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DEPARTMENT OF TRANSPORTATION

Evaluation of the Ticketing Aggressive Cars and Trucks (TACT) Program in Pennsylvania (071408)

Project Report

Final Report

August 14, 2009

By Cambridge Systematics, Inc.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

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16. Abstract The Pennsylvania State Police and Pennsylvania Department of Transportation implemented the "Ticketing Aggressive Cars and Trucks (TACT)" media and enforcement initiative on a portion of Interstate 81 in southern Pennsylvania, in late 2008. This report considers the evaluation of the implementation. The evaluation process included over five thousand attitudinal surveys completed by Pennsylvania drivers, field video observations of driving behavior, and analysis of relevant crash and citation data. In addition to our statistical findings, we have identified 11 procedural findings to improve the evaluation process in future implementations of TACT or similar initiatives combining media and enforcement treatments.			
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final report

Evaluation of the Ticketing Aggressive Cars and Trucks (TACT) Program in Pennsylvania (071408)

Project Report

prepared for

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August 14, 2009

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Executive Summary

This report describes the Evaluation for the Ticketing Aggressive Cars and Trucks (TACT) Evaluation Project (071409), performed by Cambridge Systematics, Inc. on behalf of the Pennsylvania Department of Transportation (DOT). Cambridge Systematics (CS) is assisted on this project by Mr. Lowell Porter, an independent consultant, and by temporary contract staff for data entry provided by Global Employment Services.

The Pennsylvania State Police and Pennsylvania Department of Transportation implemented the TACT program on a portion of Interstate 81 in southern Pennsylvania, as shown in Figure 2.1. This particular stretch of Interstate, to be referred to as the "test corridor," was selected due to its characteristics of having a substantially above-average incidence rate of crashes with known factors of relevance to the TACT concepts, as well as its proximity to the headquarters of both participating agencies.

The TACT implementation occurred between September 29, 2008, and November 14, 2008. The experimental design for a evaluation of a program such as TACT traditionally requires a "baseline" period before the beginning of implementation. Due to factors outside the Commonwealth's control, however, the collection of baseline data was unable to begin until after the media event. Furthermore, Cambridge Systematics was not contracted to begin the evaluation until October 1, 2008. These events required the evaluation to be reconsidered, and an alternative design was created to test the message retention capacity of the TACT media and enforcement campaign on the Interstate 81 corridor. The design extended the collection of data into February 2009. A "control" corridor had previously been designated by PennDOT along Interstate 80, and continued to be used in the analysis.

Four sets of TACT-specific data were used in the evaluation process:

- **Public Awareness Survey Data –** Over 5,000 drivers filled out a one-page survey at a state driver services facility near the study corridors;
- **Crash and Citation Data –** Enforcement officers collected information about crashes and issued warnings and citations in the corridors, allowing tracking of daily or weekly frequency of enforcement actions (citations, written warnings) to show an intermediate affect of the high-visibility enforcement activities as the project progresses;
- **Video Observation Data –** Enforcement officers traveled in normal shift patterns, but in unmarked cars equipped with video cameras; for over 40 hours of videos observation, these officers would provide real-time narration of situations where driver behavior occurred that normally would result in TACT-related warnings or citations; and

- **Panel Review of Video Data –** A panel of officers with expertise in the test corridor was identified by the State Police, reviewed samples of video data and provided independent assertions about the severity of the events found.

In the Interstate 81 corridor selected, there is an annual average of 202 crashes, with an average of 53 crashes involving both a heavy truck and a passenger vehicle. We assert that the distribution of the TACT message (through both media and enforcement) can prevent crashes only if all three conditions are met:

1. A situations exists where a driver could end up in a crash due to aggressive driving around a commercial vehicle, or vice versa;
2. The driver was previously reached by the TACT message; and
3. The driver changed their behavior sufficiently such that the crash was avoided.

Thirty-two percent of drivers in the Interstate 81 corridor stated that they had heard about the TACT message. Electronic media, such as television and radio, had the highest penetration, while billboards had the best message retention capacity.

A potential confounding effect of the data collected is that it is skewed towards older drivers. We believe that this effect has to do with the mix of drivers who come to a driver services facility (the survey distribution point) versus those who conduct activities over the Internet. We recommend that future initiatives consider a broader mix of collection mechanisms and locations for capturing stated driver behavior.

Based on our analysis of the data, we can reasonably assert that roughly 8 percent of all respondents change their driving behavior purely based on the media coverage for safe driving. It is possible that this value is as high as 33 percent, but deficiencies in the survey instrument provided to PennDOT from the Federal Motor Carrier Safety Administration make it difficult to quantify beyond the 8 percent mark. All things being equal, however, **our results strongly indicate that Pennsylvania drivers have the same aptitude as Washington State drivers for changing their behavior when exposed to the TACT message**, as our results in this area nearly mirror those found in Washington State.

The enforcement portion of the experiment did not have the same level of success as the media portion. Seven months after the enforcement period, officers in the region who were not involved in the TACT experiment often could not agree on the appropriate enforcement action when viewing the same video clips. While some level of disagreement is to be expected, since the TACT-related violations are not as binary in nature as wearing a seat belt, we are concerned that a lack of uniformity in interpretation will have a potential negative effect on drivers who do hear and absorb the media message and then view potential TACT-related driving behavior in front of an enforcement official.

In addition to our statistical findings, we have identified 11 procedural findings. Each of these findings involved areas where the procedures in place were outside of the control of the combined CS-Commonwealth team and had a negative effect on the level of detail of our resulting evaluation procedures. We provide these recommendations as guidance both for future Pennsylvania implementations of future "enforcement + media" safety initiatives, but also for other agencies considering piloting the TACT strategy in their jurisdictions.

Our most important procedural finding is the Commonwealth was rushed into conducting the September media event without having an appropriate evaluation framework in place. Given that TACT is a two-year Federal program (FY 2008-2009), there would have been no practical harm on the evaluation process by delaying the media event and corresponding enforcement to March 2009, as all evaluation results would still have been available by September 30, 2009.

The formal evaluation of programs as complex as TACT needs substantial advance staffing commitments and coordination. The framework requires data collection over a substantial period of time, therefore, it needs significant staffing commitments and intra and inter agency coordination. Staffing needs for each task should be clearly identified and necessary assignments should be made in advance, including back-up assignments in the case of planned staffing needs can not be met. This is particularly critical for simultaneous (at the test and control sites) data collection and achieving consistency on data items on driver surveys and citation and warning information.

Finally, we have concerns about the structure of the survey document provided to PennDOT for the TACT initiative. While the design of the survey is efficient and suitable for being completed while waiting on queue at a driver services facility (as originally implemented in Washington State), the brevity of the survey appears to lend itself to the introduction of biases – especially when a respondent has more time to think about their answers in a mail-return setting. Meanwhile, the timing of the project and the fact that the baseline surveys were already being distributed using the Washington State format eliminated our ability to make structural changes to the survey for the post-implementation period beyond adding questions to ascertain the respondent's location and date of completion. We have included our recommended design for an updated survey instrument as Appendix B of this report.

1.0 Introduction

This report describes the Evaluation for the Ticketing Aggressive Cars and Trucks (TACT) Evaluation Project (071409), performed by Cambridge Systematics, Inc. on behalf of the Pennsylvania Department of Transportation (DOT). Cambridge Systematics (CS) is assisted on this project by Mr. Lowell Porter, an independent consultant, and by temporary contract staff for data entry provided by Global Employment Services. This report is the formal deliverable for Task 5 of the project.

In 2004, more than 5,000 people died in crashes involving a large truck. Nearly 4,000 of these fatalities resulted from a crash between a passenger vehicle and a large truck.[1] As a result of the consolidated Appropriations Act of 2004, the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) were directed to consider the issue of how drivers should be educated about safety issues when driving near commercial motor vehicles. NHTSA has enjoyed substantial success with the implementation of various high-visibility enforcement programs, and work began to identify a pilot state for a high-visibility enforcement program in this area.

Washington State was selected for the initial pilot as a result of previous local initiatives in this area. The Washington pilot for NHTSA/FMCSA was named Ticketing Aggressive Cars and Trucks (TACT). The Washington TACT program was considered to be extremely successful, and as a result FMCSA has identified additional states for test sites. The Commonwealth of Pennsylvania was selected for a test site, involving both the Pennsylvania Department of Transportation (PennDOT) and the Pennsylvania State Police. As part of the pilot process, a neutral observer is requested to evaluate the implementation and results of the program, and produce documentation regarding the changes in output measures of effectiveness after the TACT pilot has been implemented. Examples of assertions the evaluator will be expected to consider are:

> Were drivers in the study corridor aware of the TACT media campaign and enforcement activities?

and

> Did drivers actually change their behavior after listening to the TACT message?

[1] Share the Road Safely web site, July 18, 2008.

A proper evaluation of an enforcement initiative such as TACT involves a multi-phase approach to understand the impact of initiative activities such as media events, posted information on state highways, and adjustment of enforcement activities and standards. The evaluation process is based on data collection of key attributes such as public awareness, enforcement activities, and crash and violations.

The document is organized in six sections as follows:

- **Section 1.0, Introduction –** Provides an overview of the report;
- **Section 2.0, Experimental Parameters –** Describes the corridors and parameters of the initiative;
- **Section 3.0, Data Acquisition –** Provides a summary of the data acquired by the Commonwealth and transcribed by the CS team before and during the project;
- **Section 4.0, Benefits Framework** – Provides a description of how various data elements can be used to identify the potential benefits of the TACT implementation;
- **Section 5.0, Analysis Results –** Provides information about the analysis of trends within the data; and
- **Section 6.0, Findings and Recommendations –** Describes key conclusions from the project, both regarding the specific statistical results of the Pennsylvania experiment as well as insights of value to agencies considering similar program implementations.

2.0 Experimental Parameters

In this section of the report, we will outline the basic parameters of the Ticketing Aggressive Cars and Trucks (TACT) experiment in Pennsylvania. The TACT experimental design is generally based on the approach used in the original TACT demonstration project in Washington State. The uniqueness of each state's situation, however, means that the design had to be customized to meet the situation at hand.

2.1 EXPERIMENT SUMMARY

The Pennsylvania State Police and Pennsylvania Department of Transportation implemented the TACT program on a portion of Interstate 81 in southern Pennsylvania, as shown in Figure 2.1. This particular stretch of Interstate, to be referred to as the "test corridor," was selected due to its characteristics of having a substantially above-average incidence rate of crashes with known factors of relevance to the TACT concepts, as well as its proximity to the headquarters of both participating agencies.

The TACT implementation involved a coordinated media and enforcement campaign. Media was both purchased and earned on a variety of platforms. Enforcement occurred in two waves of two weeks each.

The Commonwealth was formally selected to participate by the Federal Motor Carrier Safety Administration in July 2009 Media purchases were planned to coincide with a media event in Harrisburg on September 29, 2008. Executives from both participating Pennsylvania agencies as well as the Federal Motor Carrier Safety Administration were in attendance at the media event. The first enforcement wave began one week later, on October 3, 2008.

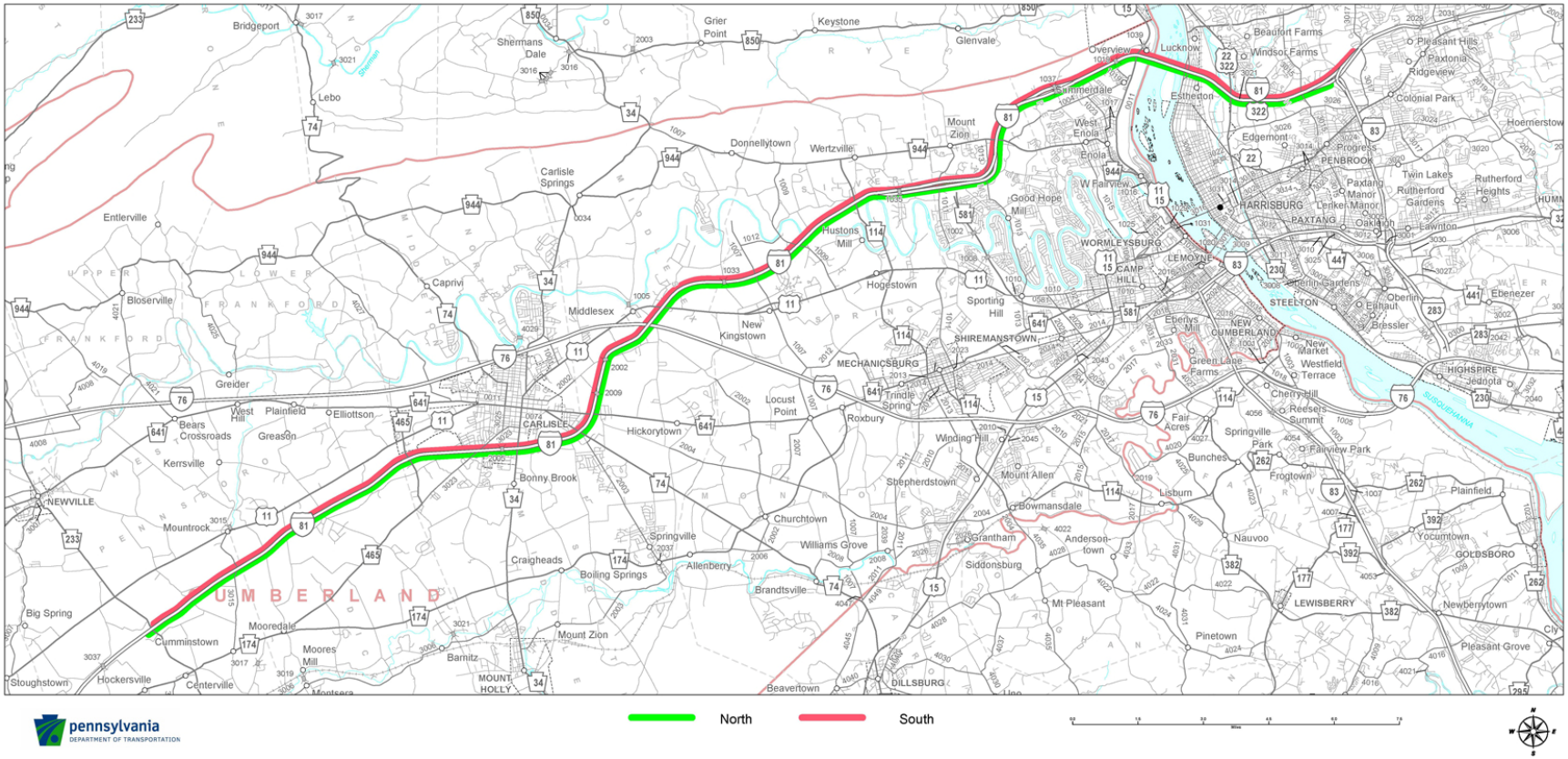
The Pennsylvania Department of Transportation issued a Request for Quotations for an evaluation contractor on July 14, 2008. The request was issued through the agency's "Transportation Research, Education, and Technology Transfer" program. The team led by Cambridge Systematics, Inc. was selected on September 8, 2008, and after brief scope and budget negotiations began work on October 1, 2008.

During the experiment, drivers would be subjected to two sets of stimuli:

- Media messages (both paid and earned) about the dangers of aggressive driving around trucks, with mention of increased enforcement activity; and
- Additional targeted enforcement of drivers on the Interstate 81 corridor, with an emphasis on "TACT-related" moving violations.

The purchased media were also augmented by brochures (primarily distributed at traffic stops) and posters provided to business owners in the region. Appendix A contains examples of the media messages developed and implemented by the participating agencies during the initiative.

Figure 2.1 TACT Test Corridor – I-81 Cumberland and Dauphin Counties



2.2 EXPERIMENTAL COMPONENTS

In TACT studies, the main effects of the program are measured on the users of the selected highway corridors. The differences in observed or reported effects on the baseline and post-intervention users on selected performance measures point out the effects of the program.

Multiple Levels of Treatment

The TACT implementation typically includes two levels of implementation components, or "treatments." The first level is the information dissemination via media, highway signs, visual aids along the roads and vehicles. The second level of treatment is the enforcement of violations of the traffic laws around trucks.

The impact of these levels on the experimental design is to include multiple types of data for collection, to understand the individual and collective impact of the initiative both on drivers as well as on law enforcement agents.

Note that in the Pennsylvania implementation, the highway signs used in Washington State were not used. This decision was due to inconsistencies between the proposed sign format and Federal Highway Administration standards.[2] Given the short time period to the media event after receiving authorization to proceed with the experiment by the Federal Motor Carrier Administration, an alternative short-term solution was not practical.

Items for Evaluation

The TACT evaluation in Pennsylvania involved the following sets of TACT-specific data in both the study corridor and in control corridors, both before and after the implementation:

- **Public Awareness Survey Data –** Over 5,000 drivers filled out a one-page survey at a state driver services facility near the study corridors;
- **Crash and Citation Data –** Enforcement officers collected information about crashes and issued warnings and citations in the corridors, allowing tracking of daily or weekly frequency of enforcement actions (citations, written warnings) to show an intermediate affect of the high-visibility enforcement activities as the project progresses;
- **Video Observation Data –** Enforcement officers traveled in normal shift patterns, but in unmarked cars equipped with video cameras; for over 40 hours of observation, and provided real-time narration of situations where driver

[2] Subsequent to the start of the TACT enforcement in Pennsylvania, FMCSA and FHWA provided guidance to agencies regarding reconciliation of potential issues in using the road signs.

behavior occurred that normally would result in TACT-related warnings or citations; and

- **Panel Review of Video Data –** A panel of officers with expertise in the test corridor was identified by the State Police, reviewed samples of video data and provided independent assertions about the severity of the events found.

