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**An Evaluation of the “Click It Or Ticket:
Buckle-up or Pay Up” Mobilization Campaign**

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September 2003

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16. Abstract <p>The study reports the results of an evaluation of the "Click It or Ticket" mobilization campaign in Michigan centered around Memorial Day of 2003. The study consisted of four survey waves: Two full statewide surveys (one conducted as a Baseline before the campaign and one conducted as a Post campaign measure) and two "mini" statewide surveys conducted to assess the media and media+enforcement components of the campaign while they were being implemented. All survey waves were conducted statewide on front-outboard occupants traveling in four vehicle types (passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks). Belt use was estimated for all commercial/noncommercial vehicle types combined (the statewide safety belt use rate) for each survey wave. Additional analyses were conducted on the two full statewide surveys (Baseline and Post) because of the larger sample sizes. Statewide safety belt use was approximately 80 percent prior to the mobilization campaign and this rate did not significantly change during the media portion of the campaign. During the media+enforcement period, however, safety belt use significantly increased to about 84 percent and this significant increase was maintained during the Post survey wave. Comparison of the statewide rates between the Baseline and Post surveys showed that safety belt use increased significantly after the mobilization campaign. In addition, the use rate for the Post survey was the highest ever found in Michigan. The study results suggest that: 1) Michigan should continue to participate in the national efforts to raise safety belt use; 2) safety belt enforcement zones were successful as implemented in Michigan and should be continued; and 3) the CIOT model as implemented in Michigan was successful.</p>					
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INTRODUCTION

The safety belt is, perhaps, the most effective occupant restraint device found in a motor vehicle. Estimates from the National Highway Traffic Safety Administration (NHTSA, 2002a) show that use of safety belts in 2000 resulted in nearly 12,000 lives saved nationally. Despite the clear safety benefits, one-quarter of motorists in the United States still do not use safety belts (Glassbrenner, 2002). If safety belt use could be increased to 90 percent nationally, thousands of lives could be saved and tens of thousands of injuries could be prevented each year.

In its continuing effort to increase safety belt use nationwide, NHTSA sponsors a number of activities and grant programs (see NHTSA, 2002a for a review). One of these activities is the Click It or Ticket (CIOT) program. Based on a successful Selective Traffic Enforcement Program (STEP) in Canada, the CIOT program was designed to increase safety belt use by stepping up enforcement and publicizing the increased enforcement through widespread public information and education (PI&E) efforts. Based on the initial success of CIOT in the mid to late 1990s, NHTSA, through Section 157 funding, began sponsoring individual states to implement CIOT in coordinated efforts usually surrounding holidays (see Solomon, Ulmer, & Preusser, 2002).

In 2002, Michigan applied for, and received sponsorship from NHTSA to participate in two of these coordinated efforts (known as mobilizations), one surrounding the Memorial Day weekend (Eby, et al., 2002) and one surrounding Thanksgiving (Eby & Vivoda, 2003). For the Memorial Day mobilization, Michigan purchased media (radio, television, and billboards) in the most populous regions of the state. While enforcement activity was present during the CIOT program, no special enforcement activity was sponsored by the state. The University of Michigan Transportation Research Institute (UMTRI) evaluated the effect of the program by conducting direct observation surveys in two regions of the state: An experimental region, where all media activity occurred, and a control region, where no CIOT media was purchased (Eby et al., 2002). UMTRI also analyzed telephone survey data from these regions collected by another firm. The direct observation survey results showed that safety belt use did not significantly increase in either region immediately after

the program. Thus, the media program did not seem to have a differential effect on safety belt use in the experimental region. One reason for this lack of effect may have been that the media campaign had far-reaching effects in Michigan. Even though no specific program activities were scheduled to appear in the counties comprising the control region, the telephone survey revealed that people in the control region were exposed to an increase in messages and enforcement during the program period. Because of this exposure in the control region to the CIOT program, we had no clear way of determining the differential effects of the program (Eby, et al., 2002).

For the Thanksgiving mobilization campaign in Michigan, 18 counties received federal funding to increase police presence on the roads (Michigan Office of Highway Safety Planning, OHSP, 2003a). These were the most populous counties in the state and represented the most problematic crash areas (OHSP, 2003a). The mobilization in Michigan lasted about two weeks and included a media campaign as well as the involvement of 484 law enforcement agencies across the state. More than 19,000 safety belt citations were written during the mobilization period (OHSP, 2003b). To evaluate the campaign, UMTRI conducted direct observation surveys before and after the program (Eby & Vivoda, 2003). We found that statewide belt use was the same for both surveys, suggesting that the Thanksgiving mobilization did not significantly increase safety belt use in Michigan. However, past research has suggested that Michigan may experience seasonal variations in safety belt use with use decreasing in Winter (Eby, Fordyce, & Vivoda, 2000; Eby, Vivoda, & Fordyce, 2002). It is possible that a seasonal decrease in safety belt use during the survey conducted after program implementation in December, masked the positive effect of the CIOT program; that is, the program may have prevented a decrease in safety belt use in December. Thus, we could not demonstrate clear effects, or lack of effects, of the CIOT program.

In 2003, Michigan received funding to participate in a CIOT mobilization campaign centered around Memorial Day. In a concerted effort to raise safety belt use in Michigan, OHSP redoubled its efforts to strengthen implementation of the enforcement and media components of CIOT. OHSP developed a new tagline for CIOT to emphasize the enforcement aspect of the campaign: *Buckle Up or Pay Up*. In addition, nearly 500 law

enforcement agencies across Michigan signed up to participate in the mobilization, and 109 law enforcement agencies in 12 of Michigan's most populated counties received funding for overtime traffic enforcement activity. Michigan also developed and piloted "safety belt enforcement zones" for this mobilization. Zones were determined based on traffic volumes, location within counties of participating agencies, ability to place zone signage, officer safety, and a documented crash risk. Safety belt enforcement within a zone involved a concentration of at least four officers in a defined stretch of roadway. A spotter placed at the beginning of the zone identified cars for the remaining officers to stop and ticket. Each zone lasted at least four hours, including briefing, set-up, and clean up. In total, 142 enforcement zones were scheduled in eight Michigan high-population counties (Bay, Grand Traverse, Ingham, Kent, Macomb, Oakland, Schoolcraft, and Wayne). Enforcement zones were conducted every day of the mobilization period. In addition to the heavy enforcement effort, Michigan also conducted a series of media events throughout the state to announce the safety belt campaign. Radio, television, and cable advertising was also purchased in the main media markets in Michigan to promote the campaign.

To properly understand the effects of such a large effort to increase safety belt use statewide, it is essential that the campaign be evaluated. An evaluation can provide important information regarding different aspects of the program to assess which parts have been effective, and which parts might need to be changed in future campaigns. An integral component of any safety belt evaluation should include direct observation surveys to estimate safety belt use rates. The purpose of the current study was to conduct four statewide direct observation surveys of safety belt use in Michigan. The first survey provided baseline safety belt use information before the mobilization began; the second assessed use during the media components of the campaign, the third determined use during the period in which both media and enforcement were present; and the fourth provided use rates after program completion.

METHODS

Sample Design

The current study consists of four survey waves: Two full statewide surveys (one conducted as a baseline before the campaign and one conducted as a post campaign measure) and two “mini” statewide surveys conducted to assess the media and media+enforcement components of the campaign while they were being implemented. The sample design for the full statewide survey was closely based upon the one used by Streff, Eby, Molnar, Joksch, and Wallace (1993), while the mini survey consisted of a subsample of the full survey. The entire sampling procedure is presented here for completeness, with modifications noted. Procedures for selecting the subsample are detailed at the end of this section.

The goal of this sample design was to select observation sites that accurately represent front-outboard vehicle occupants in eligible commercial and noncommercial vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) in Michigan, while following federal guidelines for safety belt survey design (NHTSA, 1992, 1998). An ideal sample minimizes total survey error while providing sites that can be surveyed efficiently and economically. To achieve this goal, the following sampling procedure was used.

To reduce the costs associated with direct observation of remote sites, NHTSA guidelines allow states to omit from their sample space the lowest population counties, provided these counties collectively account for 15 percent or less of the state's total population. Therefore, all 83 Michigan counties were rank ordered by population (U.S. Bureau of the Census, 1992) and the low population counties were eliminated from the sample space. This step reduced the sample space to 28 counties. In order to account for shifts in the populations among counties (U.S. Bureau of the Census, 2003), three additional counties were added to the present design bringing the total number of counties in the sample space to 31.

The original counties were then separated into four strata. The strata were constructed by obtaining historical belt use rates and vehicle miles of travel (VMT) for each

county. Historical belt use rates were determined by averaging results from three previous University of Michigan Transportation Research Institute (UMTRI) surveys (Wagenaar & Molnar, 1989; Wagenaar, Molnar, & Businski, 1987b, 1988). Since no historical data were available for six of the counties, belt use rates for these counties were estimated using multiple regression based on per capita income and education for the other 22 counties ($r^2 = .56$; U.S. Bureau of the Census, 1992).¹ These factors have been shown previously to correlate positively with belt use (e.g., Wagenaar, Molnar, & Businski, 1987a). Wayne County was chosen as a separate stratum because of its disproportionately high VMT, and because we wanted to ensure that observation sites were selected within this county. Three other strata were constructed by rank ordering each county by historical belt use rates and then adjusting the stratum boundaries until the total VMT was roughly equal within each stratum. The stratum boundaries were high belt use (stratum 1), medium belt use (stratum 2), low belt use (stratum 3), and Wayne County. The additional counties for the present survey became part of stratum 3 and all sites in this stratum were reselected and rescheduled following the procedures described below. The Michigan counties comprising each stratum can be found in Table 1.

