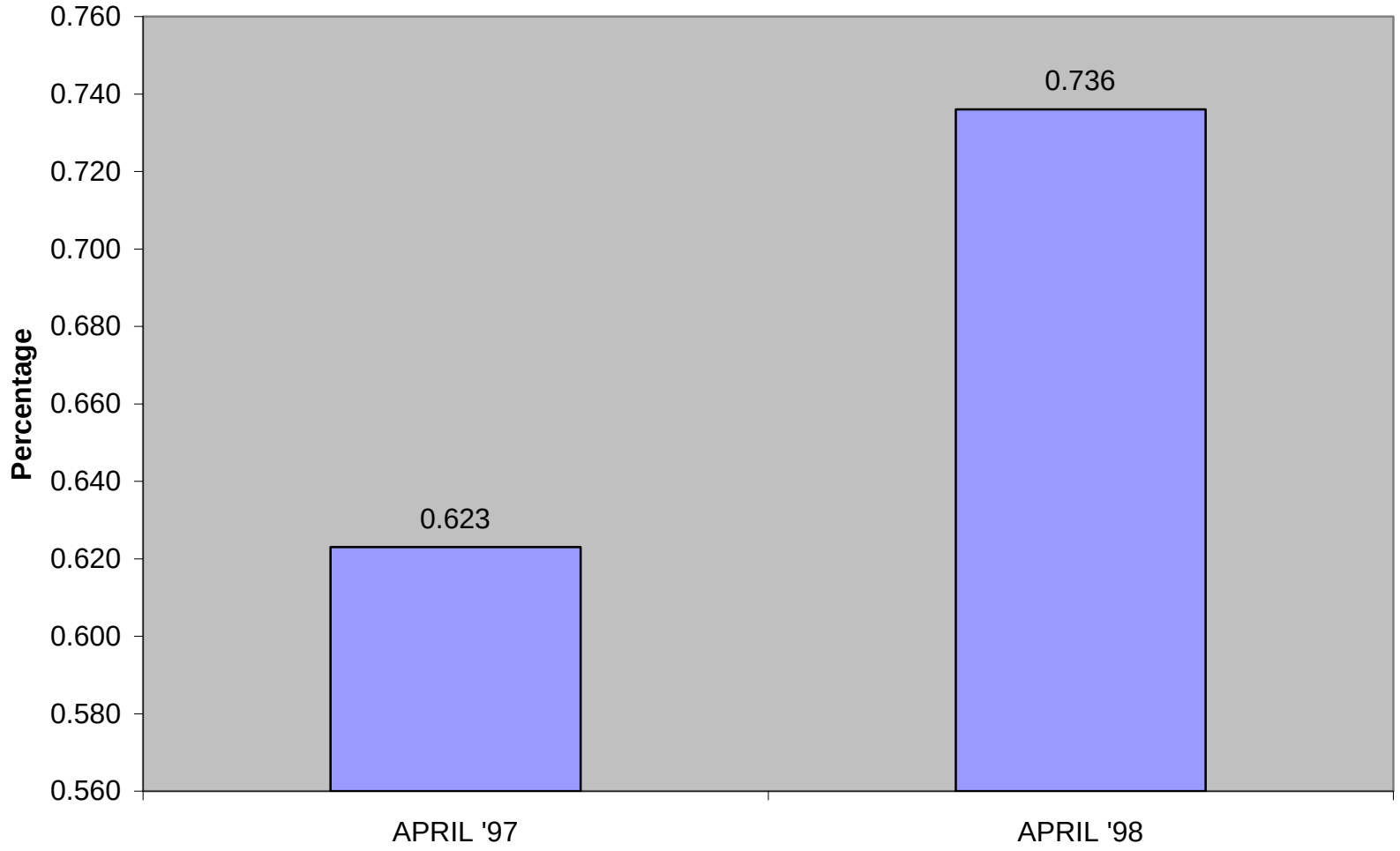