Temporal Aspects

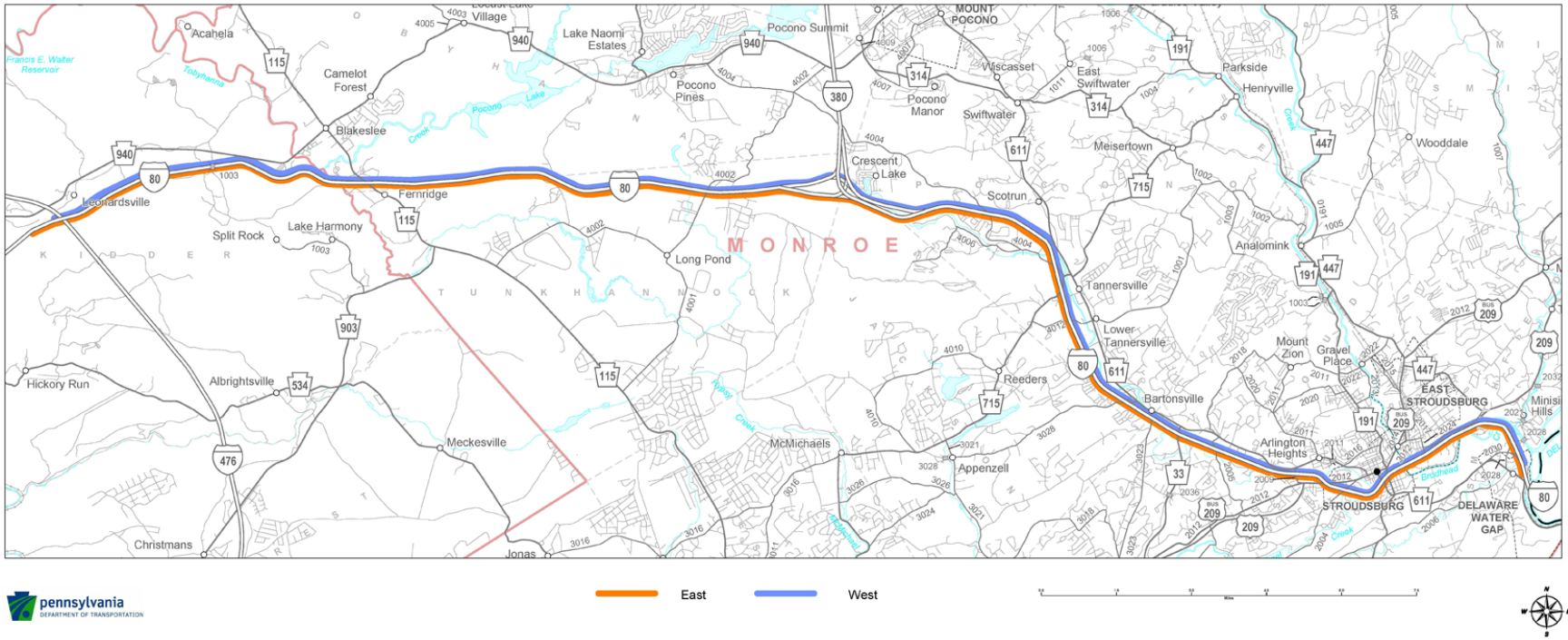
The concentrated enforcement activity was performed in two sets of two weeks each. The time between waves can vary by experiment, as in Washington the period was approximately three months, and in Pennsylvania the time was two weeks.

The impact of the temporal aspect is that the data collection has to be scheduled over a period of time. Passive data collection, such as crash data, can be captured continuously before, during, and after the implementation period. Active data collection, such as enforcement video and awareness surveys have to be scheduled for appropriate time slices over the period of time – putting the time slices too close together will obviate the ability of the experimental design to understand if the initiative is retained in the community's awareness over an extended period of time.

Control versus Implementation Corridors

Because the evaluation process is considering the change in behavior over a period of exposure to the treatment, a control corridor is required. The control corridor asks the question of what happens to behavior over time if treatment is not provided. In essence, the control provides an estimate of what level of variation in the data is truly noise and randomness, so that the evaluation team can determine if the impacts of the TACT initiative are truly above and beyond that of the noise. As shown in Figure 2.2, the Commonwealth selected a control corridor along Interstate 80, in a more rural section of Pennsylvania.

Figure 2.2 TACT Control Corridor – I-80 Monroe and Carbon Counties



2.3 INITIAL EXPERIMENT TIMELINE

This section outlines by event the project schedule and the data collected throughout the project.

The TACT media event took place on September 29, 2008. The two enforcement periods occurred between October 6-October 17, 2008, and November 3-November 14, 2008 respectively.

Objectives of the Timeline

Ideally, the data collection timeline is organized to allow the project team to test the following topics:

- The effects of the media campaign without enforcement;
- The immediate effects of each two-week enforcement wave;
- The cumulative effects of the program at its conclusion; and
- The residual effects of the program at a period of time after its conclusion.

A major constraint on the evaluation project was that the initial implementation period [from formal agreement for the Commonwealth to participate in the TACT program to the date of the media event] was insufficient. As a result, all details of timeline before the media event were finalized before the evaluation team could provide input on potential confounding factors. Specifically, the CS team was not officially engaged until after the media event had been conducted. Our approach, however, considered the limitations of the experiment and developed a timeline for the post-implementation phase that enabled the project team to still evaluate a number of temporal factors regarding the impacts of the experiment.

Ideal Baseline and Post-Implementation Periods

To determine if the temporal effects of the project on driver behavior and perception worked as proposed in the experiment, an appropriate comparison data set must be collected. A reasonable timeframe for collecting this comparison data would have been from September 3, 2008[3] to January 31, 2009. This timeframe would have provided for the adequate collection of comparison crash and citation data from which to determine if the TACT message "took" with those driving in the enforcement zones and/or those exposed to the TACT media messages.

[3] We would typically pick a full month before the media event, but the Labor Day holiday occurs at the beginning of that month-long period. Thus, it would have been appropriate to begin the following Wednesday.

Given this approach, the period from September 3 to the media event on September 29 would be considered the "baseline" period. The period from September 29 through January 31 would be considered the "post-implementation" (PI) period. Dates within the PI period, however, could be excluded as holiday periods.

2.4 REPOSITIONING THE EXPERIMENT DUE TO CONFOUNDING LIMITATIONS

Due to factors outside the Commonwealth's control, however, the collection of baseline data was unable to begin until after the media event. This approach created a significant challenge for the evaluation team. Without data from before the media event, it was be impossible to truly capture the differences in aggregate driver perception from before and after the media and enforcement events. Even more important, there was no way to "pre-test" the collection mechanisms to identify potential issues and adjust the protocols before the experimental period began.

The key factor was the timing of the experiment. TACT is a two-year program (Federal Fiscal Years 2008 and 2009), but a media event was expected in Federal Fiscal Year 2008 (e.g., before September 30, 2008). The amount of time available to the Commonwealth between selection and the end of the Federal fiscal year was far too short to be able to properly design an experiment. A characteristic of this timeline is that Cambridge Systematics was not under contract until after the baseline media event occurred, and therefore could not provide any guidance to the Commonwealth as far as structuring events before the media event. Cambridge Systematics strongly suggested that the media event be deferred, preferably into 2009 but at the earliest to the last week of October, but this request could not be accommodated by FMCSA.

Without the "before" in a "before/after" analysis, the total evaluation could have been in significant peril. Our approach, therefore, needed to become an "after"/"before" analysis, to create a situation which measured the longer-term effects of the TACT corridor on participants (both drivers and enforcement staff) with potential exposure to the initiative. Our hypothesis was that as time passed after the TACT media and enforcement events, participants would eventually "forget" the message and revert back to prior habits.

In this type of scenario, it would have been best to collect data for a very long period, perhaps even a year, after the media and enforcement events. The available resources and contractual deadlines, however, required a practical limitation. Therefore, we recommended that the project timeline be shifted as follows:

- There would be a nominal "baseline" period to be considered from the date of the Media event (September 29) through the enforcement period (November 21);
- The period from November 22, 2008 forward would be referred to as the "post-implementation" (PI) period;
- Driver attitudinal surveys would be distributed by the Pennsylvania Department of Transportation through February 28, 2009;
- Video collection by the State Police would be extended through approximately January 31, 2009, with the specific ending date to depend on operational considerations for the State Police;
- A sample of the video clips collected would be reviewed by enforcement officials during the spring of 2009; and
- Data would be collected on both the Interstate 81 (test) and Interstate 80 (control) corridors.

The situation was further confounded by the advice provided to the Commonwealth by FMCSA's external representatives regarding the amount of data to be collected. Cambridge Systematics recommended that a similar volume of data be collected in Pennsylvania as was collected in Washington State: approximately 6,000 driver awareness surveys and over 100 hours of video collection, split roughly evenly before and after the media event, and split roughly evenly between the test corridor and a control corridor. Unfortunately, the advice provided to the Commonwealth when being courted for the TACT program was that only 500 surveys and less than 20 hours of video would suffice.

When the Cambridge Systematics team explained the impacts of those volumes on the amount of statistical stratification analysis which could be accomplished, PennDOT and PSP were able to add additional resources and increase these numbers: in the end over 5,000 surveys and over 40 hours of video were collected. The results, summarized in Section 5.0 of this report, demonstrate the amount of stratification available; when reviewing the materials, the reader is encourage to consider the potential impacts of having only 10 percent of the survey data, and only one third of the video data.

The impact of these volume issues was that because data had already been collected for the "baseline" period, we could not recommend additional collection protocols without introducing a potentially significant bias into our results. Therefore, we present the results in Section 5.0 to the best of our combined (CS-Commonwealth) ability, and recognize the inherent limitations in the experimental design.

2.5 QUALITY CONTROL PROTOCOLS

At the beginning of its involvement, the CS team developed a memorandum guiding the process for assuring the quality of the data to be used in the project. Given that data collection had already begun before CS was engaged, however, the quality control protocols were modified to determine how to review collected data and evaluate its feasibility for inclusion.

Quality control protocols were developed by the CS team and reviewed with the participating agencies in the following areas:

- Data management, including transcription and storage;
- Checks for incompletely or fabricated data from drivers participating in the attitudinal surveys; and
- Confounding events such as public events, weather events, and construction activities.

3.0 Data Acquisition

The data to be acquired and analyzed for the TACT experiment in Pennsylvania was based on the development of the Quality Control (QC) plan for the experiment described in Section 2.5. The QC plan is a published internal document outlining the experimental definition, the data management procedures, and the general hypotheses for program evaluation.

The plan, however, must be by definition fluid. Events occur beyond the control of participants, response or event rates may exceed or fail to meet expectations, or the data collected could be more uniform than expected. In short, variance occurs, and is natural.

In this section, we will not attempt to recreate the entire QC plan, but instead highlight what actually occurred during the project data acquisition period. Four groups of data are identified for the TACT experiment in Pennsylvania:

1. **Public Awareness Survey Data –** Drivers fill out a one-page survey (provided by FMCSA from the Washington State pilot program) at a state driver services facility near the study corridors. In the survey, drivers indicated their level of familiarity of driving a commercial vehicle;
2. **Crash and Citation Data –** Enforcement officers collect information about crashes and issued warnings and citations in the corridors, allowing tracking of daily or weekly frequency of enforcement actions (citations, written warnings) to show an intermediate affect of the high-visibility enforcement activities as the project progresses;
3. **Video Observation Data –** Enforcement officers traveled in normal shift patterns, but in unmarked cars equipped with video cameras to document moving violations committed by cars and trucks. Officers narrated these situations where violations would normally result in warnings or citations; and
4. **Expert Panel Data –** The transcribed video observation data is compiled into a set of video clips of potential TACT-related interactions between trucks and passenger vehicles. The video clips are transferred to DVD, and sent to an expert panel of enforcement officers. The panel members independently and individually review the video clips and complete a questionnaire regarding the potential crash severity of each situation, and the enforcement action (if any) the officer would take if (s)he had been on the scene.

3.1 ACQUISITION TIMELINE

A timeframe for acquisition of each set of data was provided in the QC plan. Due to limitations within the participating agencies, the plan could not be exactly followed, but sufficient data was collected to perform the analyses required.

- Public Awareness Surveys were distributed by PennDOT staff at five motor vehicle services offices across both the test and control corridors from the beginning of October through the end of February. Issues with the printing process and the distribution of the printed surveys to the offices, however, prevented a full distribution during the period between the Thanksgiving and end-of-year holidays. Therefore, the vast majority of the PI surveys returned by drivers were completed during January and February 2009.
- The process of managing citations by the Pennsylvania State Police (PSP) meant that significant overtime would be required from PSP staff. State privacy rules prevented CS staff from viewing the original citations and warnings, and therefore PSP staff would have to transcribe relevant records from each paper citation into an electronic system, while sufficiently obfuscating the identify of the driver. As a result, citations and warnings were only collected and transcribed by PSP staff for the four weeks of additional enforcement. It was mutually determined by CS, PennDOT, and the PSP that the PSP overtime required to transcribe later citations into a format for which CS staff would have access was disproportionately high when compared to the likely value of such data. Instead, the expert panel results would suffice as a proxy for PI enforcement data.
- Crash data for the corridor was obtained for calendar years 2004 through 2008.
- Video observation data was collected by the Pennsylvania State Police at intervals between the media event and early February 2009.

All controls for confounding effects were considered, but no events of significance occurred during the PI collection period other than those mentioned above.

3.2 TRANSCRIPTION AND EXCLUSION

It is necessary for the raw data from each category to be transcribed into a format suitable for analysis. The transcription process took place during Tasks 3 and 4 of the project, between December 2008 and May 2009. Each transcription process was slightly different in mechanics.

For the public awareness surveys, the CS team developed a data entry tool using Microsoft Excel. The approach allowed quality control checks to take place during the transcription process. Staff from Global Employment Services transcribed the data, with oversight and additional quality control by the CS Task Leader.

For the video observation data, CS staff viewed each video and transcribed the results into an Excel spreadsheet. A team member reviewed a subset of the data for quality control. A limited amount of potential records were inconclusive, and a DVD was produced for review by the Pennsylvania State Police staff involved in the collection process. The updated results were then transcribed into the data set by CS staff, and video clips were created. The video clips were created using a free video clipping program that is widely available on the Internet. The program has a function that allows the user to mark the beginning and end points of the desired video clip.

The project team originally planned to create a random sample of video clips using a sampling frame of *all* violations that were observed by the officers in the vehicles. However, during this process, underlying issues with the video footage were uncovered. For example, in some cases, the same footage appeared twice. For some of the video tapes, data was overwritten on previous data, therefore, a portion of a previously recorded video continued just after the new video ended. This created issues during transcription that were identified by our quality control procedures. For some cases partial videos were transcribed and original versions were omitted due to duplication concerns. During quality control, originals were transcribed and replaced the partially transcribed data, and the duplicates were deleted from the data set. In addition, the clipping software frequently did not "read" the chapters and time in the same way that the original transcription software identified these items. As a result, in many instances it was very difficult to locate the actual violations that were noted by the officers.

To overcome this technical difficulty, the project team developed a database of all clips that were readily identifiable, rather than sampling all clips from the original footage. This smaller database consisted of about half of the original observations from the entire footage There were 124 clips available for expert panel review out of 267 violations, and the random sample of 99 clips was generated from this subset of 124.

4.0 Benefits Framework

In this section, we outline the framework of questions which influenced our analysis process during the project. Our approach must attempt to answer the question of benefit of the TACT implementation in an indirect manner, as it is impossible to monitor the highway corridor and identify that a particular potential collision was avoided due to the TACT message and enforcement treatments. The approach, however, must still reach a reasonable assessment of the question:

> Will the distribution of the TACT message in the test corridor, through both media and enforcement, prevent (fatal) crashes after the message was disseminated?

We will attack the question by dividing it into a sequence of smaller questions, to be examined in the following sections.

4.1 HOW BIG IS THE PROBLEM?

The first question to address is a variation of the cliché "if nobody hears a tree fall in the forest, did it make a sound?" We will approach the quantification of the problem from three directions:

- **Crash Information –** We cannot realistically use 2007 versus 2008 crash data to tell us that "TACT worked because there were less crashes," as there are far too many confounding factors (such as variation in miles driven, weather, and congestion) to make a concrete assessment. We will, however, use information about crash information to develop an indication of the relative size of the problem by examining crash records within the corridor and assessing how many of these crashes could potentially have been affected by the TACT message.
- **Citations and Video Observations –** While we only have two weeks of detailed citation information, it provides us with another indication of the magnitude of the problem. Similarly, the video observations give us an approximately rate statistic, as long as one takes care to properly discount the small sample size.
- **Stated Driver Behavior –** Our largest sense of the problem, however, is from the stated behavior from survey respondents. A key question in the survey asks how far the driver typically follows other vehicles. While there were many occurrences of odd answers (typically assumed to be confusing "feet" versus "car lengths"), the volume of survey responses gives us substantial insight into driver behavior.

4.2 CAN DRIVERS BE REACHED?

This problem is at the core of the TACT initiative. The combination of media and increased enforcement is designed to get drivers to think about the message regarding aggressive driving around commercial vehicles. We can therefore use two corresponding measures to determine if the drivers are in fact being reached:

- **Driver Survey Responses –** Drivers were asked two questions:
  - If they knew of the TACT program; and
  - The method(s) by which they learned of the program.
- **Expert Panel Responses –** We can reasonably assert that both the driver stopped for a TACT-related measure as well as the drivers who observed both the behavior and the traffic stop are explicitly exposed to the message. For this to be true, however, *the offending driver must actually be stopped*. The expert panel responses measure the impact of the TACT program on the field officer in the long run, as the panel was convened more than seven months after the TACT enforcement period. While the officers in the expert panel were not explicitly trained in the TACT message, they represent the officers the driver was most likely to encounter in the field. We will expand on this point in Section 4.4.

4.3 DOES DRIVER BEHAVIOR CHANGE?

Once the driver has been reached, however, the TACT message is only truly effective if the driver changes his or her behavior. For this measure, we only have one data point, which is the survey question as to whether drivers changed their driving behavior "recently," as shown in Figure 4.1.

Unfortunately, the questionnaire used (nearly identical to that developed for the Washington State TACT pilot) is silent in establishing whether the change in driving behavior was due to hearing the TACT message – instead, it is assumed. In Section 5.0, we will demonstrate how the results of this last question must unfortunately be substantially discounted.

Figure 4.1 Key Survey Questions

10. In the past two months, have you changed your driving behavior around trucks?

☐1 Yes

If yes, what did you change? (Check all that apply):

☐1 I leave more space when passing ☐2 I don't follow as closely ☐3 I stay out of the truck driver's blind spots

☐4 Other _____

☐2 No

15. Have you recently read, seen or heard anything about giving semi trucks more space when you pass them?

☐1 Yes

If yes, where did you see or hear about it? (Check all that apply):

☐1 Newspaper ☐2 Radio ☐3 TV ☐4 Road sign ☐5 Brochure ☐6 Police ☐7 Billboard ☐8 Poster ☐9 Banner

If yes, what did it say? _____

☐2 No

4.4 CONFOUNDING EFFECT: ADDITIONAL ENFORCEMENT VERSUS ADDITIONAL TACT-RELATED ENFORCEMENT

One confounding effect which must be identified is that, by definition, the "treatment" period of the initiative has more enforcement activity. The enforcement activity is designated to be TACT-related, but what would happen if it was not?

We assert that while there are practical limits to the theory that "any additional enforcement will improve traffic safety," the amount of additional enforcement hours provided through the TACT experiment does not appear to reach that practical limit. Therefore, one can expect that spending a sum of incremental funding for any additional enforcement will have a positive benefit.

As a result, a key unanswerable question becomes:

> A driver knows about the TACT program, sees TACT-related driving behavior the driver believes is aggressive[4] and an enforcement officer, and no obvious enforcement action occurs. How much does the knowledge of TACT media campaign then actually diminish the driver's perception of not only TACT, but all other future enforcement media campaigns?

[4] Note that it does not really matter if the behavior was indeed aggressive by PSP standards, if the driver who has observed the TACT message *perceives* it to be aggressive.

While there is no clear answer, we believe that an appropriate proxy is to measure the likelihood that a consistent enforcement action is not applied. While we realize that judgment is a necessary component of law enforcement in an area such as "aggressive" driving, we assert that the decision to invest funds in making drivers aware of the issue requires a corresponding rationalization of judgment within limits of practicality.

Therefore, we look to the expert panel to measure the amount at which the State Police must be concerned about such unintended consequences. The more variation among panel responses, the more likely that unintended consequences might negatively impact some drivers. That does not mean that the program would necessary have a total negative benefit, as the number of drivers positively influenced is expected to greatly outweigh those negatively influenced. It is important, however, to acknowledge the potential negatives.