Table 1: Listing of Michigan Counties by Stratum	
Stratum Number	Counties
1	Ingham, Kalamazoo, Oakland, Washtenaw
2	Allegan, Bay, Eaton, Grand Traverse, Jackson, Kent, Livingston, Macomb, Midland, Ottawa
3	Berrien, Calhoun, Clinton, Genesee, Ionia, Isabella, Lapeer, Lenawee, Marquette, Monroe, Muskegon, Saginaw, Shiawassee, St. Clair, St. Joseph, Van Buren
4	Wayne

To achieve the NHTSA required precision of less than 5 percent relative error, the minimum number of observation sites for the survey ($N = 56$) was determined based on within- and between-county variances from previous belt use surveys and on an estimated 50 vehicles per observation period in the current survey. This minimum number was then

¹ Education was defined as the proportion of population in the county over 25 years of age with a professional or graduate degree.

increased (N = 168) to get an adequate representation of belt use for each day of the week and for all daylight hours.

Because total VMT within each stratum was roughly equal, observation sites were evenly divided among the strata (42 each). In addition, since an estimated 23 percent of all traffic in Michigan occurs on limited-access roadways (Federal Highway Administration, 1982), 10 of the sites (24 percent) within each stratum were freeway exit ramps, while the remaining 32 were roadway intersections.

Within each stratum, observation sites were randomly assigned to a location using different methods for intersections and freeway exit ramps. The intersection sites were chosen using a method that ensured each intersection within a stratum an equal probability of selection. Detailed, equal-scale road maps for each county were obtained and a grid pattern was overlaid on each county map. The grid dimensions were 62 lines horizontally and 42 lines vertically. The lines of the grid were separated by 1/4 inch. With the *3/8 inch:mile* scale of the maps, this created grid squares that were .67 miles per side. (Because Marquette County is so large, it was divided into four maps and each part was treated as a separate county.) Each grid square was uniquely identified by two numbers, a horizontal (*x*) coordinate and a vertical (*y*) coordinate.

The 42 sites for each stratum were sampled sequentially. The 32 local intersection sites were chosen by first randomly selecting a grid number containing a county within a stratum.² This was achieved by generating a random number between 1 and the number of grids within the stratum. So, for example, since the high belt use stratum had four grid patterns overlaying four counties, a random number between 1 and 4 was generated to determine which grid would be selected. Thus, each grid had an equal probability of selection at this step. Once the grid was selected, a random *x* and a random *y* coordinate were chosen and the corresponding grid square identified. Thus, each intersection had an equal probability of selection. If a single intersection was contained within the square, that intersection was chosen as an observation site. If the square did not fall within the

² It is important to note that grids were selected during this step rather than counties. This was necessary only because it was impractical to construct a single grid that was large enough to cover all of the counties in the largest stratum when they were laid side by side.

county, there was no intersection within the square, or there was an intersection but it was located one road link from an already selected intersection, then a new grid number and x, y coordinate were randomly selected. If more than one intersection was within the grid square, the grid square was subdivided into four equal sections and a random number between 1 and 4 was selected until one of the intersections was chosen. This happened for only two of the sites.

Once a site was chosen, the following procedure was used to determine the particular street and direction of traffic flow that would be observed. For each intersection, all possible combinations of street and traffic flow were determined. From this set of observer locations, one location was randomly selected with a probability equal to $1/\text{number of locations}$. For example, if the intersection, was a "+" intersection, as shown in Figure 1, there would then be four possible combinations of street and direction of traffic flow to be observed (observers watched traffic only on the side of the street on which they were standing). In Figure 1, observer location number one indicates that the observer would watch southbound traffic and stand next to Main Street. For observer location number two, the observer would watch eastbound traffic and stand next to Second Street, and so on. In this example, a random number between 1 and 4 would be selected to determine the observer location for this specific site. The probability of selecting an intersection approach is dependent upon the type of intersection. Four-legged intersections like that shown in Figure 1 have four possible observer locations, while three-legged intersections like "T" and "Y" intersections have only three possible observer locations. The effect of this slight difference in probability accounts for .01 percent or less of the standard error in the belt use estimate.

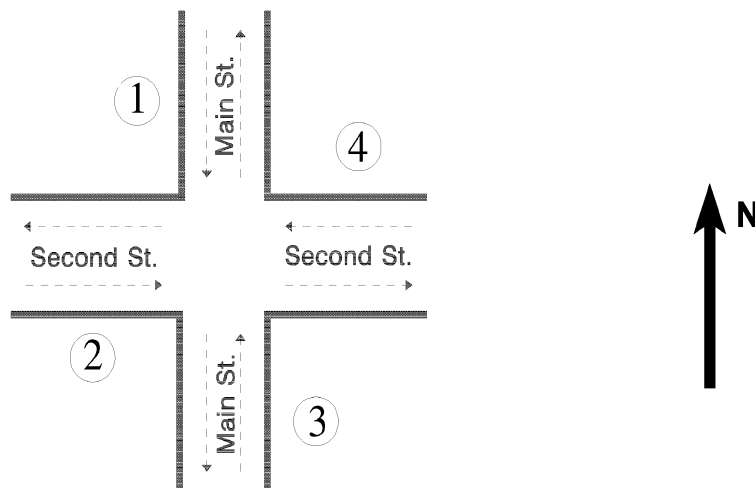


Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

For each primary intersection site, an alternate site was also selected. The alternate sites were chosen within a 20 x 20 square unit area around the grid square containing the original intersection, corresponding to a 13.4 square mile area around the site. This was achieved by randomly picking an x, y grid coordinate within the alternate site area. Grid coordinates were selected until a grid square containing an intersection was found. No grid squares were found that contained more than one intersection. The observer location at the alternate intersection was determined in the same way as at the primary site.³

The 10 freeway exit ramp sites within each stratum also were selected so that each exit ramp had an equal probability of selection.⁴ This was done by enumerating all of the exit ramps within a stratum and randomly selecting without replacement 10 numbers between 1 and the number of exit ramps in the stratum. For example, in the high belt use stratum there were a total of 109 exit ramps. To select an exit ramp, a random number

³ For those interested in designing a safety belt survey for their county or region, a guidebook and software for selecting and surveying sites for safety belt use is available (Eby, 2000) by contacting UMTRI-SBA, 2901 Baxter Rd., Ann Arbor, MI 48109-2150, or accessing <http://www-personal.umich.edu/~eby/sbs.html/>.

⁴ An exit ramp is defined here as egress from a limited-access freeway, irrespective of the direction of travel. Thus, on a north-south freeway corridor, the north and south bound exit ramps at a particular cross street are considered a single exit ramp location.

between 1 and 109 was generated. This number corresponded to a specific exit ramp. To select the next exit ramp, another random number between 1 and 109 was selected with the restriction that no previously selected numbers could be chosen. Once the exit ramps were determined, the observer location for the actual observation was determined by enumerating all possible combinations of direction of traffic flow and sides of the ramp on which to stand. As in the determination of the observer locations at the roadway intersections, the possibilities were then randomly sampled with equal probability. The alternate exit ramp sites were selected by taking the first interchange encountered after randomly selecting a direction of travel along the freeway from the primary site. If this alternate site was outside of the county or if it was already selected as a primary site, then the other direction of travel along the freeway was used. If the exit ramp had no traffic control device on the selected direction of travel, then a researcher visited the site and randomly picked a travel direction and lane that had such a device.

The day of week and time of day for site observations were quasirandomly assigned to sites in such a way that all days of the week and all daylight hours (7:00 am - 7:00 pm) had essentially equal probability of selection. The sites were observed using a clustering procedure. That is, sites that were located spatially adjacent to each other were considered to be a cluster. Within each cluster, a shortest route between all of the sites was decided (essentially a loop) and each site was numbered. An observer watched traffic at all sites in the cluster during a single day. The day in which the cluster was to be observed was randomly determined. After taking into consideration the time required to finish all sites before dark, a random starting time for the day was selected. In addition, a random number between 1 and the number of sites in the cluster was selected. This number determined the site within the cluster where the first observation would take place. The observer then visited sites following the loop in either a clockwise or counterclockwise direction (whichever direction left them closest to UMTRI at the end of the day). This direction was determined by the project manager prior to sending the observer into the field. Because of various scheduling limitations (e.g., observer availability, number of hours worked per week) certain days and/or times were selected that could not be observed. When this occurred, a new day and/or time was randomly selected until a usable one was found. The important issue about the randomization is that the day and

time assignments for observations at the sites were not correlated with belt use at a site. This quasirandom method is random with respect to this issue.