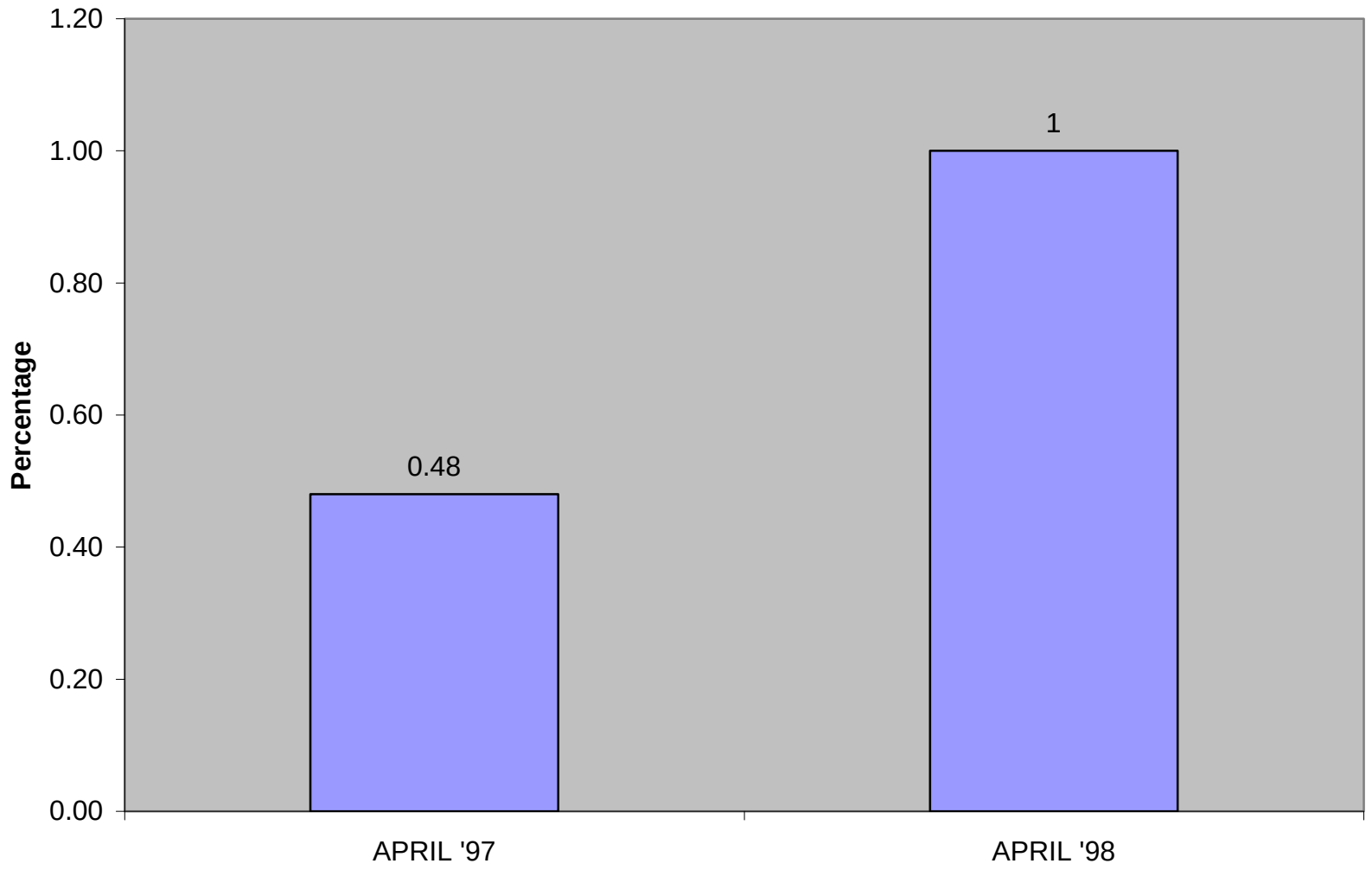