4.5 SYNTHESIS: INITIATIVE BENEFIT

Given information about these three smaller questions, we can readdress the larger question. The distribution of the TACT message will prevent (fatal) crashes only if all three conditions are met:

1. A situations exists where a driver could end up in a (fatal) crash due to aggressive driving around a commercial vehicle, or vice versa;
2. The driver was previously reached by the TACT message; and
3. The driver changed their behavior sufficiently such that the crash was avoided.

While the data available to the project team is far from conclusive enough to put a specific number on the benefit (e.g., *x* percent of crashes could be prevented), we assert that sufficient data exists for agency staff to make informed judgments about the relative benefit of the program.

Note that we are only discussing *benefit*. The project team does not have sufficient information to inform the discussion of benefit/cost analysis, as such information requires a comparison to other methods of crash avoidance. This type of comparative benefit/cost analysis is beyond the scope and resources of our research project.

With the framework established, we will now turn to the analysis of each of the specific data sets collected during the PI period.

5.0 Analysis Results

In this section, we will describe the analysis of the various data sets collected during the project, and present the most relevant statistical analyses. The total set of analysis results is excessive for the purpose of the report, and will be provided (with the transcribed data) on the project data CD-ROM to be provided to PennDOT at the end of this project.

The casual reader may wish to proceed to Section 6.0, where we summarize the findings against the benefits framework.

5.1 DRIVER SURVEY DATA

In this section, we present results from a detailed analysis of the transcribed survey data. First, summary data of interesting data variables is presented. Then, complex analyses that evaluates the effectiveness of the media advertisements and the impact of TACT on driver behavior are presented.

Survey Summary Statistics

The acquisition process for the public awareness surveys yielded 5,155 responses. Among these, 1,514 surveys were collected during the baseline phase (up to November 21, 2008) while the rest were primarily collected in the months of January, February, and March 2009 (PI period).

Demographic Information

The surveys did not have any unique identification symbols to indicate if they were distributed in the test or control corridors.[5] The PennDOT Technical Lead provided CS with ZIP code correspondence information, and the transcription staff included the ZIP code from the postmark with the data from the survey itself. Nearly 88 percent of the returned surveys were from the test area, which is representative of the relative population and driver services volume disparity between the test and control regions. This proportion was roughly the same for both base and PI period survey records.

[5] One of our recommendations in Section 6.0 is to have slightly different instruments for the test corridor and the control corridor.

In later surveys, a question was added to capture the response date,[6] since the survey was a mail-in survey. If there was no response date available, the post-mark date on the survey instruments were used to calculate the date the respondents participated in the survey. This data will be further evaluated in later sections to measure the message retention capacity of the TACT message over time. Table 5.1 provides a summary of survey distribution over time. The table indicates that very few surveys were administered during the weeks between Thanksgiving in 2008 and January 2, 2009 (57 responses across all corridors). For some of the later complex analyses, these records collected during the holiday period have been discarded so that only statistically significant data may be retained. Fifty-two responses could not be assigned to either the control or test corridors due to insufficient information.

[6] The original set of roughly 20,000 surveys was printed by PennDOT prior to Cambridge Systematics being under contract. An additional 40,000 surveys were printed in early October to cover the PI period, and included this question.

Table 5.1 Distribution of Survey Completion

Week No.	Control Corridor	Test Corridor	Unknown	Total
Base				
00 Before Oct06	0	14	0	14
01 Oct06-Oct10	20	276	0	296
02 Oct13-Oct17	72	255	0	327
03 Oct20-Oct24	69	247	2	318
04 Oct27-Oct31	29	286	0	315
05 Nov03-Nov07	33	119	0	152
06 Nov10-Nov14	10	40	1	51
07 Nov17-Nov21	6	28	0	34
Post				
08 Nov24-Nov28	3	11	2	16
09 Dec01-Dec05	3	10	0	13
10 Dec08-Dec12	1	10	0	11
11 Dec15-Dec19	0	8	0	8
12 Dec22-Dec26	0	2	1	3
13 Dec29-Jan02	1	5	0	6
14 Jan05-Jan09	11	151	1	163
15 Jan12-Jan16	13	248	3	264
16 Jan19-Jan23	47	326	2	375
17 Jan26-Jan30	20	296	3	319
18 Feb02-Feb06	52	345	9	406
19 Feb09-Feb13	46	279	6	331
20 Feb16-Feb20	45	418	8	471
21 Feb23-Feb27	42	355	7	404
22 Mar02-Mar06	24	374	5	403
23 Mar09-Mar13	17	200	2	219
24 Mar16-Mar20	0	1	0	1
Total	**564**	**4,304**	**52**	**4,920**

Source: Analysis of Survey Data by Cambridge Systematics.

The distribution of respondents by age appears to be skewed towards older drivers. As shown in Table 5.2, over 60 percent of respondents were at least 50 years old. Fewer than 23 percent of respondents were 40 years or younger. This distribution is very similar in both the base and PI periods.

Table 5.2 Distribution of Survey Respondents by Age

Age of Respondent	Control Corridor	Test Corridor	Unknown	Total
Base				
Under 21	6	35	0	41
Age between 21-25	12	60	1	73
Age between 26-39	35	193	0	228
Age between 40-49	48	234	0	282
Age between 50-59	57	294	1	352
60 years or older	73	458	2	533
Total	**231**	**1,274**	**4**	**1,509**
Post				
Under 21	14	103	2	119
Age between 21-25	14	127	1	142
Age between 26-39	53	498	6	557
Age between 40-49	76	565	11	652
Age between 50-59	78	766	16	860
60 years or older	117	1,153	29	1,299
Total	**352**	**3,212**	**65**	**3,629**
Survey Period				
Under 21	20	138	2	160
Age between 21-25	26	187	2	215
Age between 26-39	88	691	6	785
Age between 40-49	124	799	11	934
Age between 50-59	135	1,060	17	1,212
60 years or older	190	1,611	31	1,842
Total	**583**	**4,486**	**69**	**5,155**

Source: Analysis of Survey Data by Cambridge Systematics.

The distribution of respondents by race, shown in Table 5.3, was reasonably consistent with 2000 census data for Pennsylvania.[7] This distribution remains similar across the base as well as post time periods.

[7] U.S. Census Bureau via http://quickfacts.census.gov/qfd/states/42000.html.

Table 5.3 Distribution of Survey Respondents by Race

Race	Control Corridor	Test Corridor	Unknown	Total	Total Percent	2000 Census
Base						
White	202	1,132	4	1,338	90.0%	85.7%
African American	14	73	0	87	5.9%	10.7%
Other	12	50	0	62	4.1%	3.6%
Total	**228**	**1,255**	**4**	**1,487**	**100.0%**	**100.0%**
Post						
White	325	2,939	60	3,324	92.3%	85.7%
African American	10	140	1	151	4.2%	10.7%
Other	13	109	4	126	3.5%	3.6%
Total	**348**	**3,188**	**65**	**3,601**	**100.0%**	**100.0%**
Survey Period						
White	527	4,071	64	4,662	91.6%	85.7%
African American	24	213	1	238	4.7%	10.7%
Other	25	159	4	188	3.7%	3.6%
Total	**576**	**4,443**	**69**	**5,088**	**100.0%**	**100.0%**

Source: Analysis of Survey Data by Cambridge Systematics.

Stated Driving Behavior

Table 5.4 presents the survey responses to the question about the vehicle primarily driven by the respondents. The majority of respondents (60 percent) drove passenger cars as their primary vehicle. About 1.3 percent drove a commercial truck as their primary vehicle, while the remaining drivers drove various flavors of passenger vehicles with elevated seating, such as pickup trucks, sport utility vehicles, and vans. 85 percent of drivers had never driven a semi-truck, while 9 percent had driven one "a few times"[8] and 4 percent either drove regularly in the past or were currently driving a semi-truck.

There appear to be some differences, however, in the choice of primary vehicle by corridor. Nearly 53 percent of respondents in the control corridor responded using a passenger car as their primary vehicle while almost 60 percent of respondents in the test corridor reported using a similar car. It is possible that these differences are, in part, due to the differences in the "urban versus rural" nature of the two regions.

[8] While this can only be speculation, the wording of the question causes concern that these drivers perhaps were driving straight truck configurations such as those rented for moving.

Table 5.4 Distribution of Survey Respondents by Vehicle Driven

Type of Vehicle	Control Corridor	Test Corridor	Unknown	Percentage
Base				
Passenger Car	124	797	3	61.6%
Pickup Truck	32	82	0	7.6%
Semi Truck	5	15	0	1.3%
SUV	47	239	0	19.1%
Mini-van	15	94	0	7.3%
Full-van	5	16	0	1.4%
Other	3	21	1	1.7%
Total	**231**	**1,264**	**4**	**100.00%**
Post				
Passenger Car	190	1,924	34	59.3%
Pickup Truck	44	293	6	9.5%
Semi Truck	5	39	1	1.2%
SUV	71	618	16	19.5%
Mini-van	29	245	4	7.7%
Full-van	8	45	0	1.5%
Other	5	39	4	1.3%
Total	**352**	**3,203**	**65**	**100.00%**
Survey Period				
Passenger Car	314	2,721	37	60.01%
Pickup Truck	76	375	6	8.93%
Semi Truck	10	54	1	1.27%
SUV	118	857	16	19.36%
Mini-van	44	339	4	7.56%
Full-van	13	61	0	1.45%
Other	8	60	5	1.43%
Total	**583**	**4,467**	**69**	**100.00%**

Source: Analysis of Survey Data by Cambridge Systematics.

When asked about their passing behavior, drivers generally asserted that they gave more space to trucks than to cars. The result of 27 percent more distance given to trucks was almost identical between the test and control corridors, as shown in Table 5.5.

Table 5.5 Passing Distance (in car lengths) Given to Cars and Trucks by Survey Respondents

Survey Site	Cars		Trucks	
	Number	Mean Distance	Number	Mean Distance
Base				
Control Corridor	216	3.04	205	3.85
Test Corridor	1,169	3.03	1,114	3.85
Study Area	1,388	3.03	1,321	3.85
Post				
Control Corridor	324	3.03	296	3.80
Test Corridor	2,948	3.07	2,771	3.90
Study Area	3,272	3.07	3,067	3.89
Survey Period				
Control Corridor	540	3.03	501	3.82
Test Corridor	4,117	3.06	3,885	3.89
Study Area	4,660	3.06	4,386	3.88

Source: Analysis of Survey Data by Cambridge Systematics.

Note: Respondents who answered leaving less than half a car length or more than 10 car lengths were excluded from this analysis.

Figures 5.1 and 5.2 provide histograms of the distribution of responses regarding the amount of distance left between vehicles in the test and control corridors, respectively. The graph for the test corridor indicates that fewer truck overtaking responses are included in bins of lower than 4 car lengths than car overtaking responses. The greatest percentage of respondents report leaving a distance of 2–3 car lengths when overtaking a car and 3-4 car lengths when overtaking a truck. These patterns are almost identical to the patterns from the control corridor.

Figure 5.1 Histogram of Reported Overtaking Distance in the Test Corridor

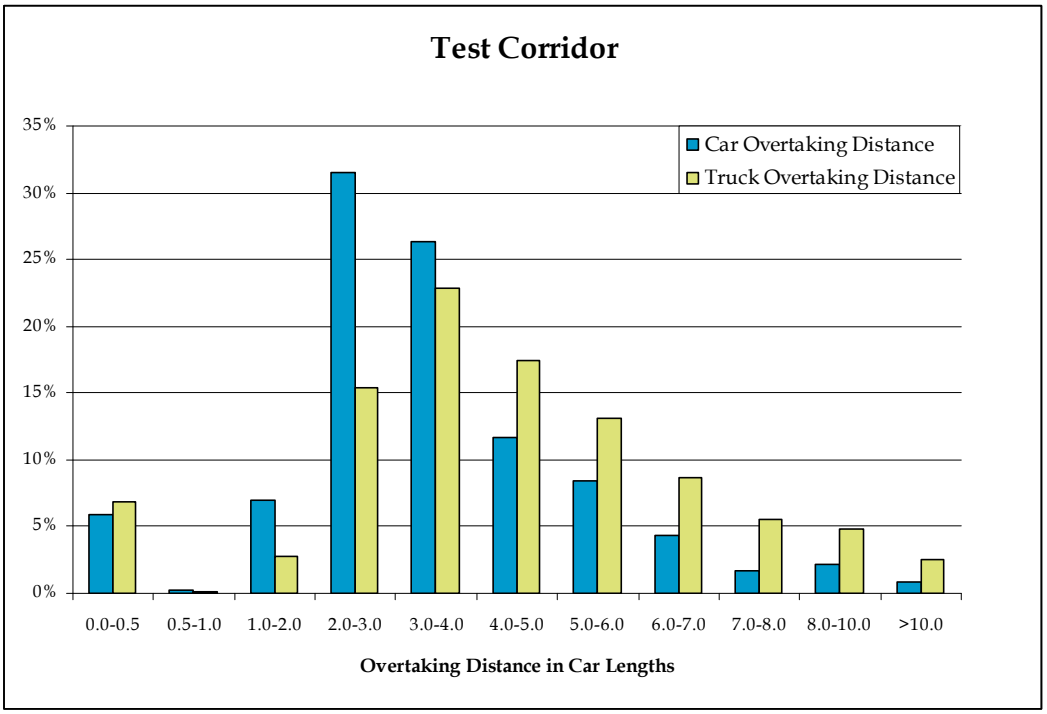
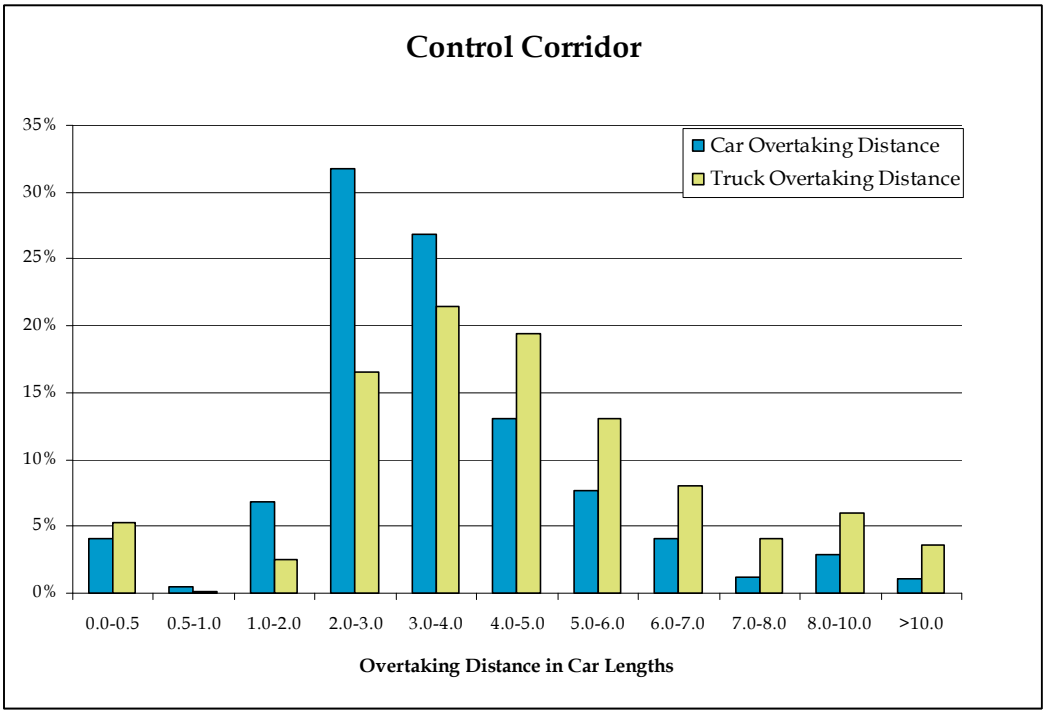


Figure 5.2 Histogram of Reported Overtaking Distance in the Control Corridor



In both figures, we assert that the drivers in the first and last bins (less than 0.5 car lengths and greater than 10 car lengths) are potential errors for how the question is worded in the survey instrument, with choices for both car lengths and feet. In Appendix B, we present a proposed modification to the survey instrument where these questions are simplified to remove this potential misunderstanding.

We conducted a statistical analysis of the variance of this information based on other questions in the survey, including:

- Test versus Control corridor (as a proxy for urban versus rural driving);
- Stated exposure to the TACT message;
- Reported recent change in driving behavior; and
- Demographic information.

In general, the variance of the data found was within statistical bounds, with the exception of gender.[9] As shown in Table 5.6, female respondents used nearly a quarter less distance when passing passenger cars, with a difference that would be statistically insignificant only one time per 10,000.

Women in the PI period revealed slightly greater average passing distance than women interviewed in the base period while men revealed slightly lower average passing distance than men from the base period. These results are inconclusive as to whether the TACT message could have had an implicit change in their behavior.

Table 5.6 Passing Distances for Cars by Baseline Survey Respondents
By Gender

	Distance Given When Passing Cars			Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Gender	**N**	**Mean**	**Std. Dev.**	**Model**	**1**	**275.50**	**275.50**	**154.22**	**<.0001**
Base									
Female	724	2.61	1.17	Error	1,383	2,470.6	1.79		
Male	661	3.50	1.50	Corrected Total	1,384	2,746.1			
Post									
Female	724	2.61	1.17	Error	1,383	2,470.6	1.79		
Male	661	3.50	1.50	Corrected Total	1,384	2,746.1			

Source: Analysis of Survey Data by Cambridge Systematics.

[9] The details of these results, as well as other analyses where results were within statistical bounds, will be provided on the project CD-ROM.

Media Effectiveness

This section evaluates the effectiveness of the advertising programs that were designed to propagate the concept of TACT among drivers in the region. Specifically, the performance of different media (electronic, print etc.), the effect of time (message retention capacity), and the demographic groups that was targeted best are discussed.

The TACT program included a "kickoff" publicity event which used advertisements via television and radio; billboards; newspaper, brochures, posters, and banners; and by law enforcement officers during enforcement activities.[10] This menu of publicity activities were designed to assist in educating the motoring public and raising their awareness regarding the hazards when driving around commercial vehicles.

Table 5.7 indicates that nearly 31 percent of all survey respondents reported having heard about the TACT program on at least one medium. Only 16 percent of respondents on the control corridor responded having heard about the TACT program which seems reasonable as the TACT media event was geared towards respondents in the test corridor.

An unusually high percentage of respondents from the holiday period responded having heard about TACT. However, only 57 respondents completed surveys during this period. To preserve the overall quality of data, these responses have been discarded in various media effectiveness calculations.

To better evaluate the performance of the different media, different media groups were created:

- Electronic Media that comprises of advertisements placed on television and radio;
- Print Media that includes articles and advertisements in newspapers, brochures and posters;
- Highway Media that includes road signs, banners and billboards; and
- Police Media that includes educational awareness promoted by law enforcement agencies.

[10] Road signs were not included. See Section 6.0 for an explanation of the subsequent directive regarding road signs.