The sample design was constructed so that each observation site was self-weighted by VMT within each stratum. This was accomplished by selecting sites with equal probability and by setting the observation interval to a constant duration (50 minutes) for each site.⁵ Thus, the number of vehicles observed at an observation site reflected safety belt use by VMT; that is, the higher the VMT at a site, the greater the number of vehicles that would pass during the 50-minute observation period. However, since all vehicles passing an observer could not be surveyed, a vehicle count of all eligible vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) on the traffic leg under observation was conducted for a set duration (5 minutes) immediately prior to and immediately following the observation period (10 minutes total).

Table 2 shows descriptive statistics for the 168 observation sites for the two full statewide surveys: Wave 1 (Baseline) conducted between 4/17/03 - 4/30/03 and Wave 4 (Post) conducted between 5/29/03 - 6/11/03. As shown in this table, the observations for both surveys were fairly well distributed over day of week. Observations were also well distributed by time of day except for the latest time period. Note that an observation session was included in the time slot that represented the majority of the observation period. If the observation period was evenly distributed between two time slots, then it was included in the later time slot. This table also shows that nearly every site observed was the primary site and that observations were mostly conducted during sunny and cloudy weather conditions. Very few observations were conducted in rainy or snowy conditions for either survey.

⁵ Because of safety considerations, sites in the city of Detroit were observed for a different duration. See data collection section for more information.

Table 2. Descriptive Statistics for the 168 Observation Sites for the Two Full Statewide Surveys: Wave 1 (%) and Wave 4 (%), Respectively.											
Day of Week			Time			Site			Weather		
Wave	1	4		1	4		1	4		1	4
Monday	13.7	13.7	7-9 a.m.	10.7	10.1	Primary	98.8	98.2	Sunny	54.2	36.3
Tuesday	13.1	13.1	9-11 a.m.	19.1	19.1	Alternate	1.2	1.8	Cloudy	39.9	50.0
Wednesday	11.3	11.3	11-1 p.m.	16.7	16.7				Rain	5.3	13.7
Thursday	16.1	16.7	1-3 p.m.	23.2	22.6				Snow	0.6	0.0
Friday	17.9	17.3	3-5 p.m.	19.6	21.4						
Saturday	17.8	17.8	5-7 p.m.	10.7	9.5						
Sunday	10.1	10.1	7-9 p.m.	0.0	0.6						

Mini Survey Subsample Selection

The purpose of the mini survey was to quickly determine the overall statewide safety belt use rate with a limited number of sites without the requirements of providing safety belt rates by day of week, time of day, or demographics of occupants. As described earlier, to achieve the required precision of less than 5 percent relative error, the minimum number of observation sites for the survey was determined to be 56 sites, 14 in each stratum. To begin the subsample selection, all of the freeway sites within each stratum of the full statewide survey were assigned a number 1-10. Since 24 percent of the sites within each stratum of the full sample were freeway exit ramps (to match the freeway travel in Michigan), it was necessary for two of the subsample strata to have 3 freeway sites and the other two strata to have 4. To randomly determine which strata would have 3 freeway sites, two random numbers between 1 and 4 were generated to correspond with the stratum numbers. Random numbers corresponding to the freeway sites were then generated until the proper number had been chosen for each stratum. The remaining intersection sites within each stratum were assigned a number 1-32, and then a random number was generated between 1 and 32 for Stratum 1. The site that corresponded to that number was chosen as a site for the subsample. Random numbers continued to be generated without replacement until all 14 sites had been chosen within the stratum. This site selection process was repeated for each of the remaining 3 strata until all 56 sites had been sampled from the original 168. The scheduling of the sites for the mini survey was completed using the same clustering procedure described above.

Table 3 shows descriptive statistics for the 56 observation sites for two the mini statewide surveys: Wave 2 (media), conducted between 5/12/03 - 5/18/03, and Wave 3 (media+enforcement), conducted between 5/19/03 - 5/25/03. As stated earlier, the purpose of this phase of the study was to provide only an overall estimate of statewide safety belt use in Michigan. Given the compressed schedule that was necessary to complete this survey, and the small number of sites relative to the full statewide survey, an even distribution of observations over day of week and time of day was not possible. As such, observations were not well distributed over day of week or time of day (see Table 2). This table also shows that nearly every site observed was the primary site and that observations were mostly conducted during sunny and cloudy weather conditions, with a smaller percentage conducted during rainy weather. No observations were conducted during snowy conditions.

Table 3. Descriptive Statistics for the 56 Observation Sites for the Two Statewide Mini-Surveys: Wave 2(%) and Wave 3 (%), Respectively.											
Day of Week			Time			Site			Weather		
Wave	2	3		2	3		2	3		2	3
Monday	19.6	19.6	7-9 a.m.	12.5	12.5	Primary	98.2	98.2	Sunny	50.0	46.4
Tuesday	17.9	17.9	9-11 a.m.	28.6	28.6	Alternate	1.8	1.8	Cloudy	39.3	50.0
Wednesday	8.9	8.9	11-1 p.m.	17.8	17.8				Rain	10.7	3.6
Thursday	8.9	8.9	1-3 p.m.	25.0	25.0				Snow	0.0	0.0
Friday	14.3	14.3	3-5 p.m.	14.3	14.3						
Saturday	12.5	12.5	5-7 p.m.	1.8	1.8						
Sunday	17.9	17.9									

Data Collection

Data collection for the study involved direct observation of shoulder belt use, estimated age, and sex. Trained field staff observed shoulder belt use of drivers and front-right passengers traveling in passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks during daylight hours. Observations of safety belt use, sex, age, vehicle type, and vehicle purpose (commercial or noncommercial) were conducted when a vehicle came to a stop at a traffic light or a stop sign.

Data Collection Forms

Two forms were used for data collection: a site description form and an observation form. The site description form (see Appendix A) provided descriptive information about the site including the site number, location, site type (freeway exit ramp or intersection), site choice (primary or alternate), observer number, date, day of week, time of day, weather, and a count of eligible vehicles traveling on the proper traffic leg. A place on the form was also furnished for observers to sketch the intersection and to identify observation locations and traffic flow patterns. Finally, a comments section was available for observers to identify landmarks that might be helpful in characterizing the site (e.g., school, shopping mall) and to discuss problems or issues relevant to the site or study.

A second form, the observation form, was used to record safety belt use, passenger information, and vehicle information (see Appendix A). Each observation form was divided into four boxes, with each box having room for the survey of a single vehicle. For each vehicle surveyed, shoulder belt use, sex, and estimated age of the driver as well as vehicle type were recorded on the upper half of the box, while the same information for the front-outboard passenger could be recorded in the lower half of the box if there was a front-outboard passenger present. Children riding in child safety seats (CSSs) were recorded but not included in any part of the analysis. Occupants observed with their shoulder belt worn under the arm or behind the back were noted but considered as belted in the analysis. Based upon NHTSA (1999) guidelines, the observer also recorded whether the vehicle was commercial or noncommercial. A commercial vehicle is defined as a vehicle that is used for business purposes and may or may not contain company logos. This classification includes vehicles marked with commercial lettering or logos, or vehicles with ladders or other tools on them. At each site, the observer carried several data collection forms and completed as many as were necessary during the observation period.

Procedures at Each Site

All sites in the sample were visited by one observer for a period of 1 hour, with the exception of sites in the city of Detroit. To address potential security concerns, these sites were visited by two-person observer teams for a period of 30 minutes. Observations at other Wayne County sites scheduled to be observed on the same day as Detroit sites were

also completed by two observers. Because each team member at these sites recorded data for different lanes of traffic, the total amount of data collection time was equivalent to that at single observer sites.

Upon arriving at a site, observers determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), observers proceeded to the alternate site. Otherwise, observers completed the site description form and then moved to their observation position near the traffic control device.

Observers were instructed to observe only the lane immediately adjacent to the curb for safety belt use, regardless of the number of lanes present. At sites visited by two-person teams, team members observed different lanes of the same traffic leg with one observer on the curb and one observer on the median (if there was more than one traffic lane and a median). If no median was present, observers were instructed to stand on diagonally opposite corners of the intersection.

At each site, observers conducted a 5-minute count of all eligible vehicles in the designated traffic leg before beginning safety belt observations. Observations began immediately after completion of the count and continued for 50 minutes at sites with one observer and 25 minutes at sites with two observers. During the observation period, observers recorded data for as many eligible vehicles as they could observe. If traffic flow was heavy, observers were instructed to record data for the first eligible vehicle they saw, and then look up and record data for the next eligible vehicle they saw, continuing this process for the remainder of the observation period. At the end of the observation period, a second 5-minute vehicle count was conducted at one-observer sites.

Observer Training

Prior to data collection, field observers participated in 5 days of intensive training, including both classroom review of data collection procedures and practice field observations. A few observers were replaced during the course of the four surveys. These observers received 2 days of training and reached an interobserver reliability with the other observers. Each observer received a training manual containing detailed information on

field procedures for observations, data collection forms, and administrative policies and procedures. A site schedule identifying the location, date, time, and traffic leg to be observed for each site was included in the manual (see Appendix B for a listing of the sites).