Figure 9: Vehicle Crashes Per 100 Million Vehicle Miles on I-495 in Montgomery County



strategies which are intended to reduce highway operating speeds. Unlike accident rates based on exposure, speed databases tend to be large, especially when collected with ATRs. The analysis of the speed data utilized the Chi Square method after transformation into a contingency table. As with the previous Chi Square analyses, a 10% level of significance was applied. The tabulated analysis is presented in Table B.7 in Appendix B.

Results of Goal No. 2 Analysis

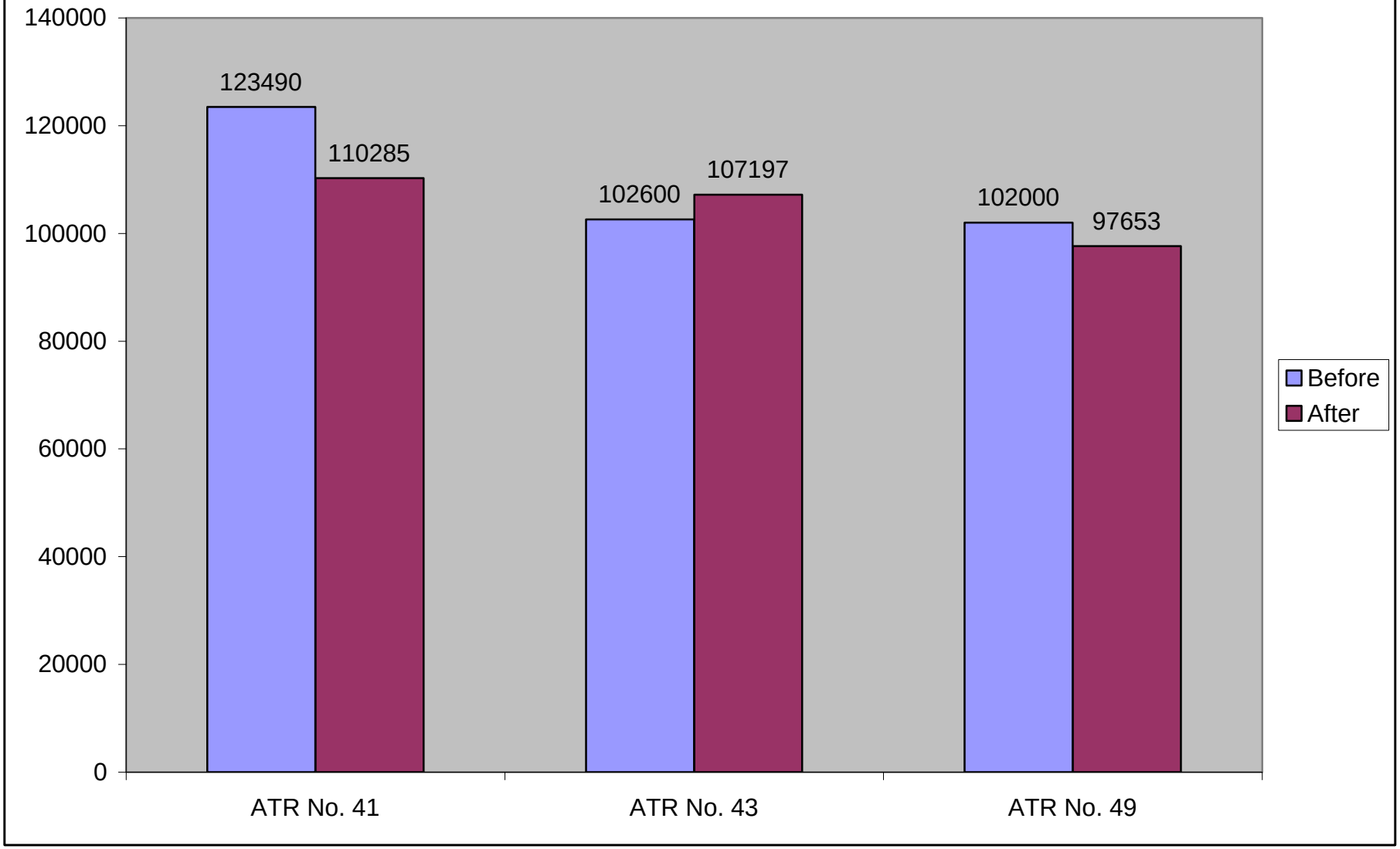
Reduction in Vehicle Crashes: The accident exposure data show a pattern of increase in accident rate with time in both Montgomery and Prince George's Counties. Limitations in the data and scope of evaluation did not permit a reasonable statistical experiment design. Thus, it could not be determined, without a rigorous multivariate approach, whether the ADIE program had any impact on accidents. Data for a longer period--one to two years-would provide a better basis for a crash analysis.