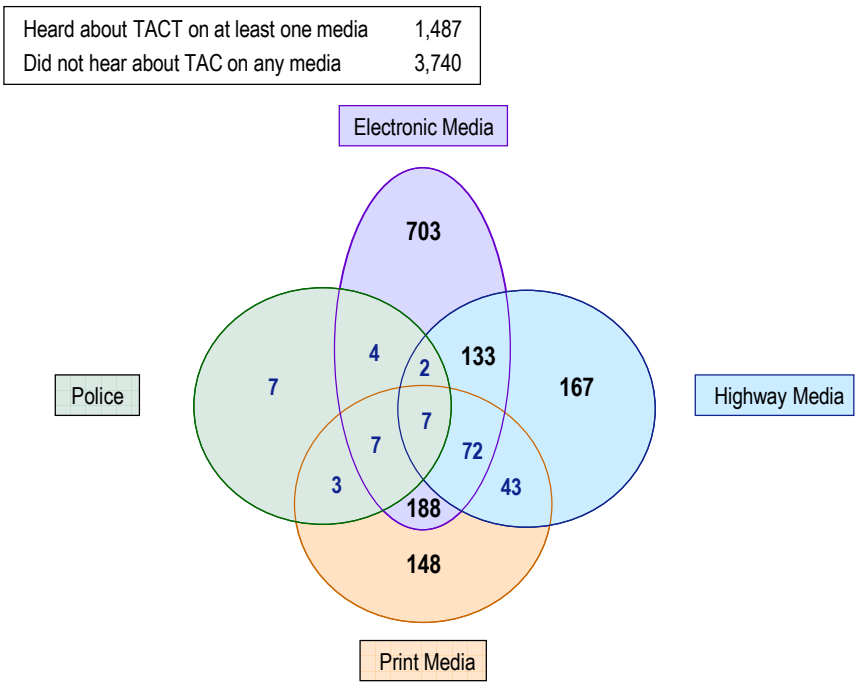
Table 5.7 Survey Respondents Who Heard about TACT on at Least One Media

Week No.	Control Corridor	Control Corridor Percentage	Test Corridor	Test Corridor Percentage	Total	Total Percentage
Base						
00 Before Oct06	0	0%	7	50%	7	50%
01 Oct06-Oct10	5	25%	121	44%	126	43%
02 Oct13-Oct17	16	22%	112	44%	128	39%
03 Oct20-Oct24	12	17%	99	40%	111	35%
04 Oct27-Oct31	3	10%	98	34%	101	32%
05 Nov03-Nov07	2	6%	37	31%	39	26%
06 Nov10-Nov14	1	10%	16	40%	17	34%
07 Nov17-Nov21	2	33%	6	21%	8	24%
Post						
08 Nov24-Nov28	1	33%	4	36%	5	43%
09 Dec01-Dec05	0	0%	2	20%	2	15%
10 Dec08-Dec12	0	0%	1	10%	1	9%
11 Dec15-Dec19	0	0%	2	25%	2	25%
12 Dec22-Dec26	0	0%	1	50%	1	50%
13 Dec29-Jan02	0	0%	5	100%	5	83%
14 Jan05-Jan09	2	18%	51	34%	53	33%
15 Jan12-Jan16	3	23%	80	32%	83	32%
16 Jan19-Jan23	5	11%	103	32%	108	29%
17 Jan26-Jan30	2	10%	80	27%	82	26%
18 Feb02-Feb06	9	17%	116	34%	125	32%
19 Feb09-Feb13	11	24%	73	26%	84	26%
20 Feb16-Feb20	3	7%	125	30%	128	29%
21 Feb23-Feb27	6	14%	80	23%	86	22%
22 Mar02-Mar06	4	17%	102	27%	106	27%
23 Mar09-Mar13	3	18%	55	28%	58	27%
24 Mar16-Mar20	0	0%	0	0%	0	0%
Total	**90**	**16%**	**1,376**	**32%**	**1,466**	**31%**

Source: Analysis of Survey Data by Cambridge Systematics.

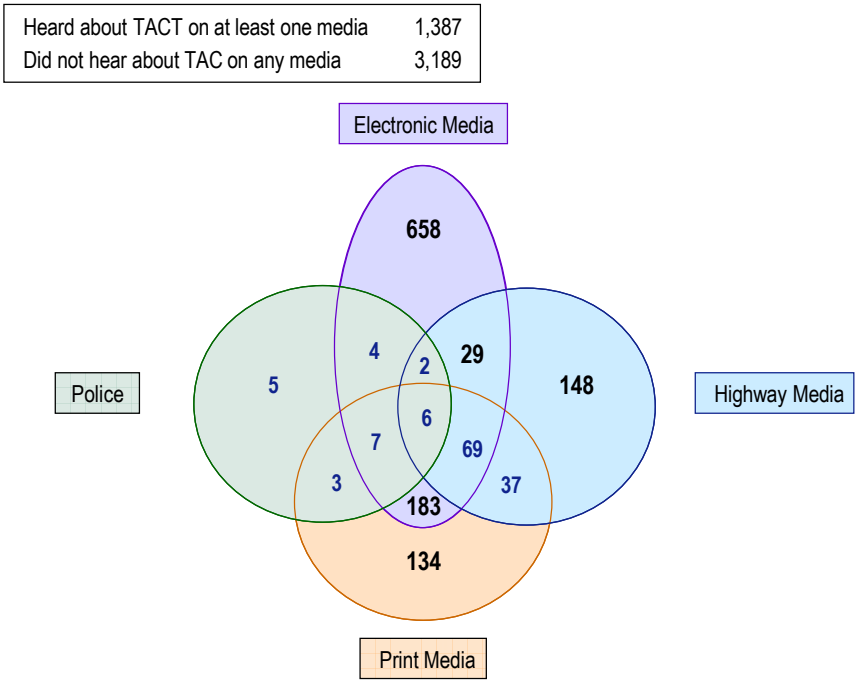
Figure 5.3 and Figure 5.4 present the effectiveness of different groups of media. Figure 5.3 focuses on all the respondents who had heard about TACT on various media in both the test and control corridors. Figure 5.4 focuses exclusively on respondents from the test corridor.

Figure 5.3 Message about TACT Heard by Survey Respondents on Various Media



Source: Analysis of Survey Data by Cambridge Systematics.

Figure 5.4 Message about TACT Heard by Survey Respondents in the Test Corridor on Various Media



Source: Analysis of Survey Data by Cambridge Systematics.

- Electronic media was, by far, the most effective way to advertise about TACT. Over 650 respondents reported having heard about TACT *only* on the electronic medium in the test corridor.
- An additional 50 respondents from the control corridor also heard about TACT on the electronic media *alone*.[11]
- Another 400 respondents in the test corridor reported having heard about TACT on the electronic medium and at least one other medium.
- Fewer than 300 respondents in the test corridor reported having heard about TACT *exclusively* through print or highway media.

Additional analyses of the most effective medium, i.e., the electronic medium was carried out to evaluate its performance across key variables. Further, only data from the test corridor was analyzed as this was the audience who were targeted during the media advertising.

Figure 5.5 and Table 5.8 present comparisons of media effectiveness by time period on the test corridor alone. Figure 5.5 maps the percentage of respondents who heard about TACT on different types of media each week. Figure 5.3 indicates that electronic media outscored all other media among respondents on a weekly basis. Additionally, the lowest response percentage on the electronic media was higher than the highest point on any of the other two top mediums.

Table 5.8 calculates the performance of each of the media types among those respondents who had heard about TACT in the test corridor. On average, 70 percent of those respondents who had heard about TACT report having heard it on the electronic medium (in addition to other media). The market share of the highway medium improves with time. This is potentially due to the fact that billboards advertising TACT were visible throughout the data collection period. The market share of the other two media remains steady throughout the data collection period.

[11] The questionnaire did not ask respondents about their travel patterns, so we do not know if these responses are due to drivers whose patterns take them through the test corridor, or if they are due to drivers who misunderstood or tried to guess the "correct" answer.

Figure 5.5 Percentage of Respondents Who Heard about TACT on an Electronic Medium with Time

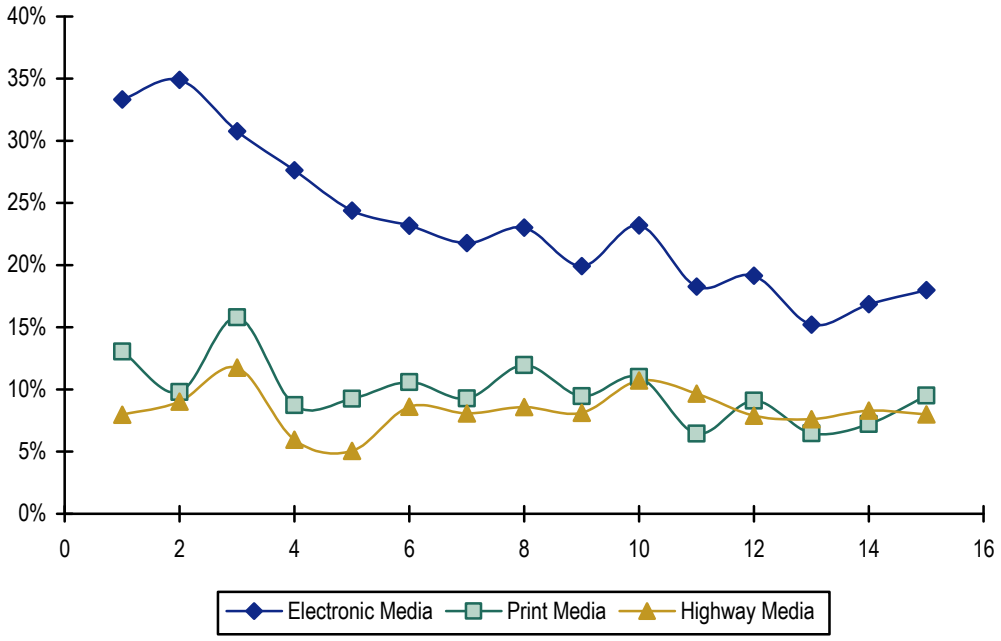


Table 5.8 Percentage of Respondents by Heard Medium from among Those Who Heard about TACT

Week No.	Electronic Medium	Print Medium	Highway Medium
01 Oct06-Oct10	73.8%	28.9%	17.7%
02 Oct13-Oct17	77.3%	21.7%	20.0%
03 Oct20-Oct24	74.9%	38.4%	28.6%
04 Oct27-Oct31	78.1%	24.7%	16.8%
05 Nov03-Nov07	76.4%	29.0%	15.8%
06 Nov10-Nov14	73.1%	30.5%	18.3%
07 Nov17-Nov21	61.9%	31.0%	0.00%
14 Jan05-Jan09	66.8%	30.6%	24.8%
15 Jan12-Jan16	66.1%	28.2%	24.5%
16 Jan19-Jan23	71.7%	37.3%	26.8%
17 Jan26-Jan30	72.3%	34.3%	29.4%
18 Feb02-Feb06	67.6%	32.1%	31.3%
19 Feb09-Feb13	68.4%	24.1%	36.2%
20 Feb16-Feb20	62.2%	29.5%	25.6%
21 Feb23-Feb27	64.5%	27.5%	32.2%
22 Mar02-Mar06	60.0%	25.7%	29.5%
23 Mar09-Mar13	63.5%	33.5%	28.2%
Total	**69.6%**	**29.3%**	**25.8%**

Source: Analysis of Survey Data by Cambridge Systematics.

Table 5.9 maps the performance of the electronic medium by gender in the test corridor. Slightly more females than males report having heard about TACT via electronic media. Splitting the media into its components, more males responded that they had heard about TACT on the radio than females, while a greater percentage of females respond having heard about TACT on television than men. Nearly 6 percent of men respond having heard about TACT on both television and radio as compared to 4 percent of women.

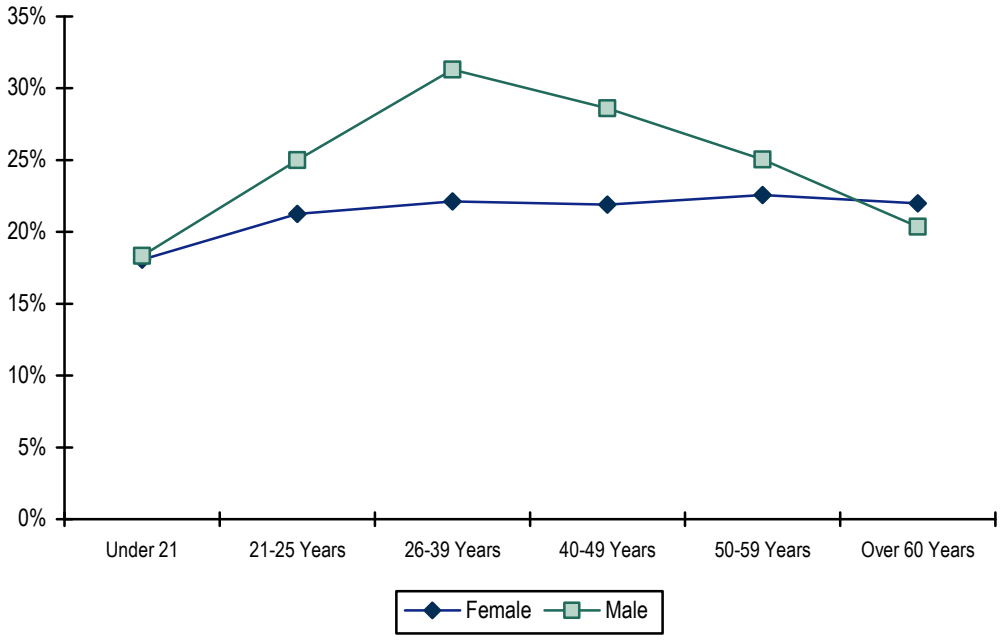
Table 5.9 Effectiveness of the Electronic Medium by Gender

Gender	Electronic Media	TV Media Only	Radio Media Only	Heard Both	Electronic Media Percentage	TV Media Percentage	Radio Percentage	Heard Both Percentage
Female	542	282	164	96	22%	11.4%	6.7%	3.9%
Male	510	210	186	114	24%	10.0%	8.9%	5.5%
Total	**1,052**	**492**	**350**	**210**	**23%**	**10.8%**	**7.7%**	**4.6%**

Source: Analysis of Survey Data by Cambridge Systematics.

Figure 5.6 plots the effectiveness of the electronic medium against gender and age group category of the respondents. The graph for females is flat, indicating that the same percentage of female respondents in all age groups heard about TACT on the electronic medium. However, for males the graph has a pronounced peak for the age group of 26 to 39 years. Nearly 32 percent of male respondents belonging to this age group reported having heard about TACT on the electronic medium while only 20 percent of male respondents under 16 and over 60 reported having heard about TACT. This is likely due to the selection of specific media outlets on which these advertisements were aired, and their respective market and target audiences.

Figure 5.6 Effectiveness of the Electronic Medium by Age and Gender



Change In Driving Behavior

One of the measures of effectiveness for the TACT program is evaluating the number of individuals who changed their driving behavior around trucks and cars after being exposed to the media advertisements regarding TACT. This section provides an evaluation of these data points.

Table 5.10 provides a summary of respondents who reported changing their driving behavior in the study corridors. In the test corridor, almost 1,400 respondents reported a change in their driving behavior. Of these, over 60 percent reported not having heard any media advertising for driver safety that would influence their change in behavior.

Table 5.10 Effects of Media Advertisements on Change in Driving Behavior among Survey Respondents

Corridor	Changed Driving Behavior	Unchanged Driving Behavior
Test Corridor		
Seen Media Advertising	541	875
Did not see Media Advertising	875	2,130
Control Corridor		
Seen Media Advertising	40	53
Did not see Media Advertising	133	335
Total	**1,505**	**3,393**

Source: Analysis of Survey Data by Cambridge Systematics.

In the control corridor, another 160 respondents reported changing their driving behavior. Among them, only 40 respondents reported having made the change and listened about TACT on the media.

The reason behind the change of driving behavior when respondents had not heard about TACT on various media is unclear. Also, there was no follow-up question requesting information regarding the reason behind this change of driving behavior. This behavior, however, is not unique to TACT; other traffic safety initiatives which include an aggressive and high-visibility enforcement component, such as "Click-It-Or-Ticket" or "Drive Hammered Get Nailed," have documented similar outcomes.

These results illustrate the need for a rigorous survey design to identify potential biases of respondents. The survey instrument appears to induce respondents to try and be "correct" when filling out the survey. Questions need to be added to the survey to try and isolate such drivers, as well as to capture other reasons for driver behavior changes.

Data from the test corridor in Table 5.10 was disaggregated to check for any discernable patterns in different market segments. Tables 5.11 and 5.12 provide results from this analysis.

Table 5.11 Effects of Media Advertisements on Change in Driving Behavior by Gender

Gender	Changed Behavior	Unchanged Behavior
Seen Media Advertising		
Male	238	428
Female	302	442
Did Not See Media Advertising		
Male	316	1,009
Female	473	1,113

Source: Analysis of Survey Data by Cambridge Systematics.

Table 5.12 Effects of Media Advertisements on Change in Driving Behavior by Age Group

Age Group	Changed Behavior	Unchanged Behavior
Seen Media Advertising		
Under 21 years	14	21
21-25 years	23	40
26-39 years	83	155
40-49 years	93	195
50-59 years	118	220
Over 60 years	210	242
Did Not See Media Advertising		
Under 21 years	40	65
21-25 years	31	94
26-39 years	106	331
40-49 years	111	389
50-59 years	179	511
Over 60 years	323	731

Source: Analysis of Survey Data by Cambridge Systematics.

Table 5.11 studies the impacts of media advertisements on driver behavior change based on gender. Results indicate that women were more likely to change their behavior than men. Results also indicate that women who saw media advertisements regarding vehicle safety were more likely to make changes to their driving behavior than women who were not exposed to these media advertisements.

Table 5.12 presents the patterns of change in driving behavior based on the age of the respondent. Respondents 21 years of younger seemed most likely to change their driving behavior. In fact, nearly 40 percent of drivers in this category reported having changed their driving behavior whether or not they were exposed to media advertisements. 25 percent of respondents from other age groups reported changing their driving behavior despite not hearing any media advertisements. This number jumped to 33 percent when they were exposed to media advertisements.

Using these two statements, we can reasonably assert that roughly 8 percent of all respondents change their driving behavior purely based on the media coverage for safe driving. Because of the nature of the questions, it is more problematic to assert the full 33 percent was due to TACT. The questions in this area of the survey need to be revised for future implementations.

Table 5.13 provides mean average passing distances in car lengths for drivers in the test and control corridors. The results do not indicate any clear pattern. However, drivers in the control corridor who did not change their behavior even after seeing the media advertisements, on average, had the greatest passing distance among all the groups. This probably indicates that these drivers did not change their behavior even after seeing the media advertisements, as they considered themselves safe drivers.

Table 5.13 Mean Passing Distance for Trucks Reported by Respondents

Driving Behavior	Test Corridor	Control Corridor
Seen Media Advertising		
Changed Behavior	4.94	4.76
Unchanged Behavior	4.78	6.71
Not Seen Media Advertising		
Changed Behavior	4.43	4.92
Unchanged Behavior	4.70	4.67

Source: Analysis of Survey Data by Cambridge Systematics.

Note: Respondents who answered leaving less than two car lengths were excluded from this analysis.

Table 5.14 classifies test corridor respondents who reported changing their driving behavior based on their reported passing distance. The results in the table are presented as percentages of the total number of respondents who in that category of passing distance. Figure 5.7 maps these data.