After intensive review of the manual, observers conducted practice observations at several sites chosen to represent the types of sites and situations that would actually be encountered in the field. None of the locations of the practice sites were the same as sites observed during the study. Training at each practice site focused on completing the site description form, determining where to stand and which lanes to observe, conducting the vehicle count, recording safety belt use, and estimating age and sex. Observers worked in teams of two, observing the same vehicles, but recording data independently on separate data collection forms. The forms were then compared for accuracy. Teams were rotated throughout the training to ensure that each observer was paired with every other observer. Each observer pair practiced recording safety belt use, sex, and age until there was an interobserver reliability of at least 85 percent for all measures on drivers and front-right passengers for each pair of observers.

Each observer was provided with an atlas of Michigan county maps and all necessary field supplies. Observers were given time to locate their assigned sites on the appropriate maps and plan travel routes to the sites. After marking the sites on their maps, the marked locations were compared to a master map of locations to ensure that the correct sites had been pinpointed. Field procedures were reviewed for the final time and observers were informed that unannounced site visits would be made by the field supervisor during data collection to ensure adherence to study protocols.

Observer Supervision and Monitoring

During data collection, each observer was spot checked in the field on at least two occasions by the field supervisor. Contact between the field supervisor and field staff was also maintained on a regular basis through staff visits to the UMTRI office to deliver completed forms and through telephone calls from staff to report progress and discuss

problems encountered in the field. Field staff were instructed to call the field supervisor's home or cellular phone if problems arose during evening hours or on weekends.

Incoming data forms were examined by the field supervisor and problems (e.g., missing data, discrepancies between the site description form and site listing or schedule) were noted and discussed with field staff. Attention was also given to comments on the site description form about site-specific characteristics that might affect future surveys (e.g., traffic flow patterns, traffic control devices, site access).

Data Processing and Estimation Procedures

The site description form and observation form data were entered into an electronic format. The accuracy of the data entry was verified in two ways. First, all data were entered twice and the data sets were compared for consistency. Second, the data from randomly selected sites were reviewed for accuracy by a second party and all site data were checked for inconsistent codes (e.g., the observation end time occurring before the start time). Errors were corrected after consultation with the original data forms.

For each site, a computer analysis program determined the number of observed vehicles, belted and unbelted drivers, and belted and unbelted passengers. Separate counts were made for each independent variable in the survey (i.e., site type, time of day, day of week, weather, sex, age, seating position, and vehicle type). This information was combined with the site information to create a file used for generating study results.

As mentioned earlier, our goal in this safety belt survey was to estimate belt use for the state of Michigan based on VMT. As also discussed, the self-weighting-by-VMT scheme employed is limited by the number of vehicles for which an observer can accurately record information. To correct for this limitation, the vehicle count information was used to weight the observed traffic volumes so they would more accurately reflect VMT.

This weighting was done by first adding each of the two 5-minute counts and then multiplying this number by five so that it would represent a 50-minute duration.⁶ The resulting number was the estimated number of vehicles passing through the site if all eligible vehicles had been included in the survey during the observation period at that site. The estimated count for each site is divided by the actual number of vehicles observed there to obtain a volume weighting factor for that site. These weights are then applied to the number of actual vehicles of each type observed at each site to yield the weighted N for the total number of drivers and passengers, and total number of belted drivers and passengers for each vehicle type. Unless otherwise indicated, all analyses reported are based upon the weighted values.

The overall estimate of belt use per VMT in Michigan was determined by first calculating the belt use rate within each stratum for observed vehicle occupants in all vehicle types using the following formula:

$$r_i = \frac{\text{Total Number of Belted Occupants, weighted}}{\text{Total Number of Occupants, weighted}}$$

where r_i refers to the belt use rate within any of the four strata. The totals are the sums across all 42 sites within the stratum after weighting, and occupants refers to only front-outboard occupants. The overall estimate of belt use was computed by averaging the belt use rates for each stratum. However, comparing total VMT among the strata, one finds that the Wayne County stratum is only 88 percent as large as the total VMT for the other three strata. In order to represent accurately safety belt use for Michigan by VMT, the Wayne County stratum was multiplied by 0.88 during the averaging to correct for its lower total VMT. The overall belt use rate was determined by the following formula:

$$r_{all} = \frac{r_1 + r_2 + r_3 + 0.88(r_4)}{3.88}$$

⁶ As mentioned previously, the Detroit sites were visited by pairs of observers for half as long. For these sites, the single 5-minute count was multiplied by five to represent the 25-minute observation period.

where r_i is the belt use rate for a certain vehicle type within each stratum and r_4 the Wayne County stratum.

The estimates of variance and the calculation of the confidence bands for the belt use estimates are complex. See Appendix C for a detailed description of the formulas and procedures. The same use rate and variance equations were utilized for the calculation of use rates for each vehicle type separately.

RESULTS

As discussed previously, the current study of safety belt use in Michigan reports results from four direct observation survey waves. The first survey wave consisted of a full statewide survey conducted to determine baseline use rates prior to the campaign. The second and third survey waves were mini-surveys conducted to assess the media and media+enforcement components of the campaign, respectively. The fourth survey wave was a full statewide survey conducted to assess the effects of the campaign. Note again, that the mini-surveys only allow us to determine an overall statewide safety belt use rate, stratum use rates, and rates by seating position, while the full statewide surveys allow us to determine use rates by several other categories. Therefore we first discuss these three belt use categories first for all four survey waves and then discuss changes in safety belt use by the other categories for only the two full statewide surveys (waves 1 and 4).

Overall Safety Belt Use

Table 4 shows the statewide safety belt use rates and unweighted number of front-outboard occupants (N) for the four survey waves. The "±" value following the use rate indicates a 95 percent confidence band around the percentage. This value should be interpreted to mean that we are 95 percent sure that the actual safety belt use rate falls somewhere inside the band created by these percentages. As shown in this table, statewide safety belt use was approximate 80 percent prior to the mobilization campaign and this rate did not significantly change during the media portion of the campaign. During the media+enforcement period, however, safety belt use significantly increased and this significant increase was maintained during the post, follow up period. Comparison of the statewide rates between the baseline and post surveys show that safety belt use increased significantly after the mobilization campaign. In addition, the use rate of 38.9 percent for the Post survey was the highest ever found in Michigan.

Table 4: Overall Safety Belt Use and Unweighted N by Survey Wave			
Survey	Statewide Use Rate	Unweighted N	Relative Error
Baseline (full)	80.1 ± 1.9%	12,244	1.24%
Media (mini)	78.9 ± 2.3%	4,635	1.50%
Media+Enforcement (mini)	84.0 ± 2.7%	4,308	1.62%
Post (full)	83.9 ± 1.7%	12,694	1.00%

Safety Belt Use by Stratum

Estimated safety belt use by stratum and survey wave is shown in Table 5. This table shows that safety belt use increased significantly from Baseline to the Post survey for only strata 2 and 3. For the baseline survey, safety belt use followed the historical trends with use highest in stratum 1 and lowest in stratum 3. Stratum 4 (Wayne County) use rates were not significantly different from each other.

Table 5: Safety Belt Use and Unweighted N by Stratum and Survey Wave				
	Baseline	Media	Media+ Enforcement	Post
Stratum 1	87.5 ± 2.2% (3,635)	79.2 ± 3.0% (1,448)	84.6 ± 3.5% (1,298)	83.2 ± 3.4% (3,881)
Stratum 2	79.7 ± 4.8% (2,350)	83.8 ± 5.1% (919)	85.4 ± 7.7% (637)	88.0 ± 3.8% (2,455)
Stratum 3	73.4 ± 4.8% (1,599)	80.7 ± 2.4% (673)	89.2 ± 3.1% (710)	81.4 ± 3.3% (1,556)
Stratum 4	80.0 ± 2.8% (4,660)	71.0 ± 7.2% (1,595)	75.7 ± 5.6% (1,663)	82.8 ± 2.3% (4,802)

Safety Belt Use by Seating Position

Estimated safety belt use by position in vehicle and survey wave is shown in Table 6. This table shows that safety belt use for drivers was slightly higher than use by front-right passengers for all survey waves. Belt use for both drivers and passengers increased between the media and media+enforcement components of the campaign and remained at these elevated levels during the post survey. Belt use increased more for passengers than for drivers.

Table 6: Safety Belt Use and Unweighted N by Stratum and Survey Wave				
	Baseline	Media	Media+ Enforcement	Post
Driver	81.0 (9,707)	80.0 (3,694)	84.7 (3,354)	84.7 (9,954)
Passenger	76.9 (2,537)	74.1 (941)	81.1 (954)	80.8 (2,750)

Safety Belt Use by Subgroup (All Vehicle Types Combined)

Statewide safety belt use rates by site type, time of day, day of week, weather, occupant sex, and age group are shown in Table 7 by survey wave. Recall that use rates for the subgroups could only be calculated for the full statewide surveys (baseline and post).

Site Type

As is typically found (Eby, Molnar & Olk, 2000), safety belt use was slightly higher for limited access exit ramps than for non-limited access intersections. Both site types showed increased safety belt use in the Post survey when compared to the baseline survey.

Time of Day

For both surveys, safety belt use was relatively high during the morning commute. When compared to the Baseline survey, safety belt increased for all time periods during the day in the Post survey, with the largest increase occurring for the evening rush hour.

Day of Week

As is commonly found, there were no consistent trends in belt use by day of week. Comparing between the surveys, however, showed that safety belt use was higher during the Post survey for all days of week except Tuesday.