Reduction in Traffic. Operating Speed: The observed x^2 value of 98.456 was found to be greater than the critical x^2 value of 4.605, with significance < 0.1 (Refer to Table 2). Thus. the null hypothesis was rejected at level of significance 0.1. This can be interpreted by stating that the ADIE program had a significant effect on traffic operating speed on the Capital Beltway. This indicates a statistically significant decrease in the number of motorists who are driving above 60 mph on the Capital Beltway. The largest reduction (123490 to 110285) was observed at ATR No. 41 located in the Montgomery County where highway geometries do not present favorable conditions for traditional law enforcement (Refer to Figure 10).

Table 2: Results of the Analysis of Goal No. 2

HYPOTHESIS	OBSERVED x^2	CRITICAL x^2	SIG. OF P-VALUE
2.3	98.456	4.6051	0.00

Figure 10: Observation of Speeds in Excess of 60mph at ATRs on the Capital Beltway



Goal No. 3: Utilizing the ADIE system to Improve the Productivity of Law Enforcement

The evaluation of Goal No, 3 is deferred until the ADIE system is enhanced to improve its reliability to a point where the operators are satisfied with field performance. Since April 1998, the evaluation team has been receiving enforcement logs on traditional and ADlE-based enforcement. The data clearly show too many events of problems with the ADIE technology to enable a fair comparison with the traditional enforcement methods. The developers of the ADIE technology have identified several enhancements to improve accuracy and reliability. This report provides no evaluation of Goal No. 3. However, the ADIE system was successful as a tool that could eventually have widespread use for law enforcement on Maryland's freeways. More than 200 warnings have been sent to vehicle owners in the period January through July, 1998

CONCLUSIONS

1. The media campaign of the ADIE program was very successful in establishing the perception of the omnipresence of law enforcement on the Capital Beltway in Maryland. Although motorists were not able to identify specific sponsors of the ADIE Program, the data shows that the awareness of aggressive driving was increased immensely by the media campaign.

2. Two of the three automatic traffic recording stations showed a reduction in the number of motorists exceeding 60 mph on the Capital Beltway which is posted for 55 mph. One of the stations located in Montgomery County showed the greatest reduction in operating speed. Montgomery County is known for having Beltway segments with combinations of vertical and horizontal curves and limited shoulders which make traditional enforcement unsafe and difficult.

3. The survey also tested motorists' attitude on the effectiveness of law enforcement on the Capital Beltway. Although the ADIE program improved motorists* perception

that enforcement is effective, the survey shows that at most 48% of the motorists believe that enforcement is effective. More than 90% of the motorists would like to see improvement in enforcement and more than 85% would like MSP to utilize video imaging technologies.

4. The ADIE system has had a successful demonstration of its capability as a tool for law enforcement. It was able to provide accurate information on targeted vehicle such as movement in lanes, speed and vehicle identification. The system's ability to automatically process field data in an office setting, leading to the issuance of warnings in the mail, was also successfully demonstrated. The demonstration has a positive implication for the ADIE technology as an enforcement tool which could reduce the frequency of police pursuit of violators during heavy freeway traffic conditions.

5. The system, however, has not yet been developed to its full potential to enable it to compete in the realm of law enforcement productivity. The engineers of the Aberdeen Test Center have already identified solutions to existing unpredictable malfunctions during field operation and for improving efficiency and accuracy in systems operation. It should be noted that the technical problems of the type experienced during field operations are not unusual when complex systems are integrated to serve a new function. Engineers of the Aberdeen Test Center claim to have solutions to all existing equipment problems.

APPENDIX

APPENDIX A-l
DATA FOR EVALUATING GOAL No. 1

GOAL No.1: Increasing Motorists' Perception of the Omnipresence of Law Enforcement

Table 1.1: Motorist's Perception of the extent of the Aggressive Driving Problem

How would you characterize aggressive driving on the Capital Beltway?