Results indicate that, on average, about 27 percent of drivers change their driving behavior around cars and trucks. **Over 30 percent of drivers who leave fewer than three car lengths when passing a car report changing their behavior.** This number falls off for higher reported passing distances. This appears to indicate that respondents feel safer when leaving greater than three car lengths to pass a car and do not feel a need to change their driving behavior.

While overtaking trucks, over 32 percent of drivers report changing their behavior when the passing distance was five car lengths of less. This number drops off for higher passing distances. This appears to indicate that drivers feel more comfortable about their safety when their passing distance is five car lengths or more when passing a truck and feel less necessity to change their driving behavior in such cases.

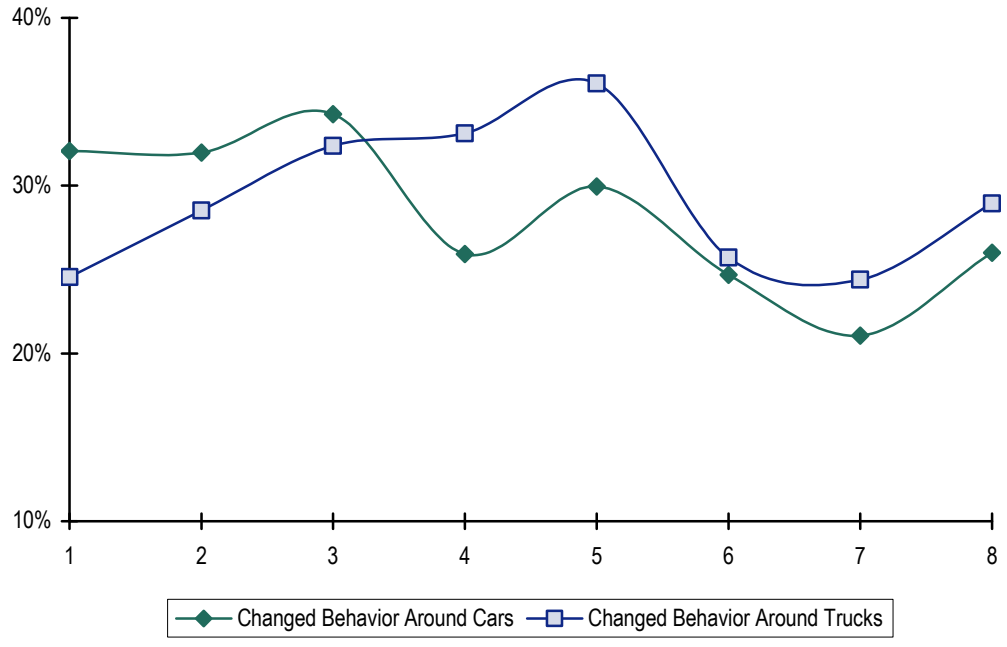
Table 5.14 Passing Distance for Trucks by Riders in the Test Corridor by Changed Behavior

Passing Distance in Car Lengths	Passing Distance for Cars	Passing Distance for Trucks
1-2 Car Lengths	31.96%	28.51%
2-3 Car Lengths	34.25%	32.36%
3-4 Car Lengths	25.93%	33.12%
4-5 Car Lengths	29.95%	36.10%
5-6 Car Lengths	24.68%	25.72%
6-7 Car Lengths	21.05%	24.39%
7-8 Car Lengths	26.00%	28.93%
8-9 Car Lengths	50.00%	20.00%
9-10 Car Lengths	28.26%	28.43%

Source: Analysis of Survey Data by Cambridge Systematics.

Note: Respondents who answered leaving less than one car length and greater than 10 car lengths were excluded from this analysis.

Figure 5.7 Passing Distance for Trucks by Riders in the Test Corridor by Changed Behavior



Source: Analysis of Survey Data by Cambridge Systematics.

5.2 FIELD VIDEO OBSERVATIONS OF DRIVING BEHAVIOR

Video data was collected by video camera-equipped unmarked vehicles with narration by the trooper driving the vehicle. The vehicle followed usual enforcement protocols but did not make any stops or issue any citations. Other enforcement vehicles were not "warned off" of the area during the video collection, so occasionally the vehicle will pass or be passed by another enforcement officer. Interactions with large trucks were observed and narrated more closely. Violations of TACT rules were narrated including type of violation, offending vehicle and suggested enforcement action for the offending vehicle.

During the study a total of more than 42 hours of video was recorded. Table 5.15 shows the distribution of hours of video data, number of violations and violation rate by study period and corridor location. Additional detailed tables of video data will be provided on the project CD-ROM.

Table 5.15 Violations and Observation Durations by Study Period and Corridor Location

		Baseline	Post Implementation	All
I-81 (Test)	Violations	41.0	99.0	140.0
	Duration (Hours)	6.2	15.7	21.9
	Violations/Hour	6.6	6.3	6.4
I-80 (Control)	Violations	54.0	73.0	127.0
	Duration (Hours)	5.0	15.4	20.4
	Violations/Hour	10.8	4.8	6.2
All	Violations	95.0	172.0	267.0
	Duration (Hours)	11.2	31.1	42.3
	Violations/Hour	8.5	5.5	6.3

A total of 267 violations was observed during this part of the study. On average, there was a TACT violation every 10 minutes. In the test corridor rate of violations were reduced slightly, however, this difference is not statistically significant ($p = 0.80$). The breakdown of violation rates in the control corridor indicates that data from control corridor cannot be used as intended since there is very large drop in violation rates. This indicates presence of potential confounding factors that resulted in observations in the unexpected ways. These are discussed in further detail later in this section.

Another important variable in evaluating the impacts of the campaign was severity of violations. Although officers were not required to comment on the

severity of violations during recording, an ordinal-scale variable was created based on the enforcement action suggested for each violation in the data. The enforcement decision had five different levels:

1. Let the driver proceed;
2. No action stated;
3. Stop the vehicle but no action stated;
4. Stop the vehicle and issue warning; and
5. Stop the vehicle and issue citation.

By assuming the order above is representative of the severity of observed violation, each record in the data was given a violation severity score. Based on this score average violation severity by study period and corridor location were computed. Table 5.16 shows the average violation severity and rate of violation severity by study period and corridor location.

Table 5.16 Violation Severity and Observation Durations by Study Period and Corridor Location

		Baseline	Post Implementation	All
I-81 (Test)	Total Severity	108.0	361.0	469.0
	Duration (Hours)	6.2	15.7	21.9
	Average Severity	2.6	3.6	3.4
	Severity/Hour	17.4	23.0	21.4
I-80 (Control)	Total Severity	183.0	204.0	387.0
	Duration (Hours)	5.0	15.4	20.4
	Average Severity	3.4	2.8	3.0
	Severity/Hour	36.6	13.3	19.0
All	Total Severity	291.0	565.0	856.0
	Duration (Hours)	11.2	31.1	42.3
	Average Severity	3.1	3.3	3.2
	Severity/Hour	26.0	18.2	20.3

The analysis of mean violation severity shows that, on average, violation severity is at a medium level (3.2 overall). However, while severity was reduced in control corridor after the study, severity was increased in the test corridor. Moreover, control corridor had more severe violations than the test corridor. The statistical analysis indicated that difference in violation severity between study periods are statistically significant ($p < 0.05$) at both corridors (Section 3.2).

This is another unexpected and counterintuitive result, since changes in the control corridor was expected to be minimal and a reduction in severity was expected in the test corridor. Based on our observations of the video data for each time period and location, we identified several potential confounding factors which yielded these observed patterns of violation severity. These included inconsistencies in observation dates, times, and narration of suggested enforcement actions, and differences in traffic patterns and composition.

Another variable of interest was the severity per hour. This variable gauges the total severity score observed in an hour in each time periods and corridor location. In general, total severity per hour was approximately 20, which is equivalent or one potential citation every 15 minutes of observation. But when severity rate is broken down by study period and location, we found another counterintuitive result: the highest rate was observed at the *control* corridor during baseline (36.6 per hour) and the rate was substantially reduced to 13.3 per hour after the campaign. Meanwhile, on the test corridor, severity was low during the baseline while it *increased* for the post implementation period. Statistical tests also indicated that the differences at both corridors were statistically significant ($p < 0.01$).

These results can only realistically be taken as inconclusive. Our assertion is that the variation seen is more likely due to differences in the quality of narration and traffic flow patterns between the study periods and locations than any particular structural changes in driving behavior on either corridor.

In order to demonstrate the findings above, we have broken down the observation periods at each location and study period into 15-minute intervals and created cumulative distributions of number of violations and severity scores. Figure 5.8 provides four plots that shows the differences in the violations and severity by study period and corridor location graphically.

While the analysis of violations per hour and severity were not able to measure the impacts of the campaign on the driver behavior, there are still valuable descriptive information in the data. Table 5.17 includes the frequencies of violation types for study period and corridor location. Following too closely, failure to signal, unsafe lane change and speeding were unique categories, while other notes narrated by the trooper were consolidated into other categories.

The distribution of occurrences of different violation types in the test corridor shows that there are minor differences among the percent occurrences of key TACT violations. However, speeding alone is more frequent violation in the corridor. Moreover, there is more variation in the occurrence of TACT violations across study period at the test corridor. While following too closely has the highest percentage during the baseline, unsafe lane change becomes a more frequent TACT-related violation in the control corridor.

Figure 5.8 Cumulative Distribution of Violations and Severity at 15-Minute Intervals

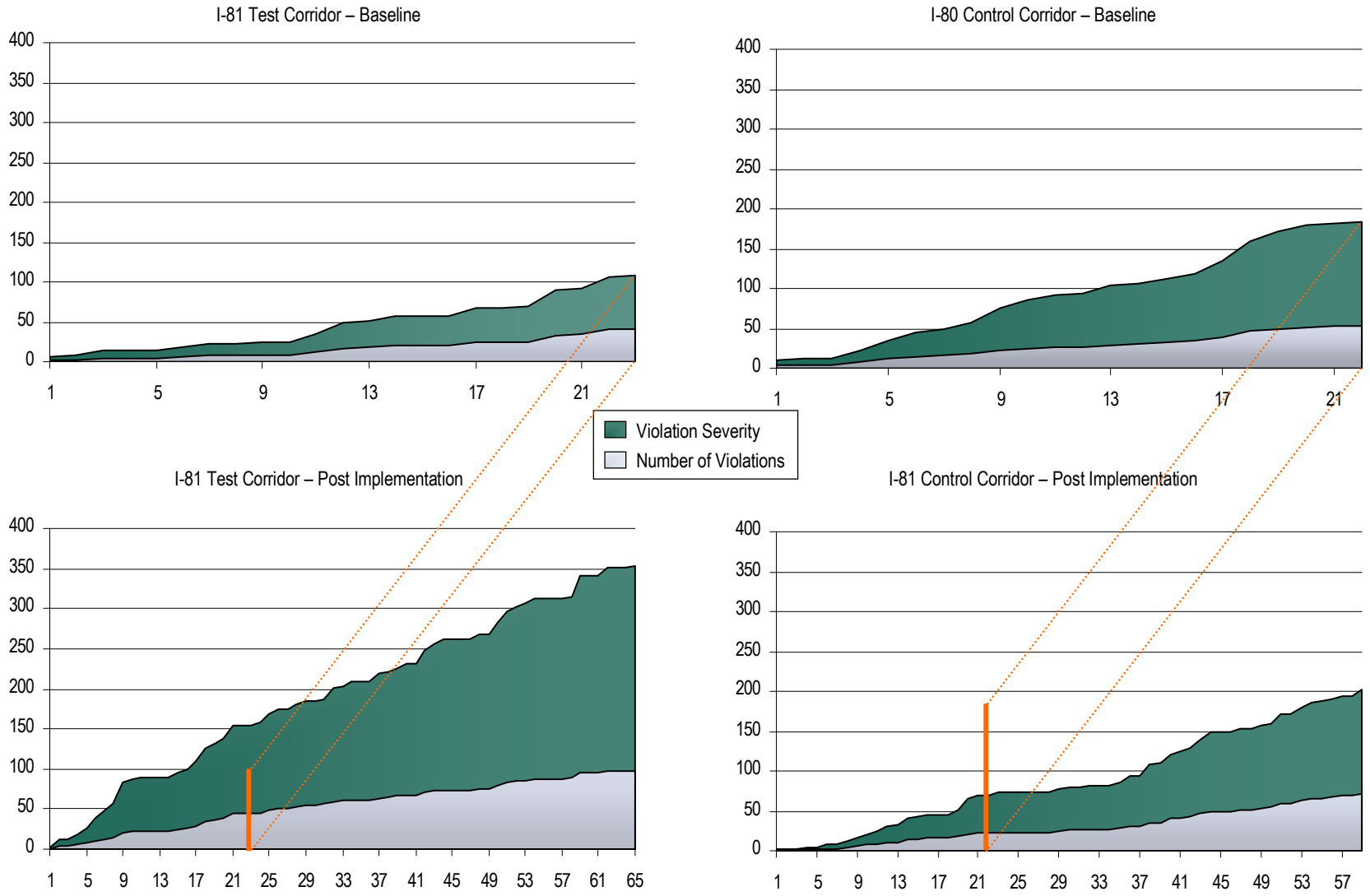


Table 5.17 Violation Types by Study Period and Corridor Location

		Baseline		Post Implementation		All	
		Number of Violations	Percent Violations	Number of Violations	Percent Violations	Number of Violations	Percent Violations
I-81 (Test)	Following too closely	11	26.8%	28	28.3%	39	27.9%
	Lane change no signal	13	31.7%	26	26.3%	39	27.9%
	Unsafe lane change	10	24.4%	29	29.3%	39	27.9%
	Speeding	5	12.2%	11	11.1%	16	11.4%
	Other	2	4.9%	5	5.1%	7	5.0%
I-80 (Control)	Following too closely	19	35.2%	12	16.4%	31	24.4%
	Lane change no signal	4	7.4%	18	24.7%	22	17.3%
	Unsafe lane change	12	22.2%	23	31.5%	35	27.6%
	Speeding	12	22.2%	15	20.5%	27	21.3%
	Other	7	13.0%	5	6.8%	12	9.4%
All	Following too closely	30	31.6%	40	23.3%	70	26.2%
	Lane change no signal	17	17.9%	44	25.6%	61	22.8%
	Unsafe lane change	22	23.2%	52	30.2%	74	27.7%
	Speeding	17	17.9%	26	15.1%	43	16.1%
	Other	9	9.5%	10	5.8%	19	7.1%

Table 5.18 presents average severity by violation type and contribution of each violation type to the total severity score. In the test corridor unsafe lane change seems to become more frequent and more severe violation. Following too closely appears to be a more serious violation in control corridor during baseline. Unsafe lane change was also observed more frequently but had lower severity throughout the post implementation period.

Table 5.18 Severity of Violations by Type, Study Period, and Corridor Location

		Baseline		Post Implementation		All	
		Mean Severity	Percent of Total Severity	Mean Severity	Percent of Total Severity	Mean Severity	Percent of Total Severity
I-81 (Test)	Following too closely	2.8	28.7%	3.7	28.5%	3.4	28.6%
	Lane change no signal	2.3	27.8%	2.7	19.4%	2.6	21.3%
	Unsafe lane change	2.2	20.4%	4.3	34.3%	3.7	31.1%
	Speeding	4.2	19.4%	4.0	12.2%	4.1	13.9%
	Other	2.0	3.7%	4.0	5.5%	3.4	5.1%
I-80 (Control)	Following too closely	3.2	33.3%	2.6	15.2%	3.0	23.8%
	Lane change no signal	2.5	5.5%	2.1	18.6%	2.2	12.4%
	Unsafe lane change	3.5	23.0%	2.9	32.8%	3.1	28.2%
	Speeding	3.5	23.0%	3.5	26.0%	3.5	24.5%
	Other	4.0	15.3%	3.0	7.4%	3.6	11.1%
All	Following too closely	3.1	31.6%	3.4	23.7%	3.2	26.4%
	Lane change no signal	2.4	13.7%	2.5	19.1%	2.4	17.3%
	Unsafe lane change	2.9	22.0%	3.7	33.8%	3.4	29.8%
	Speeding	3.7	21.6%	3.7	17.2%	3.7	18.7%
	Other	3.6	11.0%	3.5	6.2%	3.5	7.8%

Overview of Video Data Analysis

The statistical analysis of violation rates (number of violations per hour) and violation severity identified likely biases in the underlying data. Due to certain factors that can not be controlled by the project team, several confounding factors could not have been avoided. These include variations and inconsistencies in:

- Dates of observations;
- Time of day;
- Traffic flow patterns;
- Narration detail and attention, especially in the suggested enforcement action portion;
- Presence of construction zones; and
- Regular enforcement activities during the observation period.

Data collection spanned a time period between September 3, 2008 and February 9, 2009. This resulted in very different traffic flow patterns between the baseline and post implementation periods and corridors. For example, late

summer or fall traffic flow patterns and composition were quite different from conditions in January. Furthermore, variations in time of day selected for the observations created potential biases. For example, afternoon peak time conditions were very different from early morning traffic patterns and composition.

There was a substantial variation in the narration, particularly in the details surrounding the trooper's decision on what should be done in case of an particular offense. While several inconclusive cases were returned to the troopers for repeat narration, the situation directly affected the assessment of violation severity. Although there was a significant improvement through the waves of observation, with the best narration in the post implementation period at the test corridor, sizeable variation was observed at the control corridor during the post implantation period observations. Table 5.19 shows the distribution of narrated enforcement action by study periods and corridor location. Post period test corridor assessment is substantially better with fewer indecisive statements and more definite action. High proportions of "No Action Stated" and "Stop, No Action Stated" categories creates ambiguity about the severity of offense and result in possibly a lower severity rating, lowering the scores in baseline and control corridor cells in Table 5.16. In addition, throughout the recordings officers paid more attention to interaction with trucks, and focus on speeding violations was quite high.

Table 5.19 Enforcement Action against Observed Violations by Study Period and Corridor Location

		Baseline		Post Implementation		All	
		Number of Violations	Percent Violations	Number of Violations	Percent Violations	Number of Violations	Percent Violations
I-81 (Test)	Let the driver proceed	2	4.9%	10	10.1%	12	8.6%
	No action stated	17	41.5%	10	10.1%	27	19.3%
	Stop, no action stated	6	14.6%	5	5.1%	11	7.9%
	Stop and warning	9	22.0%	35	35.4%	44	31.4%
	Stop and citation	7	17.1%	39	39.4%	46	32.9%
I-80 (Control)	Let the driver proceed	2	3.7%	9	12.3%	11	8.7%
	No action stated	15	27.8%	30	41.1%	45	35.4%
	Stop, no action stated	7	13.0%	5	6.8%	12	9.4%
	Stop and warning	9	16.7%	17	23.3%	26	20.5%
	Stop and citation	21	38.9%	12	16.4%	33	26.0%
All	Let the driver proceed	4	4.2%	19	11.0%	23	8.6%
	No action stated	32	33.7%	40	23.3%	72	27.0%
	Stop, no action stated	13	13.7%	10	5.8%	23	8.6%
	Stop and warning	18	18.9%	52	30.2%	70	26.2%
	Stop and citation	28	29.5%	51	29.7%	79	29.6%

Another confounding factor observed during transcription of the video data was occasionally marked State Police cruisers were being spotted during these periods, drivers tend to pay more close attention to rules to avoid a traffic stop or a citation. Such behavior changing events creates biases towards safe driving.