Weather

Safety belt use did not systematically vary by weather condition. Comparison between surveys on this variable shows that some sites in the baseline survey were observed when it was snowing, while no sites had snow in the Post survey. In addition, the number of observations for the various other weather conditions varied greatly. Therefore, comparisons of safety belt use between surveys by weather is problematic.

Sex

Again, as is typically found in Michigan (see e.g., Eby, Fordyce, & Vivoda, 2000; Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002), safety belt use was higher for women than for men in both surveys. When compared to the baseline survey, safety belt use for both sexes, was higher for the post survey with greater increases found for men than for women.

Age Group

Because of the low number of occupants under age 16 riding in the front-outboard passenger position, use rates for the two youngest age groups should be interpreted with caution. Excluding these age groups, we found that safety belt use increased with age, as has been found in the past (see e.g., Eby, Fordyce, & Vivoda, 2000; Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). In all age groups, except for the youngest where only a total of eight occupants were observed between the two survey waves, safety belt use increased from the baseline survey to the post survey.

Table 7. Percent Shoulder Belt Use and Unweighted N by Subgroup and Survey (All Vehicles Combined)				
	Baseline		Post	
	Percent Use	N	Percent Use	N
Site Type				
Intersection	79.7	8,364	83.1	8,770
Exit Ramp	82.2	3,880	86.5	3,924
Time of Day				
7 - 9 a.m.	86.9	1,323	89.1	1,270
9 - 11 a.m.	81.1	1,838	84.3	2,152
11 - 1 p.m.	80.6	1,694	82.3	1,588
1 - 3 p.m.	82.1	2,958	84.0	3,012
3 - 5 p.m.	78.4	2,696	82.4	2,902
5 - 7 p.m.	76.7	1,735	89.2	1,770
Day of Week				
Monday	79.1	1,931	86.6	2,007
Tuesday	85.8	1,409	84.7	1,509
Wednesday	81.2	865	82.1	891
Thursday	79.9	1,845	82.5	2,117
Friday	80.0	2,835	81.3	2,423
Saturday	81.4	2,180	89.9	2,297
Sunday	84.1	1,179	89.1	1,450
Weather				
Sunny	81.3	5,900	86.9	4,852
Cloudy	77.9	5,814	83.9	6,457
Rainy	74.1	426	80.3	1,385
Snowy	90.4	104	---	0
Sex				
Male	74.9	6,662	79.8	6,844
Female	86.5	5,582	88.4	5,849
Age				
0 - 3	99.9	3	53.2	5
4 - 15	80.0	297	82.9	370
16 - 29	76.6	3,727	80.9	3,730
30 - 59	81.0	6,338	84.5	7,044
60 - Up	84.0	1,876	88.1	1,544

Safety Belt Use by Subgroup and Vehicle Type

Safety belt use rates and unweighted Ns by vehicle type and subgroup can be found in Tables 8a (passenger cars), 8b (sport-utility vehicles), 8c (van/minivans), and 8d (pickup trucks).

Vehicle Type

Safety belt use rates for passenger cars, sport-utility vehicles, and van/minivans were roughly the same, while belt use for pickup truck occupants was significantly lower than these other vehicle types for both surveys. Low safety belt use in pickup trucks has been found previously in Michigan for both commercial and noncommercial light vehicles (see e.g., Eby, Fordyce, & Vivoda, 2000; Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). Comparisons within vehicle type across surveys showed that safety belt use was higher in the Post survey, with the greatest percentage point increase found for vans/minivans and passenger cars.

Site Type

Safety belt use was found to be higher for limited access exit ramps than for non-limited access intersections for all vehicle types and surveys except for the Baseline survey for passenger cars where the use rates were essentially the same. Comparison across surveys within each vehicle type, show that safety belt use was higher for the post survey for all vehicle and site types.

Time of Day

Few consistent trends in safety belt use by time of day were found, except that belt use tended to be highest during the morning commute for all vehicle types for the baseline survey. During the post survey, however, this trend seems to have diminished. When compared to the baseline survey, safety belt increased for nearly all time periods during the day in the Post survey, with the largest increase tending to occur for the evening rush hour.

Day of Week

There were no consistent trends in belt use by day of week for any of the vehicle types. Comparing across surveys, however, showed that safety belt use generally was higher during the Post survey for all days of week. The results for all non-passenger car vehicle types should be interpreted with caution due to some small sample sizes.

Weather

Safety belt use did not systematically vary by weather condition. Because of small sample sizes for the rainy and snowy weather conditions, comparisons on these variables are not meaningful.

Sex

For all vehicle types and surveys, safety belt use was higher for women than for men. When compared to the baseline survey, safety belt use for both sexes, was higher for the post survey with greater increases found for men than for women. Belt use for both men and women in pickup trucks showed only very slight increases in the post survey.

Age Group

Again, because of the low number of occupants under age 16 riding in the front-outboard passenger position, comparison of use rates for the two youngest age groups cannot be made. Excluding these groups, we found that in the baseline survey, safety belt use increased with age for only passenger car occupants. For the sport-utility vehicle and van/minivan occupants, belt use was lower for the oldest age group than for the 30-50 age group in the baseline survey. For pickup truck occupants, safety belt use was lowest for the 30-59 age group. During the post survey, however, safety belt use generally increased with age. Comparison between survey waves within each vehicle type, showed that safety belt use was higher for the post survey in nearly all cases.

Table 8a. Percent Shoulder Belt Use and Unweighted N by Subgroup and Survey (Passenger Cars)				
	Baseline		Post	
	Percent Use	N	Percent Use	N
Passenger Cars	82.4	6,179	86.6	6,375
Site Type				
Intersection	82.9	4,164	86.5	4,371
Exit Ramp	82.5	2,015	87.3	2,004
Time of Day				
7 - 9 a.m.	88.9	666	92.0	683
9 - 11 a.m.	85.9	845	87.2	1,001
11 - 1 p.m.	83.8	840	82.9	791
1 - 3 p.m.	85.0	1,418	86.9	1,478
3 - 5 p.m.	80.4	1,429	85.3	1,492
5 - 7 p.m.	76.2	981	90.1	930
Day of Week				
Monday	79.0	1,226	85.8	1,217
Tuesday	87.9	675	88.2	760
Wednesday	87.1	430	84.6	462
Thursday	79.4	859	87.7	1,046
Friday	81.6	1,394	84.8	1,194
Saturday	86.3	1,035	92.9	1,115
Sunday	84.3	560	94.3	581
Weather				
Sunny	83.2	2,879	90.6	2,400
Cloudy	80.4	3,053	86.5	3,269
Rainy	66.9	206	79.9	706
Snowy	85.4	41	---	0
Sex				
Male	77.7	2,998	84.0	3,064
Female	86.8	3,181	88.9	3,310
Age				
0 - 3	100	2	53.2	4
4 - 15	73.8	124	86.9	157
16 - 29	78.7	2,217	82.6	2,268
30 - 59	84.7	2,747	88.2	3,028
60 - Up	85.6	1,087	90.9	917

Table 8b. Percent Shoulder Belt Use and Unweighted N by Subgroup and Survey (Sport Utility Vehicles)				
	Baseline		Post	
	Percent Use	N	Percent Use	N
Sport-Utility Vehicles	83.2	2,125	85.8	2,213
Site Type				
Intersection	82.0	1,495	85.1	1,520
Exit Ramp	87.7	630	89.3	693
Time of Day				
7 - 9 a.m.	79.6	239	84.6	213
9 - 11 a.m.	83.7	294	87.0	364
11 - 1 p.m.	80.4	279	91.2	268
1 - 3 p.m.	86.2	589	84.0	524
3 - 5 p.m.	80.9	470	84.0	505
5 - 7 p.m.	85.5	254	87.4	339
Day of Week				
Monday	81.1	279	91.0	318
Tuesday	90.1	225	86.8	269
Wednesday	86.3	134	89.0	128
Thursday	89.1	304	84.9	339
Friday	84.2	517	86.0	373
Saturday	80.8	421	89.4	466
Sunday	89.4	245	75.7	320
Weather				
Sunny	85.2	1,051	90.4	869
Cloudy	79.8	981	85.7	1,077
Rainy	89.3	71	88.0	267
Snowy	100	22	---	0
Sex				
Male	78.8	1,014	82.3	1,046
Female	87.3	1,111	88.8	1,167
Age				
0 - 3	---	0	---	0
4 - 15	87.3	57	79.8	67
16 - 29	75.2	579	82.1	611
30 - 59	86.2	1,254	86.9	1,379
60 - Up	85.7	235	90.1	156