Survey	**No** Problem	Minor Problem	Major Problem	Critical Problem	TOTALS
Before	21	237	530	197	985
After	24	211	408	117	760
TOTALS	45	448	938	314	1745

Table 1.2: Motorist's Perception of Observed Aggressive Driving Behavior

What kind of aggressive driving Patterns have observed on the Capital Beltway?

Survey	Speeding	Tailgating	Multi-lane Change	Other	TOTALS
Before	818	753	847	232	2650
After	416	398	433	94	1341
TOTALS	1234	1151	1280	326	3991

Table 1.3: Motorist's Awareness of Media Program

Are you aware of any enforcement program aimed at aggressive drivers in the area?

Survey	Aware	Not Aware	TOTALS
Before	184	805	989
After	407	344	751
TOTALS	591	1149	1740

APPENDIX B
ANALYSES FOR GOAL No. 1

Table B.1

Observed frequencies

	Problem Characterization				
Survey	Npblm	Mnpblm	Mjpblm	Crpblm	Totals
Before	21	237	530	197	985
After	24	211	408	117	760
Grand Totals	45	448	938	314	1745

Expected frequencies

	Problem Characterization			
Survey	Npblm	Mnpblm	Mjpblm	Crpblm
Before	25.40115	252.8825	**529.4728**	177.24
After	19.59885	195.1175	408.5272	136.76

P- value	0.028007
Observed chi-square	9.09871
Alpha	0.1
Critical chi-square	6.251394

Table B.2

Observed frequencies

	Problem Characterization				
Survey	Speeding	Tailgating	MtInchgn	Other	Totals
Before	818	753	847	232	2650
After	416	**398**	433	**94**	1341
Grand Totals	1234	1151	1280	326	3991

Expected frequencies

	Problem Characterization			
Survey	Speeding	Tailgating	MtInchgn	Other
Before	819.3686	764.2571	849.9123	216.46
After	414.6314	386.7429	430.0877	109.54

P-value	0.278195
Observed chi-square	3.849375
Alpha	0.1
Critical chi-square	6.251394

Table B.3

Observed frequencies

	Awareness of Media Program		
Survey	Aware	Nt aware	Totals
Before	184	805	989
After	407	344	751
Grand Totals	591	1149	1740

Expected frequencies

	Awareness of Media Program	
Survey	Aware	Nt aware
Before	335.919	653.081
After	255.081	495.919

P- value	2.31 E-54
Observed chi-square	89.234
Alpha	0.1
Critical chi-square	4.605176

Table B.4

Observed frequencies

	Effectiveness of law Enforcement				
Survey	Vry Eff.	Swt Eff.	Nt Eff.	Dnt Knw	Totals
Before	51	367	370	219	1007
After	54	312	253	145	764
Grand Totals	105	679	623	364	1771

Expected frequencies

	Awareness of Media Program			
Survey	Vty Eff.	Swt Eff.	Nt Eff.	Dnt Knw
Before	59.70356	386.083	354.2411	206.97
After	45.29644	292.917	268.7589	157.03

P- value	0.038902
Observed chi-square	8.372909
Alpha	0.1
Critical chi-square	6.251394

Table B.5

Observed frequencies		Need for More effective measures	
Survey	YES	NO	TOTALS
Before	878	83	961
After	678	68	746
Grand Totals	1556	151	1707

Expected frequencies		
Survey		Need for More effective measures
	YES	NO
Before	875.9906	85.00937
After	680.0094	65.99063

P- value	0.729875
0 bserved chi-sq	0.119227
Alpha	0.1
Critical chi-square	2.705541

Table B.6

Observed frequencies		Acceptability of video Technology	
Survey	YES	NO	TOTALS
B e f o r e	741	158	899
After	394	63	457
Grand Totals	1135	221	1356

Expected frequencies		
		Acceptability of video Technology
Survey	YES	NO
Before	752.4816	146.5184
After	382.5184	74.48156

P- value	0.074115
Observed chi-square	3.189459
Alpha	0.1
Critical chi-square	2.705541

APPENDIX C. SURVEY PROCESS

Daniel Consultants, Inc., as a member of the SAIC team was responsible for evaluating the Aggressive Driver Imaging and Enforcement (ADlE) program being developed for the Maryland State Police. One of the primary objectives of this project was to determine the success of a media campaign that warns drivers of this new enforcement technology. This section of the report describes the driver survey that was conducted on Beltway users before and after the media campaign that accompanied the launch of the new technology.