Finally, at the control corridor during the baseline period there was a substantial amount of construction activity. The presence of construction activity not only likely to reduce the number of traffic lanes and therefore, may lead to speed reductions or short-term bottlenecks, drivers are required to slow down (change their regular driving behavior). As a results drives may tend to follow closely than normal. In addition in most cases a marked State Police cruiser was present at the beginning of construction zone urging drivers to slow down.

These effects influenced the observations in different ways. Based on our analysis, we present Table 5.20 as a summary of influential factors observed for each combination of study period and corridor location. These circumstances may have led to lower levels of violations at the test corridor during baseline period and at the control corridor during post implementation and higher number of but less severe violations at the control corridor during the baseline.

Table 5.20 Influential Factors by Study Period and Corridor Location

	Baseline	Post Implementation
Test Corridor (I-81)	• Summer/fall driving conditions • Less attention to TACT violations • Higher frequencies of indecision	• Winter conditions • Highest attention to TACT violations • Lowest level of indecision
Control Corridor (I-80)	• Summer/fall driving conditions • Moderate levels of attention to TACT violations • P.M. peak observations • Construction activity • Moderate levels of indecision	• Winter conditions • Early morning observations • Less traffic • High levels of indecision

5.3 EXPERT PANEL RESPONSES

From the above video observations, 99 video clips were randomly selected from the set of approximately 200 narrated selections. These clips were transferred to a DVD and presented to an expert panel of enforcement staff from the Pennsylvania State Police.[12] The enforcement staff were from the I-81 corridor, but had not participated in the additional targeted TACT enforcement during October and November 2008. They represent the other enforcement officials on the highway who might have had opportunity to further influence the media

[12]The 99-clip limit was due to the constraints of the DVD format, as well as to keep the exercise at a practical time commitment for the participants.

message through (not) executing an enforcement stop when TACT-related aggressive driving may have occurred.

Each DVD had the clips in a randomized order, and participants were instructed to review each clip and rate both the crash risk of the clip and the enforcement action which they would take.

The objectives of the analysis of the expert panel data focused were twofold:

1. Revisit whether the data could be used to evaluate whether the TACT campaign had an effect on driving behavior; and
2. Evaluate the differing perceptions among panel members regarding the safety of and recommended enforcement actions for different types of violations.

Impacts of the TACT Campaign on Driving Behavior

Our first step was to revisit the analysis of the clips on potential changes of driving behavior by using the crash risk and severity ratings provided by the panel members. While we had previously analyzed the clips based on the narration of the officer in the field, with more data from more officers, we can conduct a more detailed analysis on these 99 clips.

An analysis of variance (ANOVA) was used in an attempt to evaluate the effects of the TACT campaign on driving behavior. ANOVA is a statistical technique that assesses the differences across observations in a given set of categories and provides insight on whether there truly are differences across different categories. For this study, ANOVA was used in an effort to determine whether the differences between the Control and Test corridors and Baseline and Post periods are statistically significant. These categories can be summarized as:

- Control Corridor, Baseline;
- Control Corridor, Post;
- Test Corridor, Baseline; and
- Test Corridor, Post.

Table 5.21 shows the ANOVA test results for the aggressiveness rating between the Control and Test corridors and Baseline and Post periods. A p-value of 0.05 or less would indicate that differences in aggressive driving were observed at a statistically significant level between the four categories. However, the resulting p-value is 0.67. This value can be interpreted in two ways. First, it could signify that the TACT campaign did not have a measurable effect on driving behavior. However, an alternate (and more likely) explanation is that the confounding issues that were discussed in Section 5.2 are also impacting these results. As a result of these data collection issues, it is not possible to draw definitive conclusions about the effectiveness of TACT from this dataset.

Table 5.21 ANOVA Results for Aggressiveness Rating
ANOVA: Single Factor

SUMMARY						
Groups	**Count**	**Sum**	**Average**	**Variance**		
Control Base	168	438	2.607142857	2.20402053		
Control Post	102	247	2.421568627	2.206658901		
Test Base	66	163	2.46969697	2.52983683		
Test Post	258	672	2.604651163	2.053207854		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	3.379920303	3	1.126640101	0.518073048	0.669981055	2.620005546
Within Groups	1,283.05779	590	2.174674221			
Total	**1,286.43771**	**593**				

Tables 5.22 and 5.23 demonstrate the results of ANOVA analysis for the crash rating results and recommended enforcement action. As with the aggressiveness rating results, the results in these tables are not statistically conclusive; most likely for the same confounding effects.

Table 5.22 ANOVA Results for Crash Risk Rating
ANOVA: Single Factor

SUMMARY						
Groups	**Count**	**Sum**	**Average**	**Variance**		
Control Base	168	446	2.654761905	2.179498147		
Control Post	102	229	2.245098039	2.028441079		
Test Base	66	164	2.484848485	2.253613054		
Test Post	258	678	2.627906977	2.071124785		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	13.16343653	3	4.387812176	2.075010355	0.1023798	2.620005546
Within Groups	1,247.612658	590	2.114597725			
Total	**1,260.776094**	**593**				

Table 5.23 ANOVA Results for Recommended Enforcement Action
ANOVA: Single Factor

SUMMARY						
Groups	**Count**	**Sum**	**Average**	**Variance**		
Control Base	168	289	1.720238095	1.029049045		
Control Post	102	161	1.578431373	1.018540089		
Test Base	66	113	1.712121212	1.1004662		
Test Post	258	453	1.755813953	1.002397973		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	2.324964599	3	0.7749882	0.757187465	0.518462476	2.620005546
Within Groups	603.8703216	590	1.02350902			
Total	**606.1952862**	**593**				

Agreement Among Panel Members

We now focus on the level of agreement that was found among the six state troopers who witnessed the same violations on DVD. Given their ratings of each clip, we have analyzed the level of agreement among officers in terms of the following two factors:

1. Enforcement action that is recommended by the officers; and
2. Crash risk rating that is recommended by the officers.

For each type of violation that was included in the video clips, Table 5.24 shows the following:

- Number of video clips; and
- Mean (average) enforcement action (equals Action Taken) that is recommended by the reviewers, with 1 being Let the Vehicle Proceed, 2 being Verbal Warning, and 3 being Citation.

Avg. Std. Dev., Mode, Min., and Max. were calculated in two steps. First, each statistic was calculated among reviewers for each clip. Second, the statistic was averaged across all clips in the violation category.

Table 5.24 Enforcement Action Recommended by Expert Panel

Violation	Number of Clips	Action Taken					
		Mean	Avg. Std. Dev.	Avg. Mode	Avg. Min.	Avg. Max.	Avg. %Raters <> Mode
Aggressive driving	6	2.3	0.87	2.8	1.2	3.0	46
Equipment and maintenance	1	1.8	0.45	2.0	1.0	2.0	20
Following too closely	29	2.0	0.75	2.1	1.2	2.8	44
Improper use of signals and lights	2	2.0	0.56	1.5	1.5	2.5	45
Lane change no signal	29	1.8	0.62	1.8	1.2	2.6	34
Left lane violation	3	1.5	0.47	1.3	1.0	2.0	26
Unsafe lane change	29	2.1	0.71	2.2	1.2	2.8	39
Total	**99**	**2.0**	**0.69**	**2.0**	**1.2**	**2.7**	**39**

Interpretations of Avg. Std. Dev., Mode, Min., and Max. were calculated as follows:

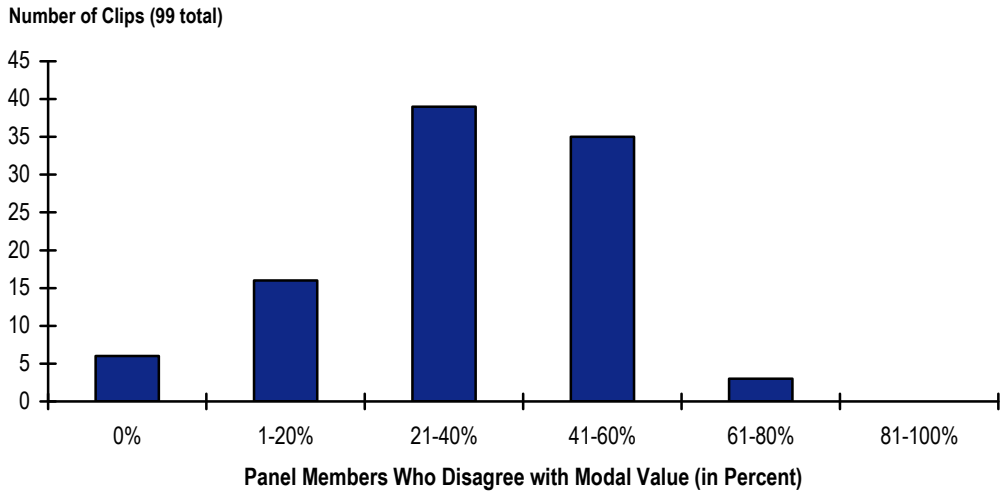
- In general, higher Std Dev means that there was less agreement among officers and lower means there was more agreement.
- Higher Avg. Mode signifies that most reviewers would assign tickets for the violations in this category that were observed in the videos. For example, the panel members generally agreed that the Aggressive Driving violations that were captured in the clips warranted tickets, while less dangerous infractions such as driving in the left lane without passing (left lane violation) and Improper use of signals and lights generally warranted either no action or a verbal warning.
- The Mode can be thought of as the "General Consensus" among panel members, and is *not* the average of the ratings.
- Avg. %Raters <> Mode was calculated in two steps:
  - For each clip, we calculated the percentage of reviewers who did not agree with the General Consensus; and
  - Then we took the average percentage for all clips of the violation type:
    - » Low percentage equals most reviewers agreed with the General Consensus; and
    - » Higher percentages indicate less agreement among panel members.

Table 5.24 demonstrates that there was substantial disagreement among the panel members as to which enforcement action should be taken, even though all the panel members have knowledge of the TACT initiative. This level of disagreement also may explain some of the earlier counterintuitive results, as we

only transcribed events where the trooper in the video-equipped vehicle identified with narration. It is important to note that we did *not* attempt to impose our own understanding of the law to the videos.

Figure 5.9 presents a graph of the "%Raters <> Mode" variable in a different format. Rather than showing the average value across all clips in one violation category (as shown in Table 5.24), Figure 5.7 shows the percentage value across all 99 clips.

Figure 5.9 Percentage of Experts Who Recommended an Enforcement Action Different from the Most Common Recommendation



While it is true that the TACT behavior requires officer judgment for interpretation, the results are striking:

- **For only 6 of the 99 video clips, all panel members agreed with the General Consensus**. This is an extremely small percentage, especially since there are only three action categories.
- For 39 of the 99 clips, 21-40 percent disagreed with the General Consensus.
- There was relatively high disagreement with 35 of the 99 clips (41-60 percent did not agree with the General Consensus).
- There was very high disagreement with only 3 of the 99 clips (61-80 percent did not agree with the General Consensus, meaning that there was really no consensus).

Table 5.25 shows an evaluation that is similar to the evaluation in Table 5.24. However, rather than using the Mode (as in Table 5.24), we use the "Mean Crash Risk Rating +/-1." Crash Risk was assigned to each video clip by panel members using a 5-point scale.

Table 5.25 Crash Risk as Perceived by Raters

Violation	Number of Clips	Crash Risk Rating			
		Mean	Avg. Std. Dev.	Avg. Rounded Mean	Avg. %Raters within +/-1 of Mean Crash Risk Rating
Aggressive driving	6	3.1	1.4	3.3	68
Equipment and maintenance	1	2.2	1.3	2.0	80
Following too closely	29	2.7	1.4	2.7	67
Improper use of signals and lights	2	3.1	1.2	3.0	82
Lane change no signal	29	2.3	1.2	2.3	81
Unsafe lane change	29	2.7	1.4	2.7	69
Left lane violation	3	2.0	0.8	2.0	94
All Video Clips	**99**	**2.6**	**1.3**	**2.6**	**73**

The variable was calculated as follows:

- First, for each video clip, crash risk was averaged across the reviewers.
- Second, the percentage of reviewers who assigned a crash risk for that video that was within +/-1 point of the mean (the rounded mean was actually used for this so that we would not get instances such as Mean = 2.3, Mean-1 = 1.3, Mean+1 = 3.3, yielding only 2 and 3 as possible selections – we preferred to tally up the officers who actually selected 1,2, or 3).
- Third, these percentages were averaged across all video clips in the Violation category.

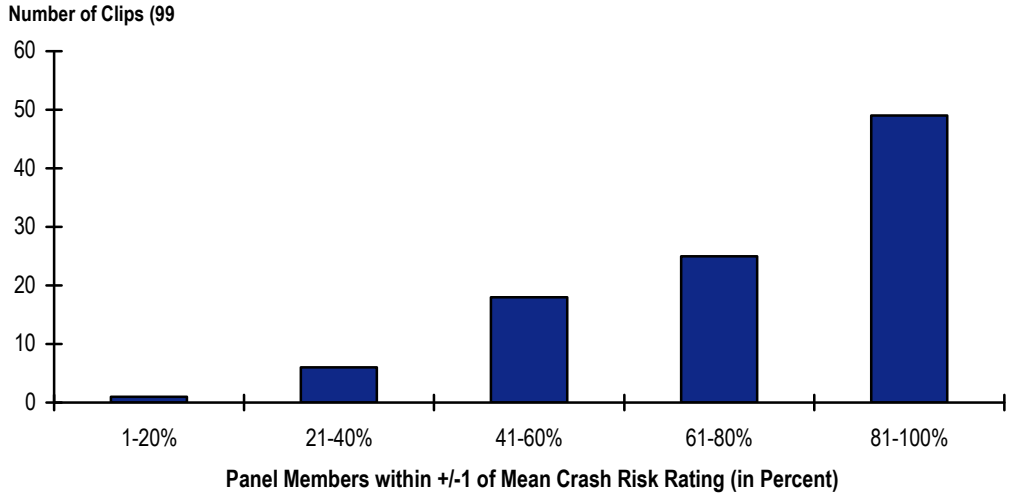
A high percentage for this variable means that there is a high "general consensus" regarding Crash Risk Rating. For example, the panel members nearly all agreed that Left Lane Violations posed relatively little Crash Risk.

Figure 5.10 relates to Table 5.25 in the same manner as Figure 5.9 related to Table 5.24: it illustrates the distribution of general consensus across the clips, except that now a *lower* value means that there is less consensus.

In general, panel members expressed wide agreement on Crash Risks. For 49 of the 99 clips, 81-100 percent of panel members agreed with the General Consensus on Crash Risk.

For a quarter of the clips, however, panel members had fairly substantial disagreements on Crash Risk. Only one clip fell into the most disputed (1-20 percent) category. This was a tailgating violation, where 3 panel members felt the Crash Risk was 1 (very little crash risk), 1 member assigned a 3 (moderate risk), and 2 assigned a 5 (high crash risk).

Figure 5.10 Differences in Perception of Crash Risk by Expert Panel Members



The project CD-ROM will include more detailed tabulations of the expert panel data, including the transcription of each expert's ratings for crash risk and enforcement action for each video clip.

5.4 CRASH DATA

Crash data for the study area was provided by the PennDOT Bureau of Highway Safety and Traffic Engineering for a five-year period from 2004 to 2008. The source of the data is police accident reports which contain detailed information about an incident if it involves an injury or a death, or physical damage on any vehicle involved so that it needed towing. Table 5.26 shows number of crashes, vehicles, and persons involved in these crashes occurred at the test (I-81) and control (I-80) corridors. The project CD-ROM will include more detailed tabulations of crashes, vehicles, and persons involved.

Between 2004 and 2008, on average, there were 204 crashes in which 352 vehicles and 482 persons, and 270 crashes in which 424 vehicles and 656 people were involved at test and control corridors, respectively. The five-year trend shows a general decline in test corridor while control corridor trend had more abrupt changes during the same period.

Table 5.26 General Crash Statistics in Test and Control Corridors for the Five-Year Period 2004-2008

	Number of Crashes		Number of Vehicles		Number of Persons	
Crash Year	**I-81**	**I-80**	**I-81**	**I-80**	**I-81**	**I-80**
2004	232	276	392	431	539	668
2005	205	302	348	477	487	746
2006	176	270	325	432	448	646
2007	213	237	356	388	493	679
2008	196	263	340	392	445	541
All	**1,022**	**1,348**	**1,761**	**2,120**	**2,412**	**3,280**
Average	204	270	352	424	482	656
Minimum	176	237	325	388	445	541
Maximum	232	302	392	477	539	746

Table 5.27 features the percentage of crashes by crash severity which was defined by the most critical injury type observed in each crash.

Table 5.27 Percentage of Crashes by Severity in Test and Control Corridors for the Five-Year Period 2004-2008

	Crash Year	Property Damage	Injury	Fatal	Unknown	All
I-81	2004	58.2%	36.6%	0.4%	4.7%	100.0%
	2005	57.1%	37.6%	0.5%	4.9%	100.0%
	2006	58.5%	34.1%	2.8%	4.5%	100.0%
	2007	60.1%	38.0%	1.4%	0.5%	100.0%
	2008	63.3%	35.7%	0.5%	0.5%	100.0%
	All	**59.4%**	**36.5%**	**1.1%**	**3.0%**	**100.0%**
I-80	2004	57.2%	38.4%	1.1%	3.3%	100.0%
	2005	54.3%	40.4%	0.3%	5.0%	100.0%
	2006	56.7%	39.3%	1.1%	3.0%	100.0%
	2007	55.3%	43.0%	0.4%	1.3%	100.0%
	2008	63.9%	33.8%	1.5%	0.8%	100.0%
	All	**57.4%**	**38.9%**	**0.9%**	**2.7%**	**100.0%**

Almost 60 percent of the crashes were property damage crashes in the test corridor, while 36.5 percent were injury crashes. On average there were slightly more than 2 fatal crashes in the test corridor, corresponding to a rate of 1.1 percent of all crashes.

Based on a statewide data, obtained from annual Pennsylvania Crash Facts and Statistics, for a period between 2004 and 2007, there were nearly 132,300 reported crashes every year. Of these crashes, 61,600 (46.5 percent) were property damage crashes, 69,300 (52 percent) were injury crashes, while 1,412 (1.1 percent) were fatal crashes.

On average, nearly 318,400 people are involved in crashes in the State, 68 percent (217,700) survives crashes without an injury, while more than 31 percent (99,200) suffers from injuries with varying severity and 0.5 percent (more than 1,500) have fatal injuries.

Of the persons involved in crashes in the test corridor, nearly 75 percent had no injury, while nearly 23 percent had some level of injury and 0.5 percent had died. This indicated slightly lower levels of injury severity for the test corridor when compared with statewide statistics.

Crashes were also tabulated based on the vehicle mix in crashes. Table 5.28 shows single and multi-vehicle crashes, and involvement of large trucks in multi-vehicle crashes. Although, the crash database contains information whether aggressive driving was a contributing factor in a crash, due to reliability concerns data implying causality was not included in the analysis. Multi-vehicle crashes involving at least one large truck were assumed as target crashes by the TACT program and referred as TACT crashes in this section.