Table 8c. Percent Shoulder Belt Use and Unweighted N by Subgroup and Survey (Vans/Minivans)				
	Baseline		Post	
	Percent Use	N	Percent Use	N
Vans/Minivans	80.8	1,813	84.8	1,892
Site Type				
Intersection	80.9	1,253	83.4	1,306
Exit Ramp	82.9	560	87.7	586
Time of Day				
7 - 9 a.m.	88.0	222	85.6	166
9 - 11 a.m.	85.4	288	84.5	362
11 - 1 p.m.	78.8	256	85.2	227
1 - 3 p.m.	82.1	463	84.8	480
3 - 5 p.m.	78.1	350	82.9	388
5 - 7 p.m.	80.7	234	88.6	269
Day of Week				
Monday	82.2	238	85.5	270
Tuesday	84.8	213	84.3	219
Wednesday	72.5	117	76.4	122
Thursday	84.1	317	77.1	335
Friday	81.6	402	84.3	384
Saturday	86.1	347	90.6	317
Sunday	82.4	179	94.6	245
Weather				
Sunny	84.3	909	88.1	758
Cloudy	76.1	843	84.1	953
Rainy	80.7	47	82.7	181
Snowy	92.9	14	---	0
Sex				
Male	74.1	950	80.7	968
Female	88.2	863	89.0	924
Age				
0 - 3	100	1	00.0	1
4 - 15	83.3	64	86.7	81
16 - 29	76.7	323	84.6	316
30 - 59	82.1	1,166	84.3	1,232
60 - Up	79.5	259	87.9	262

Table 8d. Percent Shoulder Belt Use and Unweighted N by Subgroup and Survey (Pickup Trucks)

	Baseline		Post	
	Percent Use	N	Percent Use	N
Pickup Trucks	71.3	2,127	73.3	2,214
Site Type				
Intersection	69.0	1,452	72.0	1,573
Exit Ramp	76.6	675	79.3	641
Time of Day				
7 - 9 a.m.	82.6	196	76.4	208
9 - 11 a.m.	65.9	411	73.7	425
11 - 1 p.m.	73.0	319	71.1	302
1 - 3 p.m.	70.1	488	74.3	530
3 - 5 p.m.	72.6	447	71.7	517
5 - 7 p.m.	68.7	266	74.0	232
Day of Week				
Monday	72.7	188	82.2	202
Tuesday	77.8	296	68.2	261
Wednesday	65.7	184	76.6	179
Thursday	72.3	365	70.4	397
Friday	71.7	522	68.9	472
Saturday	71.0	377	82.7	399
Sunday	75.4	195	80.1	304
Weather				
Sunny	69.1	1,061	73.7	825
Cloudy	71.0	937	73.2	1,158
Rainy	69.7	102	73.4	231
Snowy	88.9	27	---	0
Sex				
Male	68.8	1,700	71.2	1,766
Female	81.6	427	81.9	448
Age				
0 - 3	---	0	---	0
4 - 15	80.2	52	68.7	65
16 - 29	71.2	608	70.2	535
30 - 59	68.6	1,171	73.7	1,405
60 - Up	81.0	295	73.5	209

Safety Belt Use by Age and Sex Combined

Table 9 shows the estimated safety belt use rates and unweighted Ns for age and sex combined for each survey. Again, because of low sample sizes for the two youngest age groups, results for these groups should be considered tentative. For males, safety belt use was higher in the post survey than the baseline survey for the three oldest age groups, with large increases in rates found for males 30 years of age and older. For women, we also found that safety belt use rates were higher in the post survey. These increases were only modest (about 1 percentage point) for the two oldest age groups and fairly large for women 16 to 29 years of age.

Table 9. Percent Shoulder Belt Use and Unweighted N by Age and Sex (All Vehicle Types Combined)				
Age Group	Male		Female	
	Baseline	Post	Baseline	Post
0 - 3	100 (2)	53.2 (3)	100 (1)	100 (2)
4 - 15	82.5 (160)	82.1 (198)	76.5 (137)	84.0 (172)
16 - 29	72.2 (1,949)	75.4 (1,866)	81.4 (1,778)	86.1 (1,863)
30 - 59	74.9 (3,515)	80.7 (3,958)	88.8 (2,823)	89.3 (3,086)
60 - Up	78.4 (1,034)	84.2 (819)	90.6 (842)	91.9 (725)

DISCUSSION

The estimated statewide safety belt use rates for front-outboard occupants of passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks combined was 80.1 ± 1.9 percent during the baseline survey wave; 78.9 ± 2.3 during the media component of the campaign; 84.0 ± 2.7 percent during the media+enforcement component of the campaign; and 83.9 ± 1.7 percent after the campaign (post). Safety belt use increased significantly during the media+enforcement component of the campaign and remained high after the campaign was completed. In addition, the use rate for the post survey, which was determined using the full statewide design, revealed the highest safety belt use rate ever achieved in Michigan. Thus, these findings suggest that the present mobilization campaign focused on the Memorial Day period in 2003, was successful in raising Michigan safety belt use to its highest level.

Belt use rates were also analyzed as a function of stratum and survey wave. These analyses showed that the increase in safety belt use statewide was largely due to increases observed in strata 2 and 3, where nearly 10 percentage point increases were observed between baseline and post surveys. No significant differences were found for stratum 1 or 4 (Wayne County) between baseline and post surveys.

The study also examined safety belt use by position in vehicle across the four survey waves. For all survey waves, safety belt use was slightly higher for drivers than for front-right passengers. Belt use for both drivers and passengers increased between the media and media+enforcement survey waves and remained elevated during the post survey. The increase in belt use was slightly greater for passengers than for drivers, indicating that the campaign may have had a greater effect on passengers.

The effects of the program on several subgroups could only be investigated by comparison between the Baseline and Post surveys, which were full statewide surveys allowing for large enough samples for subgroup analysis. We found increases in safety belt use for limited access exit ramps, local intersections, all times of day, nearly all days of the week, males, females, all age-groups over 15 years of age, and for all vehicle types.

Thus, the program had a general effect of raising safety belt use among all subgroups in Michigan. Further analysis of these data show that the greatest increases in belt use were found for males in the 30 years of age or older group and females in the 16-29 year old age group. These findings were surprising since the campaign had a special focus on young males.

In conclusion, these positive results suggest that: 1) Michigan should continue to participate in the national efforts to raise safety belt use; 2) safety belt enforcement zones were successful as implemented in Michigan and should be continued; and 3) the CIOT model as implemented in Michigan was successful.

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APPENDIX A
Data Collection Forms

SITE DESCRIPTION FORM

SITE #
1 2 3

SITE LOCATION _____

SITE TYPE

- 1 Intersection
- 2 Freeway
- 4

Exit No. _____

SITE CHOICE

- 1 Primary
- 2 Alternate
- 5

TRAFFIC CONTROL

- 1 Traffic Light
- 2 Stop sign
- 3 None
- 4 Other _____
- 6

DATE (month/day): / / /2003
7 8 9 10

	OBSERVER	DAY OF WEEK	WEATHER
1	Observer 1	1 Monday	1 Mostly Sunny
2	Observer 2	2 Tuesday	2 Mostly Cloudy
3	Observer 3	3 Wednesday	3 Rain
4	Observer 4	4 Thursday	4 Snow
5	Observer 5	5 Friday	13
6	Observer 6	6 Saturday	
7	Observer 7	7 Sunday	
11		12	

START TIME: : (24 hour clock)
14 15 16 17

END TIME: : (24 hour clock)
18 19 20 21

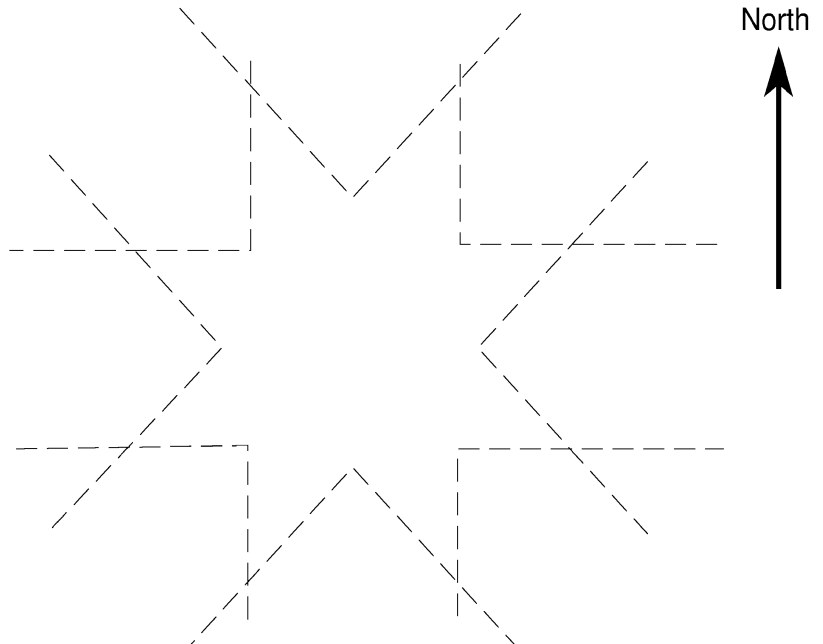
INTERRUPTION (total number of minutes during observation period):
22 23

MEDIAN: 1 Yes
2 No
24

TRAFFIC COUNT 1:
25 26 27

TRAFFIC COUNT 2:
28 29 30

COMMENTS:



ATTENTION CODING: DUPLICATE COL 1 - 3 FOR ALL VEHICLES

DRIVER	1	Not belted	1	Male	2	4 - 15	VEHICLE TYPE 1 Passenger car 2 Van 3 Utility 4 Pick-up	
	2	Belted	2	Female	3	16 - 29		
	3	B Back	5		4	30 - 59		
	4	U Arm			5	60+		
	4				6			
FRONT-RIGHT PASSENGER	1	Not belted	1	Male	1	0 - 3	Office Use Only: 11 12 13	COMM. VEHICLE 1 No 2 Yes 14
	2	Belted	2	Female	2	4 - 15		
	3	B Back	9		3	16 - 29		
	4	U Arm			4	30 - 59		
	5	CRD			5	60+		
8				10				