"BEFORE" SURVEY

The "Before" survey refers to the driver surveys that were conducted on Beltway users before the launching of the media campaign and the installation of static signs on the Beltway. The primary purpose of this survey was to determine the awareness of aggressive driving behavior among users of the Capital Beltway as well as to find out if the drivers were aware of any enforcement programs aimed at aggressive drivers.

DCI mailed out approximately 4000 surveys to randomly selected households during the last week of April 1997. The households were selected at random from a telephone directory on CD-ROM. Towns and communities adjacent to the Beltway in Maryland were used for random sampling. The most recent release of the CD-ROM was used.

DCI also distributed approximately 300 surveys to 15 trucking companies that us the Beltway on a regular basis. DCI also distributed surveys to truck drivers at the Park & Ride lot at the 1-95/l-495 junction, near College Park.

Approximately 300 surveys were returned back to DCI as undeliverable. To compensate for these returns, DCI mailed another 300 surveys to new addresses selected at random.

The responses from the returned surveys were entered into a DBASE file for analysis. The return rates and result summaries are presented in the main part of this document.

"AFTER" SURVEY

The media campaign for this project was initiated before Thanksgiving weekend of 1997. The static signs along the Beltway were installed a little earlier, in September. DCI conducted the "After" survey during the fiist week of March, 1998. A similar methodology was used in sample selection and mail-out. The survey responses are presented in the main part of this document.

APPENDIX D

AGGRESSIVE DRIVER IMAGING ON THE CAPITAL BELTWAY

SURVEY QUESTIONNAIRE

The Maryland State Police (MSP), in cooperation with the Maryland State Highway Administration (SHA). and the Federal Highway Administration (FHWA), is testing a new technology to aid in detecting aggressive drivers on the Capital Beltway. For the purposes of this survey, an "Aggressive Driver" is defined as someone who is excessively speeding, following too closely, making multiple lane changes within a short distance, or failing to grant the right-of-way to other motorists. The Maryland State Police is seeking to evaluate the effectiveness of a media campaign that complements the enforcement effort. You have been selected from a random sample of Beltway users to participate in this evaluation. Please take a minute to answer the following questions and return the postage-paid questionnaire. Any response provided by you will be kept strictly confidential and will be used for analysis purposes only. Your cooperation will be greatly appreciated. If you have any questions regarding this study, please contact Maryland State Police at (410)- 653-4236.

1. How often do you use the Capital Beltway?
☐ Never/seldom ☐ Occasionally ☐ Once a week ☐ 2-3 times a weeks ☐ Daily

2. What type of driver's license do you have? ☐ Regular ☐ Commercial ☐ Both

3. How would you characterize aggressive driving on the Capital Beltway?
☐ Not a problem ☐ Minor problem ☐ Major problem ☐ Critical problem

What kind of aggressive driving patterns have you observed on the Capital Beltway?
☐ Speeding ☐ Tailgating ☐ Multiple lane changes ☐ Other

4. Are you aware of any enforcement programs aimed at aggressive drivers in the area? ☐ Yes ☐ No
If Yes, can you name the program or agency?_____

5. In your opinion. how effective is the law enforcement on the Capital Beltway?
☐ Very effective ☐ Somewhat effective ☐ Not effective ☐ Don't know

6. Do you believe law enforcement agencies should consider use of more effective measures to control aggressive driving? ☐ Yes ☐ No
If Yes. would you consider use of video cameras as acceptable alternatives? ☐ Yes ☐ No
If No, can you suggest any other measures to curb aggressive driving?