In the test corridor, on average, more than 56 percent of all crashes were multi-vehicle crashes, and 45 percent of those were TACT crashes.

There were 53 TACT crashes in the test corridor annually for the last past five years. This accounts for nearly 26 percent of all recorded crashes in the test corridor. The five-year trend does not show a clear pattern rather it fluctuates considerably.

There were about 150 individuals are involved in TACT crashes annually in the test corridor, nearly 2.85 persons per crash. Patterns of injury severity indicated a level of 78 percent survival without an injury, 17 percent injury with varying severity and 0.4 percent fatal injuries.

Statewide data indicated that between 2004 and 2007 there were more than 19,000 TACT crashes. If the same rate of aggressive driving and same level of person involvement were assumed, then there would be more than 54,000 individuals involved in these crashes each year in Pennsylvania. Based on the average rates above nearly 9,200 injuries and 216 fatalities can be expected each year.

Table 5.28 Number of Crashes by Vehicle Mix in Test and Control Corridors for the Five-Year Period 2004-2008

	Crash Year	Single Vehicle Crashes	Multivehicle Crashes	Multivehicle Crashes Involving a Large Truck	All Crashes
I-81	2004	108.0	124.0	59.0	232.0
	2005	91.0	114.0	41.0	205.0
	2006	68.0	108.0	56.0	176.0
	2007	89.0	124.0	62.0	213.0
	2008	86.0	110.0	45.0	196.0
	All	**442.0**	**580.0**	**263.0**	**1,022.0**
	Average	88.4	116.0	52.6	204.4
	Minimum	68.0	108.0	41.0	176.0
	Maximum	108.0	124.0	62.0	232.0
I-80	2004	151.0	125.0	54.0	276.0
	2005	165.0	137.0	47.0	302.0
	2006	134.0	136.0	63.0	270.0
	2007	121.0	116.0	42.0	237.0
	2008	155.0	108.0	50.0	263.0
	All	**726.0**	**622.0**	**256.0**	**1,348.0**
	Average	145.2	124.4	51.2	269.6
	Minimum	121.0	108.0	42.0	237.0
	Maximum	165.0	137.0	63.0	302.0

Other interesting characteristics of TACT crashes in the test corridor are as follows:

- On average, 53 crashes occurred involving 118 vehicles, and 150 individuals per year.
- Crash severity: 56 percent property damage, 37 percent injury, 1.1 percent fatal, 5 percent unknown.
- Fifty-five percent of the vehicles in TACT crashes were trucks.
- Driver error was the primary source, 89 percent.
- Distribution of driver errors was: 40 percent unsafe lane change, 20 percent driving too fast for the conditions, 11 percent tailgating and 30 percent other types of driver errors.
- Source of error distribution was; 47 percent passenger cars and 53 percent trucks.
- Nearly two-thirds of the tailgating was cited to trucks.

- Forty-nine percent of trucks had minor, 26 percent severe, and 13 percent moderate-level damage, while 8 percent had no damage.
- Seventy percent of passenger cars had severe, 17 percent minor, and 11 percent moderate-level damage, while less than 1 percent had no damage.
- Seventy-eight percent of individuals in TACT crashes had no injury, while distribution of injury levels was, 12 percent minor, 4 percent moderate, 1.6 percent major, 0.4 percent fatal injury.
- Seven and one-half percent of drivers at fault was under 21 years of age, 12 percent were from 21-25 age group, 26 percent from 26-39, 20 percent from 40-49, 13 percent from 50-59 and 22 percent from 60 or older age group.

TACT crash profiles, driver demographics, which drivers commit which TACT violations, can vary significantly regionally. Therefore the TACT model application must be carefully tailored to address and control for these variables if desired outcomes are to be reached and a reliable research model is to be constructed to formally document these findings.

5.5 CITATION DATA

The study included two waves of two-week enforcement action which focused on moving violations when passenger vehicles were interacting large trucks. Carlisle and Harrisburg supported the enforcement activity by putting up a total of 1,651 hours. Weekly enforcement summaries were used to compile the data. Since these summaries did not have sufficient level of detail on the offense and offending vehicle and driver, a database was developed to store this information. Due to the workflow surrounding the citation documents within the State Police, and the point in which the CS team realized that the citation data being collected was only in a summary form, the first week data could not be complied in this database. Therefore, only the weekly summaries are used to quantify the enforcement activity for that period. The data from the second wave were tabulated and will be provided on the project CD-ROM. Table 5.29 features the number of warnings and citations issued during the enforcement of TACT rules.

During the TACT enforcement a total of 265 drivers were stopped and issued either a warning or a citation due to violation of a TACT rule. Passenger cars were the most frequent offenders, passenger car drivers received 93 percent of the warnings and 89 percent of the citations. The overall rate of serious TACT violation is about one violation per 6.2 hours. However, when rates for each wave and enforcement station are computed, we observed a substantial difference between stations and across waves. The rate of violations drops considerably for the Harrisburg station. While these two stations service area are adjacent to each other sudden changes in the violation rates can be partially explained by variation in attention given to TACT rules and their enforcement. The difference in the second wave is even greater. Due to these factors, no statistical tests were conducted using citation data.

Table 5.29 Summary of Enforcement Activity during the Implementation Period

		TACT – Warnings[a]		TACT – Citations[a]		All		All Vehicles	Number of Hours Worked	Frequency
		Passenger	Commercial	Passenger	Commercial	Passenger	Commercial			
Wave I[b]	Carlisle	45	2	76	5	121	7	128	384	In every 3 hours
	Harrisburg	28	5	13	11	41	16	57	477	In every 8.4 hours
	All	**73**	**7**	**89**	**16**	**162**	**23**	**185**	**861**	In every 4.7 hours
Wave II[c]	Carlisle	14	0	52	2	66	2	68	380	In every 5.6 hours
	Harrisburg	1	0	11	0	12	0	12	411	In every 34.2 hours
	All	**15**	**0**	**63**	**2**	**78**	**2**	**80**	**791**	In every 9.9 hours
TACT Enforcement	Carlisle	59	2	128	7	187	9	196	764	In every 3.9 hours
	Harrisburg	29	5	24	11	53	16	69	887	In every 12.9 hours
	All	**88**	**7**	**152**	**18**	**240**	**25**	**265**	**1,651**	In every 6.2 hours

[a] If the charge in the warning/citation falls under ‘‘Following too Closely,’’ ‘‘Unsafe Lane Change,’’ or ‘‘Failure to Signal Lane Change,’’ then it is labeled as a TACT Offense.

[b] Data source is enforcement activity summaries by station.

[c] Data source is the Access database provided by the PSP.

6.0 Findings and Recommendations

In Section 3.0, we presented an approach to incrementally address the following question:

> Will the distribution of the TACT message in the test corridor prevent (fatal) crashes after the message was disseminated?

Through our statistical analysis, we are able to assert a number of important findings regarding the components of our evaluation framework.

6.1 How Big is the Problem?

We identified three elements towards addressing the size of the problem.

1. **Crash Information –** Between 2004 and 2008, on average in the test corridor, there were 204 total crashes in which 352 vehicles and 482 persons were involved. Of this average number, approximately 50 indicate that the TACT message may have prevented the crash. These "TACT-related" crashes had a lower incidence of injury, but with the small sample size that may not be relevant. Roughly 1 percent of all crashes included a fatality.
2. **Citations and Video Observations –** Video observation identified an average of just over six observations per hour where a potential educational message could be imparted. These are situations not involving actual crashes, but behavior which if left uneducated could lead to a crash in the future. Officers reviewing video clips typically asserted that these observations were a "moderate" crash risk, and there was substantial agreement among the officers even with independent review.
3. **Stated Driver Behavior –** The average driver who responded to the survey states that (s)he leaves 3 car lengths for another car, and 3.8 car lengths for a truck. Female respondents claimed to leave significantly less distance behind other vehicles than male drivers, but no other stratification stood out as significant.

6.2 Can Drivers Be Reached?

The TACT program used a mix of media and enforcement to reach drivers. Our analysis concluded that the media has done a more effective job of reaching drivers than the enforcement.

- **Driver Survey Responses –** 31 percent of all survey respondents reported having heard about the TACT program on at least one medium. Electronic media had the biggest market penetration, but this is partially skewed

because the Commonwealth had difficulty purchasing billboards on short notice. The billboards, however, had the better retention rate over time, most likely because they were visible for the entire five-month period of the study. Between radio and television, television had better retention over time.

Females of all ages recognized the electronic media at roughly equal percentages, while for males the percentage spiked for males 26-39 due to radio. This spike is likely caused due to the nature of the earned radio coverage, since the demographics of the stations which provided the most coverage fit this listener pattern.

- **Expert Panel Responses –** The results here are mixed. The main issue is whether the inconsistencies in the expert panel's decisions regarding enforcement action (all experts agreed only 6 percent of the time) still translates into an increased enforcement profile. Adding in the results of the full video set, with an observed event on average every 10 minutes, and it is unlikely that the TACT-related enforcement as currently deployed actually reaches additional drivers (compared to before October 2008) except in the most egregious cases. While the officers trained in the TACT protocols during the enforcement period may reach additional drivers, the majority of enforcement hours would be less relevant.

6.3 DOES DRIVER BEHAVIOR CHANGE?

The results here have to be discounted based on the wording of the questionnaire, and its inability to catch drivers who are trying to guess the "correct" answer.[13] Even with the discounted results, we can conclude that at least 8 percent of the drivers reached by the TACT message can be expected to change their behavior, and that this number might be as high as one-third.

The Confounding Effect of Variable Officer Behavior

In Section 4.4, we discussed the potential issue of an officer inadvertently creating a negative impact by not making an enforcement stop in the presence of a driver who has heard the TACT message. Note that it does not matter if the stop was or was not appropriate if the driver thinks the stop was or was not appropriate based on his or her interpretation of the media, and the enforcement officer proceeds in a different way (even if justified), there is a potential negative effect.

We are concerned by the fact that unanimous agreement from the expert panel occurred in only 6 percent of the cases. While we understand and appreciate the need for judgment, this figure still appears to be lower than expected.

[13] In our Task 5 Final Report, we will have some concrete recommendations for improving the survey instrument and surrounding methodology for future enforcement initiatives.

6.4 SYNTHESIS: CALCULATED INITIATIVE BENEFIT

Given information about these three smaller questions, we can readdress the larger question. The distribution of the TACT message will prevent (fatal) crashes only if all three conditions are met:

1. A situations exists where a driver could end up in a (fatal) crash due to aggressive driving;
2. The driver was previously reached by the TACT message; and
3. The driver changed their behavior sufficiently such that the crash was avoided.

Raw Answers

Given this criteria, we can make some general assertions about the benefit of the initiative on an urban corridor such as I-81. These assertions are tabulated in Table 6.1.

Table 6.1 Potential Benefit of Reduced Crashes Due to TACT Message Distribution

Variable	Value
Annual number of crashes on the corridor	202
Annual number of crashes on the corridor with TACT-related coding on the crash report	53
Percentage of drivers reached by the TACT message	31%
Percentage of drivers reached by the message who (state that they) change their behavior	8% – Conservative estimate 33% – Higher estimate
Number of crashes with a TACT-related coding on the crash report which could be reasonable assumed to be avoided due to changed behavior from the TACT message	53 * 31% * (either 8% or 33%) = = 1.31 – conservative estimate = 5.42 – higher estimate

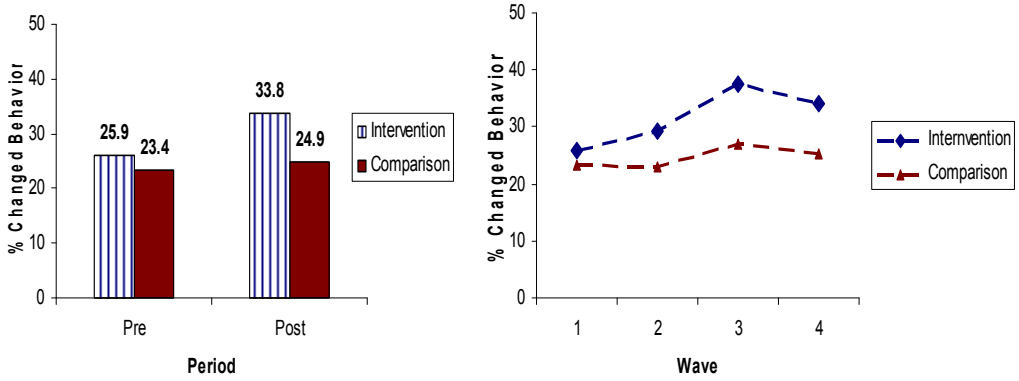
Note: Assumes that a certain percentage of those who state a change are not changing due to TACT, as per the 25 percent of those who did not know about TACT but still stated that they changed their behavior.

The Confounding Effect of the Survey Instrument

When taken with the strictest of interpretations and assumptions, it does not appear that the TACT initiative actually has substantial benefit. We must, however, realize that taking the strictest interpretation is conservative, but not necessarily unanimous.

For example, consider Figure 6.1, which illustrates the stated behavior change rate observed in Washington State, with an even larger driver sample (over 6,000) than in Pennsylvania. The stated rates for both intervention and control samples are similar to those in Pennsylvania.

Figure 6.1 Stated Driver Behavioral Change
Washington State



Source: Blomberg, Richard, et al. (2006). *Ticketing Aggressive Cars and Trucks in Washington State*. U.S. Department of Transportation, National Highway Traffic Safety Administration DOT HS 810 603. Washington, DC.

Table 6.2 recreates Table 6.1, but where possible, it places the Washington State results in parallel.

Table 6.2 Potential Benefit of Reduced Crashes Due to TACT Message Distribution, Compared to Washington State

Variable	Value – Pennsylvania	Value – Washington
Annual number of crashes on the corridor	202	N/A
Annual number of crashes on the corridor with TACT-related coding on the crash report	53	N/A
Percentage of drivers reached by the TACT message	31%	67.3%
Percentage of drivers reached by the message who (state that they) change their behavior	8% – Conservative estimate 33% – Higher estimate	8% – Implementation minus Comparison 33.8% – Implementation
Percentage of crashes with a TACT-related coding on the crash report which could be reasonable assumed to be avoided due to changed behavior from the TACT message	= 2.4% to 10.2% of relevant crashes	= 5.7% to 22.7% of relevant crashes

Source: Project data for Pennsylvania results, Ibid for Washington results.

Note: Assumes that a certain percentage of those who state a change are not changing due to TACT, as per the 25 percent of those who did not know about TACT but still stated that they changed their behavior.

When compared to Washington State, the findings can be more sharply focused. Specifically, we can draw the following conclusions:

- Drivers in Pennsylvania exhibited nearly identical rates of behavioral change (based on the syntax of the question) when they are exposed to the TACT message;
- The TACT message in Pennsylvania appears to have reached fewer drivers, but we suspect that this can likely be reflected in the particular media selections (placement and frequency), and the lack of on-road signs in Pennsylvania;
- The impact of the TACT program will be in direct correlation to the current safety in the corridor; and
- A true short-term assessment of the TACT impact cannot be estimated without confidence in the coding of the available crash records.

Our main criticism of the program, therefore, is indeed based not on the program itself, but on a technical criticism of the survey instrument provided to PennDOT. In Washington, the surveys were completed and dropped off in line, and the questionnaire had to be kept at a smaller level to encourage completion. In Pennsylvania, the mail-in nature of the survey would have given the project team time to build a more robust survey, but the fact that the project team was contracted after the media event left no time for adjustment.

We strongly encourage future TACT evaluations nationwide to focus on this issue. To stimulate discussion, we have included a potential variation on the survey instrument as Appendix B.

6.5 FINDINGS: STATISTICAL

In summary, we assert that the extended nature of our analysis timeframe has given researchers an innovative look into the confounding problems naturally involved with an evaluation project such as this one. Our approach has been to diligently document as many of these confounding factors as possible. But we take care not to criticize the overall TACT process simply on the presence of confounding effects.

Instead, we make the following assertions about the TACT experiment in Pennsylvania:

- **All things being equal, our results strongly indicate that Pennsylvania drivers have the same aptitude as Washington State drivers for changing their behavior when exposed to the TACT message;[14]**

[14]Since the TACT program was brought to states including Pennsylvania based on the perceived success of the Washington State program, we assert that this is a critically positive outcome of the Pennsylvania program.

- The billboards have provided the best long-term recall, especially considering that the State could only purchase a limited amount of billboard space on short notice, and that the corridor is not uniformly covered by billboards;
- Other electronic media coverage far outstrips the remaining forms of media in terms of driver awareness via the medium;
- Radio and television have different long-term message retention rates, and therefore the annual cost of such media must assume corresponding repurchase rates to keep the message fresh in drivers' minds;
- TACT must be considered primarily for those regions with a high percentage of crashes due to aggressive interaction between motor vehicles and cars – in Pennsylvania it is not clear if the 53 reported crashes per year on I-81 with a defined interaction in the crash record is a sufficient number to justify the expense of aggressive media coverage; and finally,
- The enforcement portion of the experiment did not have the same level of success as the media portion. Seven months after the enforcement period, officers in the region who were not involved in the TACT experiment often could not agree on the appropriate enforcement action when viewing the same video clips. Additional protocols or emphasis should be placed on the enforcement part of the message to reduce the likelihood of the confounding effects on driver message as described in Section 4.4, while still maintaining an appropriate level of officer judgment.

6.6 FINDINGS: PROCEDURAL RECOMMENDATIONS

In addition to our statistical findings, we have identified a number of procedural findings. Each of these findings involved areas where the procedures in place were outside of the control of the combined CS-Commonwealth team and had a negative effect on the level of detail of our resulting evaluation procedures. We provide these recommendations as guidance both for future Pennsylvania implementations of future "enforcement + media" safety initiatives, but also for other agencies considering piloting the TACT strategy in their jurisdictions.

Site Selection

1. **The control corridor selected did not have sufficient population to provide a proper comparison to the test corridor.** The control corridor was selected by PennDOT (and approved by FMCSA's outside representatives before Cambridge Systematics' involvement) because it closely matched the I-81 corridor on crash and vehicle miles traveled data. Failing to consider population, however, caused an issue with the surveys, as the population simply could not generate enough surveys at the vehicle services facility in the timeframe. The proportional lack of data from the control area complicated the statistical analyses. The control corridor should be as similar to the test corridor as practical, including population, heavy-truck-related crashes and

vehicle miles traveled, as well as in average trip length. In Pennsylvania, there were many mid-sized urban areas which could have been used for a control, but at a substantial additional expense for executing the various experiment components such as video collection.

Preparation and Timing

2. **The Media Event should have been delayed until March 15, 2009.** Section 2.4 of this report documented the serious confounding factors introduced by the desire to have the media event occur during Federal Fiscal Year 2008. Given that TACT is a two-year Federal program (FY 2008-2009), there would have been no practical harm in delaying the media event and enforcement. It is clear that an absolute minimum of seven months are required between awarding TACT funds to a state and the initial media event:
   - Two months to issue a request for proposals from potential evaluators;
   - Two months to select and contract an evaluator;
   - One month for the evaluator to determine the parameters of the TACT experiment given the situation in that state, including site visits to all proposed enforcement, control, and data collection locations; and
   - Two months to adjust collection instruments and collect sufficient baseline data prior to the media event.