DRIVER	1	Not belted	1	Male	2	4 - 15	VEHICLE TYPE 1 Passenger car 2 Van 3 Utility 4 Pick-up	
	2	Belted	2	Female	3	16 - 29		
	3	B Back	5		4	30 - 59		
	4	U Arm			5	60+		
	4				6			
FRONT-RIGHT PASSENGER	1	Not belted	1	Male	1	0 - 3	Office Use Only: 11 12 13	COMM. VEHICLE 1 No 2 Yes 14
	2	Belted	2	Female	2	4 - 15		
	3	B Back	9		3	16 - 29		
	4	U Arm			4	30 - 59		
	5	CRD			5	60+		
8				10				

DRIVER	1	Not belted	1	Male	2	4 - 15	VEHICLE TYPE 1 Passenger car 2 Van 3 Utility 4 Pick-up	
	2	Belted	2	Female	3	16 - 29		
	3	B Back	5		4	30 - 59		
	4	U Arm			5	60+		
	4				6			
FRONT-RIGHT PASSENGER	1	Not belted	1	Male	1	0 - 3	Office Use Only: 11 12 13	COMM. VEHICLE 1 No 2 Yes 14
	2	Belted	2	Female	2	4 - 15		
	3	B Back	9		3	16 - 29		
	4	U Arm			4	30 - 59		
	5	CRD			5	60+		
8				10				

DRIVER	1	Not belted	1	Male	2	4 - 15	VEHICLE TYPE 1 Passenger car 2 Van 3 Utility 4 Pick-up	
	2	Belted	2	Female	3	16 - 29		
	3	B Back	5		4	30 - 59		
	4	U Arm			5	60+		
	4				6			
FRONT-RIGHT PASSENGER	1	Not belted	1	Male	1	0 - 3	Office Use Only: 11 12 13	COMM. VEHICLE 1 No 2 Yes 14
	2	Belted	2	Female	2	4 - 15		
	3	B Back	9		3	16 - 29		
	4	U Arm			4	30 - 59		
	5	CRD			5	60+		
8				10				

APPENDIX B
Site Listing

Survey Sites By Number

No.	County	Site Location	Type	Str
001	Oakland	EB Whipple Lake Rd. & Eston Rd.		1
*002	Kalamazoo	EB S Ave. & 29 th St.		1
003	Oakland	SB Pontiac Trail & 10 Mile Rd.		1
004	Washtenaw	SB Moon Rd. & Ann Arbor-Saline Rd./Saline-Milan Rd.		1
005	Oakland	WB Drahnner Rd. & Baldwin Rd.		1
006	Oakland	SB Rochester Rd. & 32 Mile Rd./Romeo Rd.		1
007	Oakland	SB Williams Lake Rd. & Elizabeth Lake Rd.		1
008	Ingham	SB Searles Rd. & Iosco Rd.		1
*009	Kalamazoo	WB D Ave. & Riverview Dr.		1
010	Washtenaw	EB N. Territorial Rd. & Dexter-Pinckney Rd.		1
*011	Washtenaw	NB Schleeweis Rd./Macomb St. & W. Main St.		1
012	Ingham	NB Shaftsbury Rd. & Haslett Rd.		1
013	Oakland	NB Middlebelt Rd. & 9 Mile Rd.		1
*014	Washtenaw	WB Packard Rd. & Carpenter Rd.		1
015	Ingham	EB Haslett Rd. & Marsh Rd.		1
*016	Washtenaw	NB Jordan Rd./Monroe St. & US-12/Michigan Ave.		1
017	Washtenaw	SB M-52/Main St. & Old US-12		1
018	Kalamazoo	SB 8th St. & Q Ave.		1
*019	Washtenaw	WB 8 Mile Rd. & Pontiac Trail		1
*020	Oakland	SB Lahser Rd. & 11 Mile Rd.		1
*021	Kalamazoo	NB Ravine Rd. & D Ave.		1
022	Washtenaw	EB Glacier Way/Glazier Way & Huron Pkwy.		1
023	Washtenaw	WB Bethel Church Rd. & M-52		1
024	Washtenaw	SB Platt Rd. & Willis Rd.		1
*025	Ingham	WB Fitchburg Rd. & Williamston Rd.		1
026	Washtenaw	EB Merritt Rd. & Stoney Creek Rd.		1
027	Oakland	SB Hickory Ridge Rd. & M-59/Highland Rd.		1
028	Kalamazoo	SB Douglas Ave. & D Ave.		1
*029	Oakland	WB Walnut Lake Rd. & Haggerty Rd.		1
030	Oakland	NB Jossman Rd. & Grange Hall Rd.		1
031	Kalamazoo	EB H Ave. & 3rd St.		1
032	Kalamazoo	EB TU Ave. & 24th St./Sprinkle Rd.		1
033	Oakland	WBD I-96 & Milford Rd.. (Exit 155B)	ER	1
*034	Washtenaw	WBP I-94 & Whittaker Rd./Huron St. (Exit 183)	ER	1
*035	Kalamazoo	SBP US-131 & M-43 (Exit 38B)	ER	1
036	Washtenaw	SBD US-23 & N. Territorial Rd.	ER	1
*037	Kalamazoo	EBP I-94 & Portage Rd.	ER	1
038	Oakland	EBP I-696 & Orchard Lake Rd. (Exit 5)	ER	1
039	Kalamazoo	WBP I-94 & 9th St. (Exit 72)	ER	1
*040	Washtenaw	WBD I-94 & Jackson Rd.	ER	1
041	Kalamazoo	NBD US-131 & Stadium Dr./Business I-94	ER	1
042	Kalamazoo	NBP US-131 & Q Ave./Centre Ave.	ER	1
*043	Livingston	SB County Farm Rd. & Coon Lake Rd.		2
044	Bay	WB Nebodish Rd. & Knight Rd.		2
045	Macomb	SB Camp Ground Rd. & 31 Mile Rd.		2
046	Jackson	SB Benton Rd./Moon Lake Rd. & M-50/ Brooklyn Rd.		2
047	Allegan	SB 6th St. & M-89		2
048	Kent	EB 36th St. & Snow Ave.		2
049	Livingston	EB Chase Lake Rd. & Fowlerville Rd.		2
*050	Allegan	WB 144th Ave. & 2nd St.		2
051	Livingston	SB Cedar Lake Rd. & Coon Lake Rd.		2
052	Jackson	NB Mt. Hope Rd. & Waterloo-Munith Rd.		2
*053	Kent	WB Cascade Rd. & Thornapple River Dr.		2
*054	Allegan	NB 62nd St. & 102nd Ave.		2
055	Kent	SB Meddler Ave. & 18 Mile Rd.		2
056	Eaton	SB Houston Rd. & Kinneville Rd.		2
057	Macomb	SB M-19/Memphis Ridge Rd. & 32 Mile Rd./ Division Rd.		2
*058	Allegan	NB 66th St. & 118th Ave.		2
059	Grn Traverse	NB Silver Lake Rd./County Rd. 633 & US-31		2
*060	Grn Traverse	EB Riley Rd./Tenth St. & M-137		2
*061	Bay	SB 9 Mile Rd. & Beaver Rd.		2
062	Kent	SB Ramsdell Dr. & M-57/14 Mile Rd.		2
*063	Eaton	NB Ionia Rd. & M-50/Clinton Trail		2
064	Macomb	EB 23 Mile Rd. & Romeo Plank Rd.		2
*065	Livingston	NB Old US-23/Whitmore Lake Rd. & Grand River Rd.		2
066	Jackson	SWB Horton Rd. & Badgley Rd.		2
067	Kent	SB Belmont Ave. & West River Dr.		2
*068	Eaton	EB 5 Point Hwy. & Ionia Rd.		2
069	Allegan	WB 129th Ave. & 10th St.		2