_____

_____

7. Based on the definition of an aggressive driver, would you consider yourself to be an aggressive driver?
☐ Never ☐ Infrequently ☐ Sometimes ☐ Frequently ☐ Always

8. To help us ascertain the extent to which views on this issue may vary by age and sex kindly provide the following information:
Sex: ☐ Male ☐ Female Age: ☐ 16-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ Over 60

9. Comments:

_____

_____

APPENDIX E. COMMENTS RECEIVED RFOM MOTORISTS

- The speed limit on beltway is 55. No one drives that speed. My guess is 70 m.p.h. is the norm (reasonably safe). Troopers should target the above 70 mph drivers - especially those who change lanes frequently.

- Particularly the big trucks - too fast on the beltway and l-95.

- Driving on shoulder; other driver's going "right" into ramp entrances to Beltway to pass people who are already on the Beltway,

- Give tickets "regularly"! I have never seen a ticket given on the-Beltway. Three ticket - lose your license.

4 Observation of police with radar guns on 270 and 95.

3 Have police on Beltway and pull aggressive drivers over. I see police doing that on 270and 1-95, but not 495.

- I'm not an angry/rage driver and I don't think of myself as aggressive, but I do keep up with traffic, which often exceeds 55 mph limit.

- A serious problem that does require some attention soon

- Aggressive driving is performed by a select few; and as with any security program it is well documented that physical bodies provide the best deterrent.

- I consider myself a safe and defensive driver, with an excellent record. However, I am
- forced to be aggressive at times, due to the number of ill prepared or incompetent drivers on the road

- I am pleased to see MSP taking steps to control aggressive driving.

- Phone number to report aggressive driving - immediate forward to patrol car in vicinity

- As crazy and expensive as it seems, I think the only effective alternative is the presence of police officers on active patrol in very high visibility mode

- I try to control myself at all times, I have however reacted to bring target of aggressive drivers and overreacted on 2 or 3 occasions in the past with inappropriate actions/gestures. T.V. reports have pointed out how wrong/dangerous this reaction is and what you should do. These reports have been helpful in intellectualizing situation and not over reacting. Try hard to stay in control.

- More police on the road. More serious penalties and/or fines.

- I drive the Beltway everyday. I see aggressive drivers everyday. Mobile police or police setups at different locations (rundown) should catch the reckless drivers.

- Scare tactics such as signs that say "X # of drivers/passengers have been killed on this stretch of the beltway", etc.

> A welcome initiative to curb that type of un-social behavior.

> The sign says Aggressive Driver Imaging Program in effect, but I have no idea what that means, other than above explanation.

> Consider a specially trained 12 car patrol with special markings 24 hours a day for 12 months.

> I've been driving since I was 14 am now 83 have driven all over USA - no accidents - one speeding ticket in 1960s. Never avoided a road until the Beltway threatened my survival. I avoid it like the plague.

> Assign two lanes to semis and bus traffic. Cars can go on them if necessary, in congested traffic. Limit "monster" dangers.

> Aggressive driving happens on city and town street as well as on the Beltway. Whatever law enforcement can do, I support whole heartily. Higher fines and increased personnel.

> Thank you for asking - the "road rage" is so prevalent today FRIGHTENS me

> Have law enforcement cars drive the speed limit and pull people over that pass them I don't know how many times I've had cop cars pass me doing well over the speed limit with no lights on.

> Use more dummy patrol cars in the median and along the sides of the road

> Thanks for your concern for safety and the safety of others

> I feel the worse problem is poor driving skills. Aggressive driving, although hazardous is not widespread, thus not worth spending a lot of money on.

> Something should be done about tailgating large trucks. They seem to make a game of riding too close to the car in front of them.

> We need public service announcement explaining the rules and courtesies of the road. Germany is a good example of how to drive but perhaps not as fast.

> If you stop people during rush hour, creates traffic delay, perhaps cameras is the answer? I do not believe speed is the problem unless it is aggressive. In Europe drivers obey the rules. We need to educate drivers to pass on left and move to right if slower.

> As strange as it seems, a program to encourage 'courtesy' - which is as contagious as aggressiveness

> I know your task (on & off the Beltway) is monumental - and wish you luck