Given the above recommended schedule, the media event would have needed to take place closer to January 1, 2009. With potential weather issues at that time of year, a deferral to March 15, 2009 would have been prudent, and would have still provided enough time for the project team to complete all analyses by the end of Federal Fiscal Year 2009.

The timing of the overall initiative had the baseline survey data being collected after the media event and a substantial amount of earned media coverage. Furthermore, additional modifications could have been made to the survey mechanics and questions (see below).

3. **The formal evaluation of programs as complex as TACT needs substantial advance staffing commitments and coordination.** The framework requires data collection over a substantial period of time, therefore, it needs significant staffing commitments and intra and inter agency coordination. Staffing needs for each task should be clearly identified and necessary assignments should be made in advance, including back-up assignments in the case of planned staffing needs can not be met. This is particularly critical for simultaneous (at the test and control sites) data collection and achieving consistency on data items on driver surveys and citation and warning information.

4. **In any state, the time period for a proper amount of enforcement data may be longer than the resources available to participating agencies.** Specifically in the area of citation and video observations, based on the volume of observations we envisioned that a total experimental of 17 weeks (4 baseline, 13 post) was preferred to generate enough data observations. In that period, one could envision one person-shift per week of video observation, as well as detailed tracking of at least all of the TACT-related citations and formal warnings in the corridor. This level of agency effort could not be made available on the short notice the agencies had in planning the TACT effort, especially with a professional evaluation team not on board until after the media event.

One alternative is to have the evaluation team actually collect much of the enforcement video, and have the officers identify the events on the video. While we are concerned that the officers may lose some of the context by not being physically present, they can watch the video at 200 percent or even 300 percent speed, and pause and replay potential events. In addition, an evaluator collected process can be blended into the expert panel process, so that the entire expert panel essentially selects its own clips rather than the one officer narrating that section of video.

5. **Crash data availability should be considered when planning a TACT implementation.** Because the TACT implementation occurred near the end of the calendar year, the slight delay for receiving baseline and post-implementation crash data to late March was not a critical factor. But if the implementation had been performed early in the year, a potential one-year delay would have been extremely problematic.

6. **Enforcement immediately benefits from even small amounts of exposure to the experimental design and its goals.** We observed this phenomenon in the video observation data. Over the 16 hours of video collected, our team noticed a substantial improvement from the collection teams, and this was echoed by the state staff. States implementing TACT for the first time may wish to consider a "pre-test" video pilot of a series of three-hour shifts, before baseline collection is performed.

7. **Guidance regarding project signs must be considered by future states.** In Pennsylvania, the road signs were not installed due to conflicts with Federal Highway Administration standards. FMCSA subsequently provided a directive to states on how to incorporate the signs in an appropriate manner.

Survey Mechanics

8. **While using a driver services facility for survey distribution is efficient from the perspective of state resources, it under-represents portions of the population with less driving experience.** The age distribution of the survey respondents is problematic. While the response rate (nearly 8 percent) from the facilities is excellent for a mail-in survey, the drivers facility model may not be appropriate in many states, especially those where technology can be

used for routine transactions. We strongly recommend a mixed approach to data collection, using both agency and non-agency facilities, and potentially a mix of mail-in, telephone, and web-based survey devices. In Pennsylvania, there was not enough time to change the collection protocols without delaying the media event (see recommendation number 2).

9. **The change in retrieval method caused significant disruption**. Changing from a drop-box at the drivers services facility (the Washington state model from which the Pennsylvania survey was appropriated) to a mail-back method leads to loss or compromise of some valuable information. For example, we did not have perfect location of whether the respondents' location as far as test versus control area, or the actual date of completion. In order to collect these factors, the survey instrument was modified after the baseline period and new surveys were printed and distributed. Meanwhile, delays in distribution of the blank surveys to the field caused irregular volumes responses throughout the project duration.

Survey Questions

We have concerns about the structure of the survey document provided to PennDOT for the TACT initiative. While the design of the survey is efficient and suitable for being completed while waiting on queue at a driver services facility (as originally implemented in Washington State), the brevity of the survey appears to lend itself to the introduction of biases – especially when a respondent has more time to think about their answers in a mail-return setting. Meanwhile, the timing of the project and the fact that the baseline surveys were already being distributed using the Washington State format eliminated our ability to make structural changes to the survey for the post-implementation period beyond adding questions to ascertain the respondent's location and date of completion.

10. **The survey instrument can be revised to minimize noise in the data**. After the transcription and analysis of the baseline data, we suspect that the survey instrument may have created some level of confusion in responses. The respondents often appear to report their usual habits rather than their behavior that they had recently changed. For example, about 30 percent of the respondents stated that they changed their behavior even without hearing anything about TACT. This is not a Pennsylvania-specific phenomenon: a similar level of misreporting was also observed in Washington State (about 25 percent).

    We have included a revised instrument suitable for a mail-in survey in Appendix B.

11. **The way that the "following distance" question has been setup also created confusion for some respondents**. The existing survey design asks respondents to report following distances in feet or car lengths. "Following distance" is a dynamic distance which is quite hard to express in terms of linear feet for the uninitiated. There were instances where a respondent utilized

both feet and car length distances, but they were either inconsistent or obviously either too long or too short. In some cases, distances in car lengths may have been reported in the field for distance in feet, and vice versa. We attempted to control for these confounding effects in Section 5.0.

Furthermore, there were several respondents who did not report a numerical value but verbally described a distance that that could see the trucks both headlights from their rearview mirror, and a few other respondents suggested that their choice of following distance was a function of traveling speed. The imprecise data from these fields directly affects the quality of the hypotheses testing, as having an accurate estimate of this distance directly affects the key question of whether this driver actually needs to be reached with the TACT message in the first place.

6.7 CONCLUSION

There is no evidence to believe that a TACT implementation in Pennsylvania would have less benefit than in any other state. It is clear that at least 8 percent of drivers responded to the TACT message, and future clarifications to the survey instrument could raise our confidence that figure to as high as 33 percent. These values are nearly identical to the Washington State findings, which were the impetus for expansion of the TACT pilot to multiple states. Therefore, there is no compelling reason to assert that FMCSA should diminish its emphasis on TACT in other states purely on benefit: we cannot reasonably speak to the cost-effectiveness of the program.

Given that conclusion, however, we must caution that the strength of our statistical evaluation findings are substantially diminished by the procedural issues identified during the process. It is clear to us that the media event should have been delayed until the spring of 2009, to give the agencies involved enough time to work with the evaluation team to plan out the experimental design and mitigate as many of the confounding factors as possible. Therefore, we believe that our procedural findings are of equal if not greater value to the overall safety community than our statistical findings.

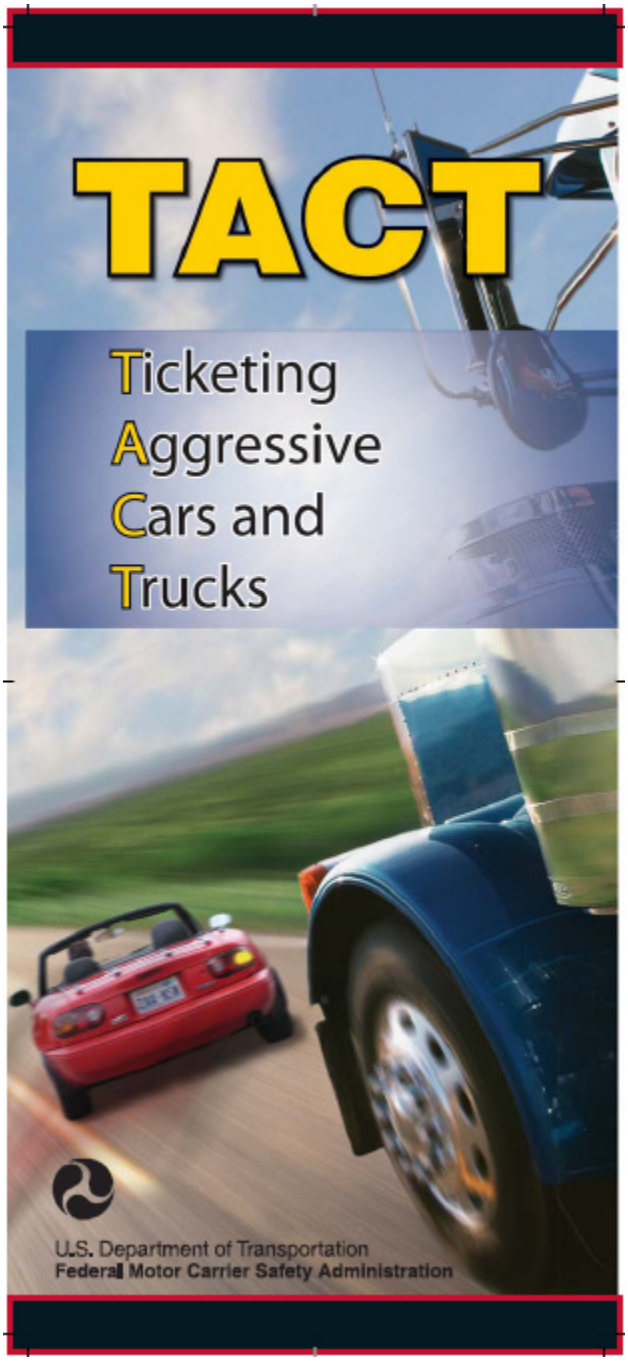
A. Appendix A – Selected Materials from the TACT Implementation

Each of the materials below were provided to Cambridge Systematics by the Pennsylvania Department of Transportation and the Pennsylvania State Police, and are presented as they were received (subject to page formatting).

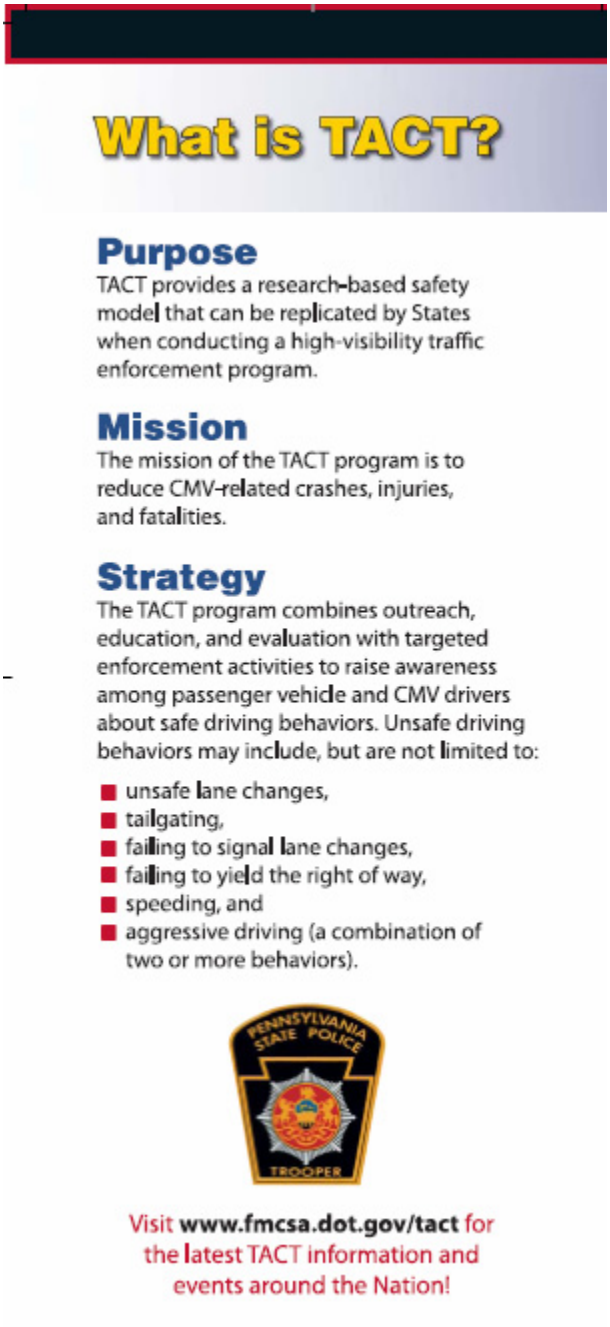
Image from the TACT Media Event

TACT Billboard Near Exit 72 on Interstate 81

TACT Pamphlet for Distribution (Front Image)



TACT Pamphlet for Distribution (Back Image)



What is TACT?

Purpose

TACT provides a research-based safety model that can be replicated by States when conducting a high-visibility traffic enforcement program.

Mission

The mission of the TACT program is to reduce CMV-related crashes, injuries, and fatalities.

Strategy

The TACT program combines outreach, education, and evaluation with targeted enforcement activities to raise awareness among passenger vehicle and CMV drivers about safe driving behaviors. Unsafe driving behaviors may include, but are not limited to:

- unsafe lane changes,
- tailgating,
- failing to signal lane changes,
- failing to yield the right of way,
- speeding, and
- aggressive driving (a combination of two or more behaviors).

PENNSYLVANIA STATE POLICE
TROOPER

Visit **www.fmcsa.dot.gov/tact** for the latest TACT information and events around the Nation!

Image of a Truck with the TACT Billboard Message

B. Appendix B – Questionnaires

pennsylvania
DEPARTMENT OF TRANSPORTATION

This Licensing Office is assisting the Bureau of Highway Safety and Traffic Engineering in a study about highway safety in Pennsylvania. Your answers to the following questions are voluntary and anonymous. Please place the completed survey in the supplied prepaid envelope and drop them off in the most convenient post office box.

1. Today's Date: _____

2. Your Zip Code: _____

3. How frequently do you drive along the test Corridor(replace with the Name of the corridor, i.e., I-70) **?**

☐1 Daily ☐2 2-3 times a week ☐3 Once a week ☐4 2-3 times a Month
☐5 Once a month ☐6 Few times a year ☐7 Never

4. About how many miles did you drive last year?

☐1 Less than 5,000 ☐2 5,000 to 10,000 ☐3 10,001 to 15,000 ☐4 More than 15,000

5. What type of vehicle do you drive most often? Please check one.

☐1 Passenger car ☐2 Pickup truck ☐3 Semi truck ☐4 Sport utility vehicle ☐5 Mini-van
☐6 Full-van ☐7 Other _____

6. In the past two months, have you changed your driving behavior around trucks?

☐1 Yes ☐2 No (Please skip to Question 9)

7. If you answered Yes to Question 6, what was the main reason for you to change your driving behavior around trucks recently? Please check one.

☐1 Involved in an accident with a truck ☐2 Almost Involved in an accident with a truck
☐3 Friend/Family member involved in an accident with a truck ☐4 Witnessed an accident involving at truck
☐5 Heard/noticed enforcement of moving violations around trucks ☐6 Received a ticket or a warning from the police
☐7 Other _____

8. If you answered Yes to Question 6, what did you change? (Check all that apply):

☐1 I leave more space when passing ☐2 I don't follow as closely ☐3 I stay out of the truck driver's blind spots
☐4 Other _____

9. Please fill in the blanks with your best estimate for the questions below.

a. When I pass a *car* on an interstate highway, I leave _____ car lengths before I pull back in.

b. When I pass a *semi truck* on an interstate highway, I leave _____ car lengths before I pull back in.

10. Have you recently read, seen or heard anything about giving semi trucks more space when you pass them?

☐1 Yes ☐2 No

If yes, where did you see or hear about it? (Check all that apply):

☐1 Newspaper ☐2 Radio ☐3 TV ☐ Road sign ☐5 Brochure ☐6 Police
☐7 Billboard ☐8 Poster ☐9 Banner ☐10Truck Wrap ☐10 at Work ☐10 Friend/Family Member

If yes, what did it say? _____

11. Can you rate your familiarity with each of these traffic safety programs?

	Very Familiar				Unfamiliar
Share the Road	☐1	☐2	☐3	☐4	☐5
TACT	☐1	☐2	☐3	☐4	☐5
Smooth Operator	☐1	☐2	☐3	☐4	☐5
The No Zone	☐1	☐2	☐3	☐4	☐5

12. How strictly do you think the Pennsylvania State Police enforce unsafe driving acts around trucks?

☐1 Very strictly ☐2 Somewhat strictly ☐3 Not very strictly ☐4 Rarely ☐5 Not at all ☐6 Do not know

13. Have you ever been stopped by the police for tailgating or cutting off a semi truck?

☐1 Yes, I got a ticket ☐2 Yes, I got a warning ☐3 No

14. How often do you use seat belts when you drive or ride in a car, van, sport utility vehicle or pick up?

☐1 Always ☐2 Nearly always ☐3 Sometimes ☐4 Seldom ☐5 Never

15. Have you ever driven a semi truck?

☐1 Never ☐2 A few times total ☐3 Used to drive a truck regularly ☐4 Drive trucks now

16. Your Gender: ☐(M) Male ☐ (F) Female

17. Your age: ☐1 Under 21 ☐2 21-25 ☐3 26-39 ☐4 40-49 ☐5 50-59 ☐6 60 Plus

18. Your race: ☐1 White ☐2 Black ☐3 Asian ☐4 Native American ☐5 Hispanic ☐6 Other

19. What is the highest level education you have completed?

☐1 Less than high school ☐2 High school or equivalency

☐3 Some college or associate's degree ☐4 Bachelor's degree ☐5 Graduate or professional degree

pennsylvania
DEPARTMENT OF TRANSPORTATION

This Licensing Office is assisting the Bureau of Highway Safety and Traffic Engineering in a study about highway safety in Pennsylvania. Your answers to the following questions are voluntary and anonymous. Please place the completed survey in the supplied prepaid envelope and drop them off in the most convenient post office box.

1. Today's Date: _____

2. Your Zip Code: _____

3. When was the last time you have driven to a destination in the test Corridor (replace with the Name of a key destination, i.e., Pittsburgh)**?**

☐1 Today ☐2 Yesterday ☐3 2 or 3 days ago ☐4 Last week
☐5 two to three weeks ago ☐6 Last month ☐7 two to three months ago ☐8 More than three months ago
☐9 Never

4. About how many miles did you drive last year?

☐1 Less than 5,000 ☐2 5,000 to 10,000 ☐3 10,001 to 15,000 ☐4 More than 15,000

5. What type of vehicle do you drive most often? Please check one.

☐1 Passenger car ☐2 Pickup truck ☐3 Semi truck ☐4 Sport utility vehicle ☐5 Mini-van
☐6 Full-van ☐7 Other _____

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If yes, what did it say? _____

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TACT	☐1	☐2	☐3	☐4	☐5
Smooth Operator	☐1	☐2	☐3	☐4	☐5
The No Zone	☐1	☐2	☐3	☐4	☐5

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☐1 Always ☐2 Nearly always ☐3 Sometimes ☐4 Seldom ☐5 Never

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16. Your Gender: ☐(M) Male ☐ (F) Female

17. Your age: ☐1 Under 21 ☐2 21-25 ☐3 26-39 ☐4 40-49 ☐5 50-59 ☐6 60 Plus

18. Your race: ☐1 White ☐2 Black ☐3 Asian ☐4 Native American ☐5 Hispanic ☐6 Other

19. What is the highest level education you have completed?

☐1 Less than high school ☐2 High school or equivalency

☐3 Some college or associate's degree ☐4 Bachelor's degree ☐5 Graduate or professional degree