*070	Eaton	EB M-43 & M-100		2
071	Ottawa	WB Taylor St. & 72nd Ave.		2
072	Bay	EB Cass Rd. & Farley Rd.		2
073	Allegan	EB 126th Ave. & 66th St.		2
074	Bay	NB Mackinaw Rd. & Cody-Estey Rd.		2
075	Jackson	EBD I-94 & Elm Ave. (Exit 141)	ER	2
076	Kent	NBD US-131 & 100th St. (Exit 72)	ER	2
*077	Ottawa	NBD I-196 & Byron Rd.	ER	2
*078	Kent	SBP US-131 & Hall St.	ER	2
079	Macomb	SBP M-53 & 26 Mile Rd.	ER	2
080	Bay	NBD I-75 & Wilder Rd. (Exit 164)	ER	2
081	Livingston	EBD I-96 & Fowlerville Rd. (Exit 129)	ER	2
*082	Macomb	EBP I-94 & 12 Mile Rd. (Exit 231)	ER	2
083	Jackson	WBD I-94 & Sargent Rd. (Exit 145)	ER	2
084	Allegan	NBP US-31/I-196 & Washington Rd./ Blue Star Hwy (Exit 47A)	ER	2
085	Calhoun	EB O Drive N. & 12 Mile Rd.		3
*086	Berrien	EB Mayflower Rd. & Chicago Rd.		3
*087	Marquette	SWB C.R. 456 & Sporley Lake Rd.		3
088	Lenawee	EB Munger Rd. & M-52		3
*089	Genesee	EB Pierson Rd. & Elms Rd.		3
*090	Clinton	NB Scott Rd. & M-21/State		3
091	Calhoun	WB R Dr. S. & 8 Mile Rd./Adolph Rd.		3
092	Calhoun	EB V Dr. N. & 20 Mile Rd.		3
093	Calhoun	NWB Dickman Rd./M-96 & Avenue A		3
094	St. Clair	WB Hewitt Rd. & Fargo Rd.		3
095	Monroe	SB Swan Creek Rd. & Labo Rd.		3
*096	Muskegon	EB Sweeter Rd. & Maple Island		3
*097	Calhoun	SB P Dr. N./Yawger Rd. & Hubbard Rd./5 Mile Rd.		3
098	St. Clair	WB Bryce Rd. & Cribbins Rd.		3
099	St. Clair	WB Lindsey Rd. & Palms Rd.		3
100	Van Buren	SB Broadway/M-140 & Phoenix Rd./BL I-196/C.R. 388		3
101	Ionia	SB Fisk Rd./Heffron Rd. & Montcalm Ave.		3
102	Clinton	EB Taft Rd. & Shepardsville Rd.		3
103	Calhoun	SB S. County Line Rd. & 23 Mile Rd.		3
*104	Calhoun	NB Waubascon Rd./4 1/2 Mile Rd. & Baseline Rd.		3
105	Monroe	WB Day Rd. & Ann Arbor Rd.		3
106	St. Joseph	WB Balk Rd./C.R. 139 & Grim Rd./Sherman Mills Rd.		3
107	Lapeer	EB Armstrong/C.R. 7 & M-53/Van Dyke Hwy.		3
*108	Saginaw	SB Chapin N./Kane Rd. & Frost Rd.		3
109	St. Clair	SB Werner/Ellsworth & Gratiot		3
110	Lenawee	NB Ogden Hwy. & US-223		3
111	Lapeer	SB Wheeling Rd. & Bowers Rd./M-52		3
112	Saginaw	NB Raucholz Rd. & Ithaca Rd.		3
*113	Shiawassee	NEB Winegar Rd. & Lansing Rd.		3
114	St. Joseph	SB Rosenbaugh Rd./40th St. & Michigan Ave./C.R. 120		3
*115	Saginaw	NB East Rd. & Ditch Rd.		3
116	Muskegon	EB Heights-Ravenna Rd. & Sullivan Rd.		3
117	Saginaw	S/EBD I-675 & Veterans Memorial Parkway (Exit 1)	ER	3
*118	Genesee	NBP I-475 & Bristol Rd./Hemphill/M-121 (Exit #4)	ER	3
119	Calhoun	EBP I-94 & 26 Mile Rd./25 1/2 Mile Rd. (Exit 119)	ER	3
120	Berrien	WBD I-94 & M-239/La Porte (Exit #1)	ER	3
*121	Van Buren	N/EBP US-31/I-196 & M-140 (Exit #18)	ER	3
122	Monroe	NBD I-75 & Huron River Dr. (Exit 26, to South Huron River Drive)	ER	3
123	Genesee	SBD US-23/I-75 & Mount Morris Rd. (Exit #126)	ER	3
*124	Isabella	SBD US-27/US-127 & M-20	ER	3
*125	Genesee	EBD I-69 & Belsay Rd. (Exit #141)	ER	3
126	St. Clair	WBD I-94/I-69 & Water St.	ER	3
127	Wayne	WB 8 Mile Rd. & Beck Rd.		4
*128	Wayne	EB Warren Rd. & Wayne Rd.		4
129	Wayne	EB McNichols Rd. & Woodward Ave.		4
*130	Wayne	NB Canton Center Rd. & Cherry Hill Rd.		4
131	Wayne	WB Ecorse Rd. & Pardee Rd.		4
132	Wayne	EB Michigan Ave. & Sheldon Rd.		4
*133	Wayne	EB Ecorse Rd. & Middlebelt Rd.		4
*134	Wayne	NB M-85/Fort Rd. & Emmons Rd.		4
135	Wayne	WB Glenwood Rd. & Wayne Rd.		4
136	Wayne	NB Haggerty Rd. & 7 Mile Rd.		4
*137	Wayne	WB 6 Mile Rd. & Inkster Rd.		4
138	Wayne	SB Inkster Rd. & Goddard Rd.		4
139	Wayne	SB Merriman Rd. & Cherry Hill Rd.		4
140	Wayne	SEB Outer Dr. & Pelham Rd.		4

*141	Wayne	NB Meridian Rd. & Macomb Rd.		4
142	Wayne	WB Ford Rd. & Venoy Rd.		4
*143	Wayne	SWB Vernor Rd. & Gratiot Rd.		4
144	Wayne	WB 5 Mile Rd. & Beck Rd.		4
145	Wayne	EB 7 Mile Rd. & Livernois Rd.		4
*146	Wayne	NB Gunston/Hoover Rd. & McNichols Rd.		4
147	Wayne	SB W. Jefferson/ Biddle Ave. & Southfield Rd.		4
148	Wayne	EB Goddard Rd. & Wayne Rd.		4
*149	Wayne	WB 8 Mile Rd. & Kelly Rd.		4
150	Wayne	SB Merriman Rd. & US-12/Michigan Ave.		4
151	Wayne	SB Telegraph Rd. & Plymouth Rd.		4
*152	Wayne	WB Sibley Rd. & Inkster Rd.		4
153	Wayne	NEB Mack Rd. & Moross Rd.		4
154	Wayne	WB Annapolis Rd. & Inkster Rd.		4
*155	Wayne	SB Greenfield Rd. & Grand River Rd.		4
156	Wayne	EB Joy Rd. & Livernois Rd.		4
157	Wayne	SEB Conner Ave. & Gratiot Rd.		4
158	Wayne	NWB Grand River Rd. & Wyoming Ave.		4
159	Wayne	WBP I-96 & Evergreen Rd.	ER	4
160	Wayne	WBP I-94 & Haggerty Rd. (Exit 192)	ER	4
*161	Wayne	NBD I-75 & Gibraltar Rd. (Exit 29)	ER	4
162	Wayne	SBP I-75 & Southfield Rd.	ER	4
*163	Wayne	NBD I-275 & 6 Mile Rd. (Exit 170)	ER	4
164	Wayne	NBP I-275 & M-153/Ford Rd. (Exit 25)	ER	4
165	Wayne	NBD I-275 & Eureka Rd. (Exit 15)	ER	4
*166	Wayne	NBP I-75 & Springwells Ave. (Exit 45)	ER	4
167	Wayne	WBD I-94 & Pelham Rd. (Exit 204)	ER	4
168	Wayne	SBD I-75 & Sibley Rd.	ER	4

*Included in the Mini Survey Subsample

APPENDIX C

Calculation of Variances, Confidence Bands, and Relative Error

The variances for the belt use estimates were calculated using an equation derived from Cochran's (1977) equation 11.30 from section 11.8. The resulting formula was:

$$var(r) = \frac{n}{n-1} \sum_i \left(\frac{g_i}{g_k}\right)^2 (r_i - r)^2 + \frac{n}{N} \sum_i \left(\frac{g_i}{g_k}\right)^2 \frac{s_i^2}{g_i}$$

where $var(r_i)$ equals the variance within a stratum and vehicle type, n is the number of observed intersections, g_i is the weighted number of vehicle occupants at intersection i , g_k is the total weighted number of occupants for a certain vehicle type at all 42 sites (14 in the mini survey) within the stratum, r_i is the weighted belt use rate at intersection i , r is the stratum belt use rate, N is the total number of intersections within a stratum, and $s_i = r_i(1-r_i)$. In the actual calculation of the stratum variances, the second term of this equation is negligible. If we conservatively estimate N to be 2000, the second term only adds 2.1×10^{-6} units to the largest variance (Stratum 4). This additional variance does not significantly add to the variance captured in the first term. Therefore, since N was not known exactly, the second term was dropped in the variance calculations. The overall estimated variance for each vehicle type was calculated using the formula:

$$var(r_{all}) = \frac{var(r_1) + var(r_2) + var(r_3) + 0.88^2 \times var(r_4)}{3.88^2}$$

The Wayne County stratum variance was multiplied by 0.88 to account for the similar weighting that was done to estimate overall belt use. The 95 percent confidence bands were calculated using the formula:

$$95\% \text{ Confidence Band } r_{all} \pm 1.96 \times \sqrt{\text{Variance}}$$

where r is the belt use of interest. This formula is used for the calculation of confidence bands for each stratum and for the overall belt use estimate.

Finally, the relative error or precision of the estimate was computed using the formula:

$$\text{RelativeError} = \frac{\text{StandardError}}{r_{all}}$$

The federal guidelines (NHTSA, 1992, 1998) stipulate that the relative error of the belt use estimate must be under 5 percent.